Tamar Field Development Project
Environmental Impact Assessment
Volume II

Matan Block Offshore Israel

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NOTE:

"ANY INVESTMENT TO BE MADE IN TAMAR FIELD DEVELOPMENT PROJECT, BY NOBLE ENERGY OR ITS PARTNERS, IS SUBJECT TO ACHIEVING, INTER ALIA, REGULATORY CERTAINTY OVER THOSE INVESTMENTS, NECESSARY INVESTMENT & REGULATORY APPROVALS, AND SATISFACTORY COMMERCIAL ARRANGEMENTS."

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APPENDICES

APPENDIX A

Field Survey Reports and Sampling Locations for the March 2013 and February 2014 Tamar Field Surveys

TAMAR FIELD BACKGROUND MONITORING SURVEY REPORT

July 2014

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TAMAR FIELD BACKGROUND MONITORING SURVEY REPORT

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EXECUTIVE SUMMARY

Noble Energy Mediterranean Ltd (Noble Energy) has conducted exploratory drilling and developed gas production and transportation systems within and extending from the Tamar and Tamar SW natural gas reservoirs (Tamar Field). The partial development of the field was conducted between 2009 and 2013. As part of this effort, the Ministry of Environmental Protection (MoEP) and Ministry of National Infrastructures, Energy and Water Resources (MNIEWR) required Noble Energy to develop and implement an environmental monitoring program.

The purpose of the Tamar Field Background Monitoring Survey was to provide a characterization of the environmental conditions within the boundaries of the field, natural gas reservoir, and pipeline corridor to establish an environmental baseline for the field after its partial development. The sampling is intended to establish the predictability of values from place to place in the study area and preclude the need for any additional pre-activity sampling within the field or pipeline corridor.
A survey of the Tamar Field was conducted in two stages. The first stage was conducted from 22 to 26 March 2013 and consisted of video, hydrographic profiling data, near-bottom water samples, and sediment and infauna samples collected within close proximity (approximately 2 km) of the Tamar wellsites. The second stage was conducted from 9 to 13 February 2014 and consisted of hydrographic profiling data, water column samples, and sediment and infauna samples collected throughout the Tamar Field. Additionally, a survey of the Tamar pipeline corridor was conducted from 26 to 31 March 2013 and consisted of sediment samples collected in close proximity (within 50 m) of the pipeline.

The survey design within the Tamar Field consisted of a uniform grid, superimposed over the natural gas reservoir, in which the center point of each grid cell was sampled. Grid cells containing previously sampled locations were not re-sampled. Data from previously sampled locations within a grid cell were averaged and assigned to the center point of that cell. The physical, chemical, geological, and biological environmental conditions were inspected for spatial variation within the study area by using geostatistical techniques based on the computation of semivariance and interpolation by kriging. The kriged data were used to assess existing effects from drilling discharges and infrastructure development through the comparison of deviations from regional ambient background values typical of the eastern Levantine Basin and internationally and locally accepted environmental standards. Additionally, the data will be used to provide information on further deviations from ambient conditions and environmental standards due to the potential effects of future development within the field. The survey design along the pipeline corridor consisted of a stratified random sampling design in which samples were randomly divided among strata that were defined by water depth. As this report is establishing the current baseline for the survey region, interpretation of data from along the pipeline is primarily descriptive; however, statistical comparisons with Levantine Basin averages are provided.

Analysis of Tamar Field and pipeline corridor data indicated that the effects of drilling and infrastructure development have been minimal. The seafloor within the survey area was relatively flat and generally undisturbed, except for some highly localized (within 10 m) visual evidence of seafloor disturbance near existing infrastructure. No hard bottom substrate or chemosynthetic communities were observed. There was visible biological activity observed on video at most of the locations surveyed by remotely operated vehicle (ROV), and observations included fauna and bioturbation (i.e., biologically maintained burrows and mounds). As may be expected for a soft bottom deepwater environment where food availability is presumably low, fauna observed on the seafloor were sparse. The organisms most commonly observed were tripod fish and unidentifiable shrimp. Small groupings of patterned burrows and small conical mounds likely created by polychaetes were observed in the soft sediments.

All seawater parameters (metals, nutrients, hydrocarbons, ions, total suspended solids, and radionuclides) were similar to Levantine Basin averages and below internationally and locally accepted environmental standards. The results indicate that water quality within the survey area has not been persistently impacted by drilling activities or infrastructure development.

Seafloor sediments within the Tamar Field were composed primarily of clay with high silt fractions and were classified as silty clay. Seafloor sediments along the pipeline were also composed primarily of clay and silt until a water depth of approximately 70 m, at which point the fine sand fraction became increasingly predominant as water depth decreased.

Total organic carbon concentrations in sediments were low throughout the field and pipeline corridor, as would be expected given the highly oligotrophic nature of the region. Sediment metals concentrations within the field and along the pipeline corridor were overwhelmingly within the 99% confidence limit (CL) of the Levantine Basin average, with the exception of barium (247 ppm). Barium concentrations within the Tamar Field were approximately two times higher (600 to 800 ppm) than the Levantine Basin average over large areas of the seafloor in the southern (around the Tamar SW-1 wellsite) and middle (around the Tamar-3, Tamar-4, Tamar-5, and Tamar-6 wellsites) of the field. Within these areas isolated pockets of barium concentrations were three to five times greater (800 to 1,200 ppm) than the Levantine Basin average. Two of these pockets were centered on existing wellsites (Tamar SW-1 and Tamar-3); however, two pockets of elevated barium concentrations occurred approximately 3 km from any existing infrastructure. The source of this anomaly is unknown and cannot be interpreted from the data. Lead concentrations around the manifold were slightly higher than ambient concentrations within the Tamar Field, but also within the 99% CL of the Levantine Basin average. Concentrations of all metals within the field and along the pipeline corridor were below ERL and ERM values with the exception of arsenic, copper, and nickel. These three metals are naturally found in high concentrations throughout the Levantine Basin. Therefore, concentrations above the ERL should be considered ambient for arsenic and copper, and concentrations above the ERM should be considered ambient for nickel.

Total petroleum hydrocarbons (TPH) concentrations were above the 99% CL of the Levantine Basin (17 ppm) within the field near the Tamar SW-1 (18 to 24 ppm) and Tamar-6 (18 to 48 ppm) wellsites and along the pipeline corridor in water depths less than 300 m (30 to 60 ppm). These concentrations while elevated above ambient conditions, are still extremely low and do not pose a threat to the environment. Within the field and along the majority of the pipeline concentrations of the U.S. Environmental Protection Agency's (USEPA) 16 priority polycyclic aromatic hydrocarbons (PAHs) were lower than their Levantine Basin averages. PAH concentrations were slightly elevated in water depths between 20 to 200 m along the pipeline corridor, but comparatively low (5 to 25 ppb) when measured against a standard reference material for oil (50 to 800 ppb). Calculation of the Fossil Fuel Pollution Index (FFPI) determined that most sources of measurable hydrocarbons within the field and along the pipeline were either pyrogenic or pyrogenic/petrogenic in composition, indicating that the majority of hydrocarbons present in sediments, including the portion of the pipeline in water depths of 20 to 200 m, were from terrestrial combustion sources and unlikely to be related to drilling or infrastructure development. The highest FFPI ratio (43%) occurred along the pipeline in a water depth of 200 TO 300 m and in close proximity to the Mari-B/Tamar Platforms, indicating some possible residual petrogenic hydrocarbon contamination within this region, although well below concentrations of concern given individual PAH concentrations between 1 and 12 ppb. There were no elevated concentrations of radionuclides in sediments collected from within the field or along the pipeline corridor.

Infaunal abundance and species richness were low in water depths greater than 300 m in the field and along the pipeline corridor. The dominant infauna within the region were worms, consisting primarily of the polychaete *Notomastus* sp. Infaunal abundance and species richness increased considerably in water depths from 300 to 20 m, where polychaete worms were the most dominant taxa and the bivalve mollusk Bivalvia sp. was the most dominant organism.

The primary findings within the Tamar Field and along the Tamar pipeline corridor that can be considered as arising from drilling and infrastructure development consisted of elevated barium concentrations and hydrocarbon concentrations in seafloor sediments at a few locations. While barium is an indicator of development activity, it is not toxic to marine organisms; therefore, its potential for environmental impact is insignificant. Hydrocarbon concentrations were low and primarily pyrogenic in origin, indicating that pollution by fossil fuels is not occurring within the survey region. Overall, the results indicate that environmental impacts resulting from drilling and the placement of infrastructure within the Tamar Field and along the pipeline corridor to date have been negligible.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAC	annual average concentration
CCC	Criterion Continuous Concentrations
CL	confidence limit
CoC	chain-of-custody
CSA	CSA Ocean Sciences Inc.
CTD	conductivity-temperature-depth
DGPS	differential global positioning system
DO	dissolved oxygen
DOC	dissolved organic carbon
EUCEQS	European Union Commission on Environmental Quality Standards
EDTA	ethylenediaminetetraacetic acid
ERL	effects range low
ERM	effects range median
FFPI	Fossil Fuel Pollution Index
GC-MS	gas chromatography-mass spectrometry
GSI	Geological Survey of Israel
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
MAC	maximum allowable concentration
MCL	maximum contaminant level
MDL	method detection limit
MEQS	Mediterranean Environmental Water Quality Standards
MNIEWR	Ministry of National Infrastructures, Energy and Water Resources
MoEP	Ministry of Environmental Protection
Noble Energy	Noble Energy Mediterranean Ltd
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
QC	quality control
ROV	remotely operated vehicle
SAP	Sampling and Analysis Plan
SBE	Sea-Bird Electronics
SOW	Scope of Work
TAMI	IMI TAMI Institute for Research & Development Ltd.
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USBL	ultra-short baseline
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION AND PROJECT DESCRIPTION

1.1 BACKGROUND

Noble Energy Mediterranean Ltd (Noble Energy) has conducted exploratory drilling and developed gas production and transportation systems within and extending from the Tamar and Tamar SW-1 natural gas reservoirs (Tamar Field) (**Figure 1**). Drilling of the Tamar Field wells was conducted between 2009 and 2013. The drilling data (volume discharged) for the Tamar SW-1 wellsite can be considered representative of the volume discharged for Tamar wellsites 1 to 6. The drilling data for Tamar SW-1 are provided in **Table 1** and discharge data is provided in **Appendix A**. The geographical coordinates of all wellsites within Tamar Field are provided in **Appendix B**.

Table 1. Total amount of drilling muds and cuttings discharged per month at the Tamar SW-1 wellsite.

Month	Number of Days	Volume Discharged			
		Drilling Mud (m^3)	Drill Cuttings (tons)	Cement (tons)	Drilling Brine (m^3)
October 2013	28	2,815	1,406	396	4,009
November 2013	30	638	532	2	0
December 2013	31	1,612	107	5	0
Total	**89**	**5,065**	**2,045**	**403**	**4,009**

Noble Energy is planning to drill additional wells, lay pipeline, and install subsea infrastructure within the Tamar Field. The monitoring areas in closest proximity to the Tamar Field include the Tanin-2 wellsite and Leviathan Field Development and floating production storage and offloading unit sampling grid (**Figure 2**). The Ministry of Environmental Protection (MoEP) and Ministry of National Infrastructures, Energy and Water Resources (MNIEWR) required Noble Energy to develop and implement a characterization of the environment encompassed within the Tamar Field before any additional drilling or construction activity is conducted.

Noble Energy engaged CSA Ocean Sciences Inc. (CSA) to provide support in developing the February 2014 Tamar Field Background Monitoring Program to describe the environment within the Tamar Field. This support included developing the Scope of Work (SOW) and Sampling and Analysis Plan (SAP) as well as conducting the Tamar Field Survey. The SOW/SAP described the existing environment in the vicinity of the Tamar Field, parameters to be sampled, sampling methods, data-processing and laboratory methods, and data analysis/reporting, and was presented to MoEP and MNIEWR in December 2013. CSA provided visual descriptions of the environment in the vicinity of several wellsites located within the Tamar Field (CSA Ocean Sciences Inc., 2013a); conducted surveys to characterize the environmental conditions along the pipeline route in the Tamar Field and leading from the field to the Tamar Platform and from the production platform to the Ashdod Onshore Terminal (CSA Ocean Sciences Inc., 2013b) (**Figure 3**); and conducted monitoring studies at the Mari-B and Tamar production platforms (CSA Ocean Sciences Inc., 2013c) (**Figure 3**). The proposed sampling design has been developed to ensure that the environment within the reservoir footprint is characterized sufficiently so that no additional pre-activity survey would be required. **Figure 1** shows the existing wellsite and infrastructure locations, proposed pipeline route, and reservoir boundaries within the Tamar Field.

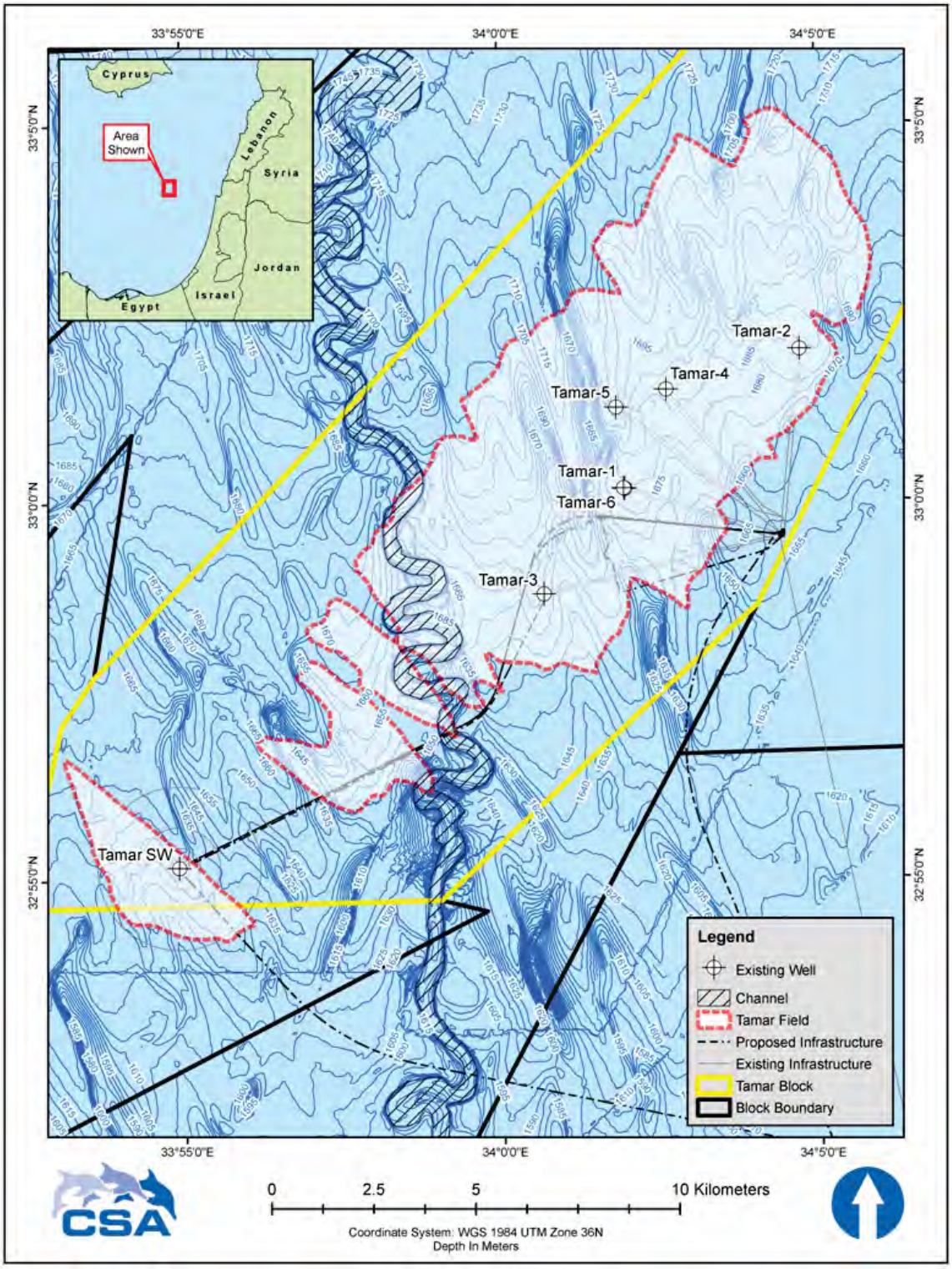

Figure 1. Location of the Tamar Field and wellsites relative to the boundaries of offshore lease blocks.

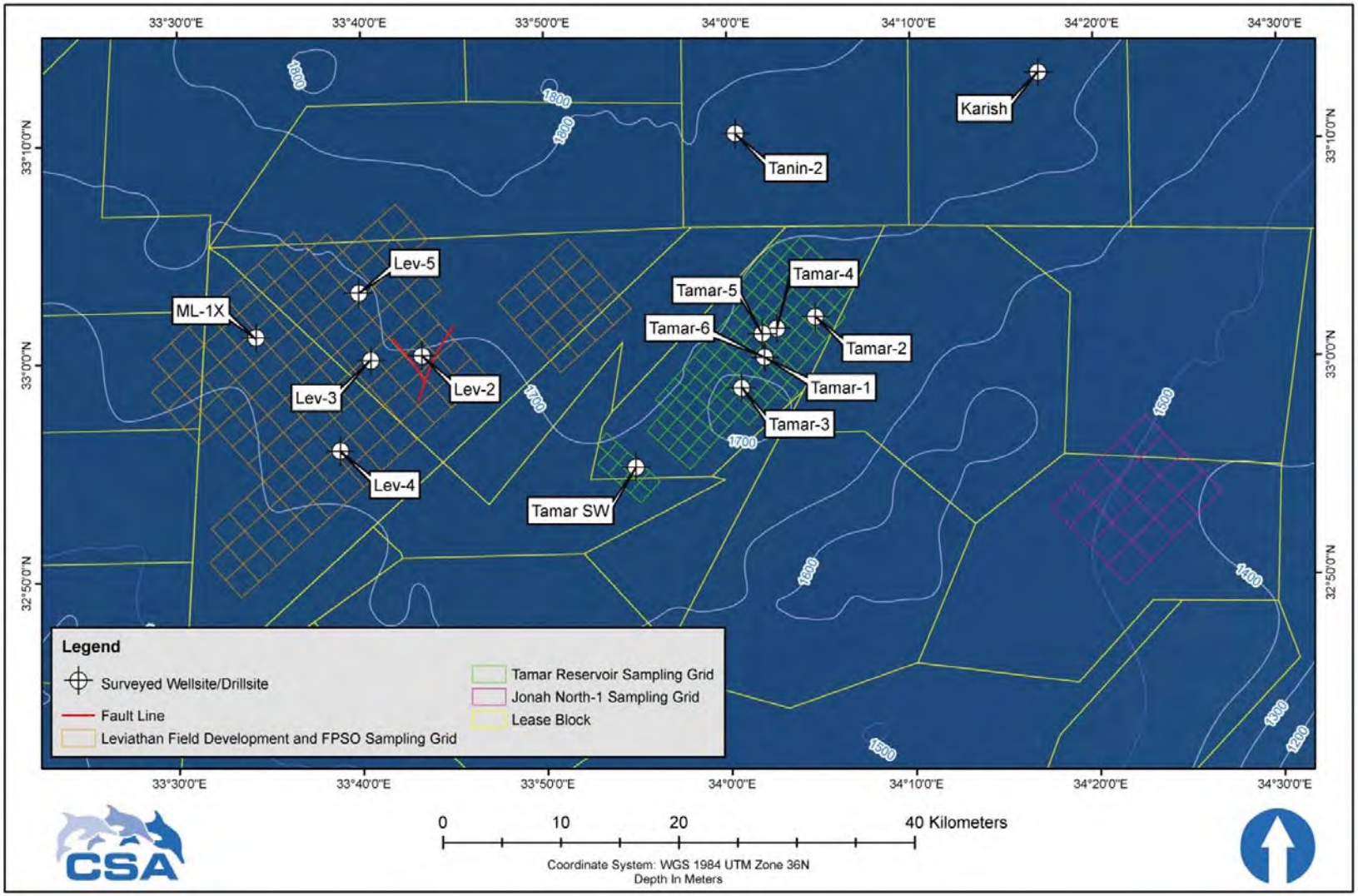

Figure 2. Location of the Tamar Field wellsite relative to other Noble Energy wellsites, monitoring areas, and offshore lease blocks.

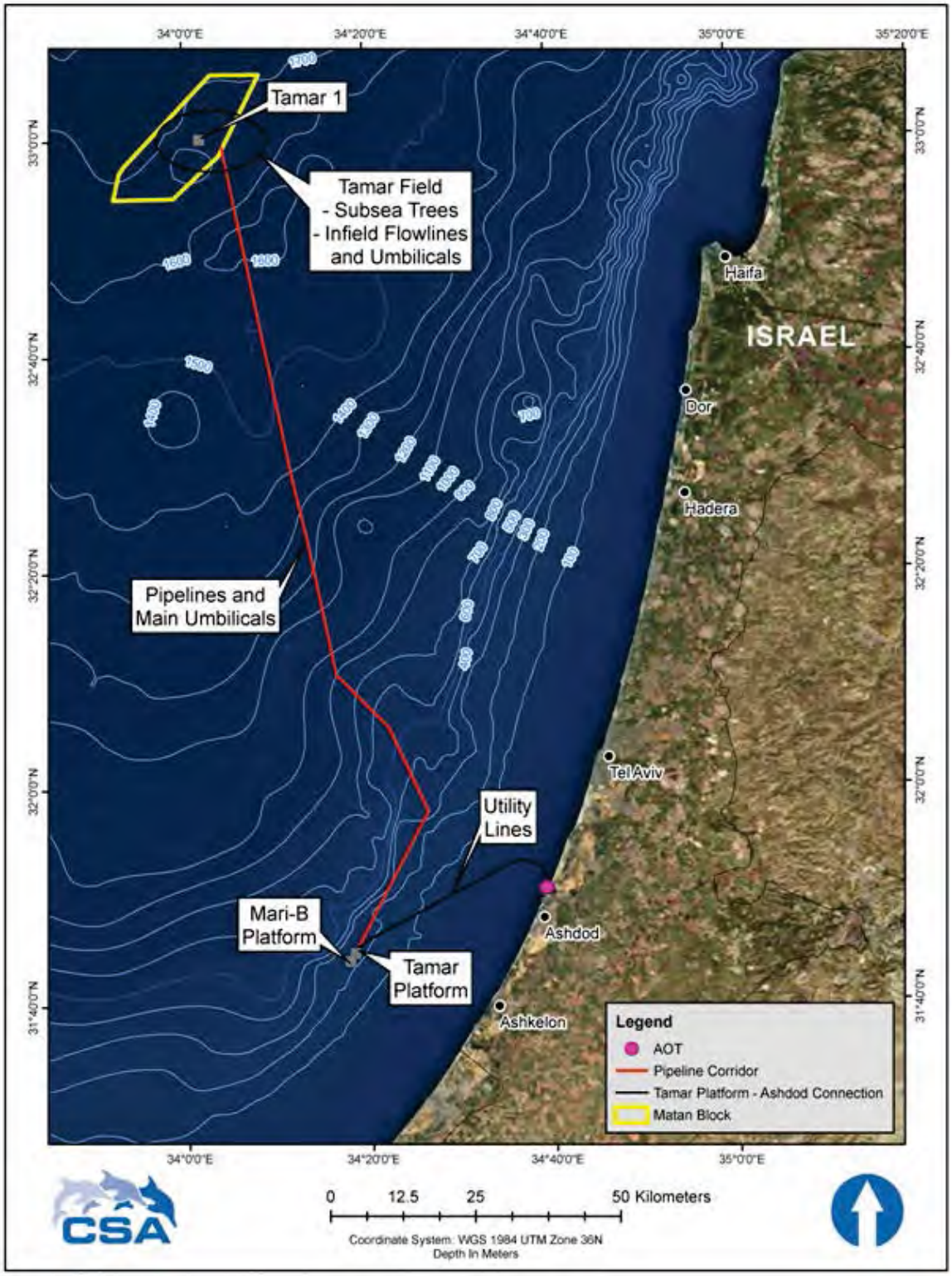

Figure 3. Location of the Tamar Field and pipeline relative to the Israeli coastline.

1.2 PURPOSE AND OBJECTIVES

The purpose of the environmental monitoring survey was to characterize the environmental conditions within the Tamar Field. The main objectives of the program were as follows:

- Monitor the environment within the reservoir footprint so that environmental conditions will be known wherever infrastructure is installed, eliminating the need for any additional pre-activity sampling;
- Monitor the environment around the proposed pipeline route that lies between the Tamar and Tamar SW reservoirs; and
- Determine spatial relationships and interpolate parameters among sampled and un-sampled locations within the reservoir footprint.

2.1 STATION CONFIGURATION

February 2014 Tamar Field Background Monitoring Survey

Given the stated objectives of this survey (**Section 1.2**), CSA sampled the Tamar Field using a uniform sampling grid design. This approach lent itself to an enhanced analysis using geostatistical methods. A grid with 107 uniform cells (area of each cell was 1.5 km^2) was superimposed over the entire Tamar Field (**Figure 4**). Due to the nature of the grid design, portions of some cells necessarily fell outside of the reservoir footprint. One fixed sediment/infauna sampling station was located in the midpoint of each cell. In cells that had existing infrastructure located within 100 m of the midpoint of the cell, the sampling station was offset for safety reasons. The offset station was re-located within the affected cell to a location that best approximated the midpoint of that cell with respect to the safety constraints. A sampling design using random placement of stations was not created because, depending on the placement of those random stations, the potential existed for one to detect false differences among successive surveys when those differences are actually due to heterogeneity within each cell.

Grid cells that contained previously sampled stations were not re-sampled during this proposed survey. An average for each parameter was calculated from all the previously sampled stations within that grid cell. That average was considered the value at the midpoint of the cell in the event that there are future comparative efforts. No drilling or anthropogenic activity has occurred within the main portion of the Tamar Field since the samples were collected; therefore, any samples that were collected previously are considered to be temporally homogeneous.

Water column sampling included water sample collection and hydrographic profiling. Water column sampling was conducted at one new sediment/infauna station located in a grid cell in the middle of the reservoir, and at one station located each within a grid cell located at the northern, southern, western, and eastern extremities of the footprint. Water samples were collected via rosette at three water depths: near-surface, mid-water, and near-bottom. All water samples were collected within the same 24-hour period. Based on previous Noble Energy survey data from the Levantine Basin, the water column is extremely homogenous and there has been no indication of meaningful spatial variability in water column data. Therefore, the spacing of the water column sampling stations (**Figure 4**) was adequate to document conditions within the study area.

Geographical coordinates of the center point of each grid cell are provided in **Appendix C**. The distance between each grid cell's center point and each wellsite located within the Tamar Field is provided in **Appendix D**.

March 2013 Tamar Field and Pipeline Survey

Sampling stations were located within two stratified random sampling designs, one corresponding to environmental characterization of the Tamar Field and the other corresponding to environmental characterization of the pipeline route. The sampling designs were selected to avoid potential pseudo-replication (*sensu* Hurlbert, 1984) and provide representative samples for characterization of the environment in the survey area. Results from the sediment stations located in the Tamar Field were incorporated into the geostatistical model described above.

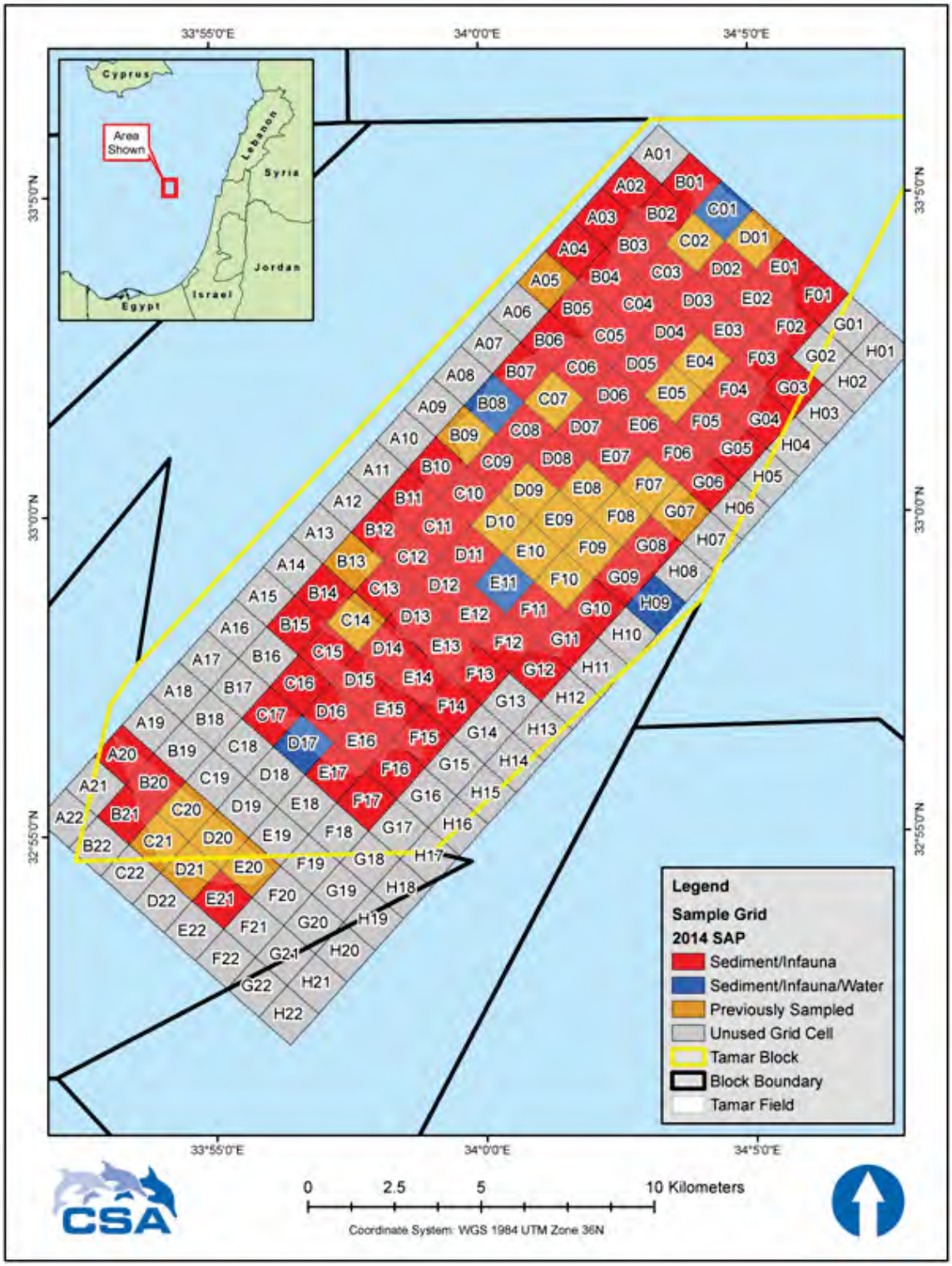

Figure 4. Uniform grid sampling design superimposed over the Tamar Field showing previously sampled stations and new stations sampled during the February 2014 Tamar Field Background Monitoring Survey.

At the Tamar Field stations, sampling consisted of collecting seawater, sediment, infauna, and video. For the pipeline route, sampling was divided among five strata defined by water depth (**Table 2**); station locations were randomly located within each stratum, and only sediment and infaunal samples were collected. The sampling effort is summarized in **Table 2** and shown in **Figure 5**. A total of 30 stations were sampled.

Video data were collected to generally characterize the substrate and associated epifauna and demersal biological community (fishes) in the vicinity of the drillsites for Tamar-1 to Tamar-6. Tamar-6 was drilled and completed within approximately 29 m of Tamar-1; thus, Tamar-1 and Tamar-6 are considered one drillsite. Data were collected along a total of 40 transects (eight 200-m transects radiating at 45° intervals from each of the five completed drillsites) for an approximate total survey distance of 8 km.

Table 2. Summary of sampling conducted for the March 2013 Tamar Field and Pipeline Survey.

Depth Stratum	Description	Sample Type	Number of Sampling Stations
20 – 200 m	Between the Tamar Platform and Ashdod Onshore Terminal	Sediment/infauna	7
200 – 300 m	Between the Tamar Platform and 300-m isobath	Sediment/infauna	4
300 – 900 m	Between the 300- and 900-m isobaths	Sediment/infauna	4
900 – 1,400 m	Between the 900- and 1,400-m isobaths	Sediment/infauna	3
1,400 – 1,700 m	Between the 1,400-m isobath and the manifold in the Tamar Field	Sediment/infauna	3

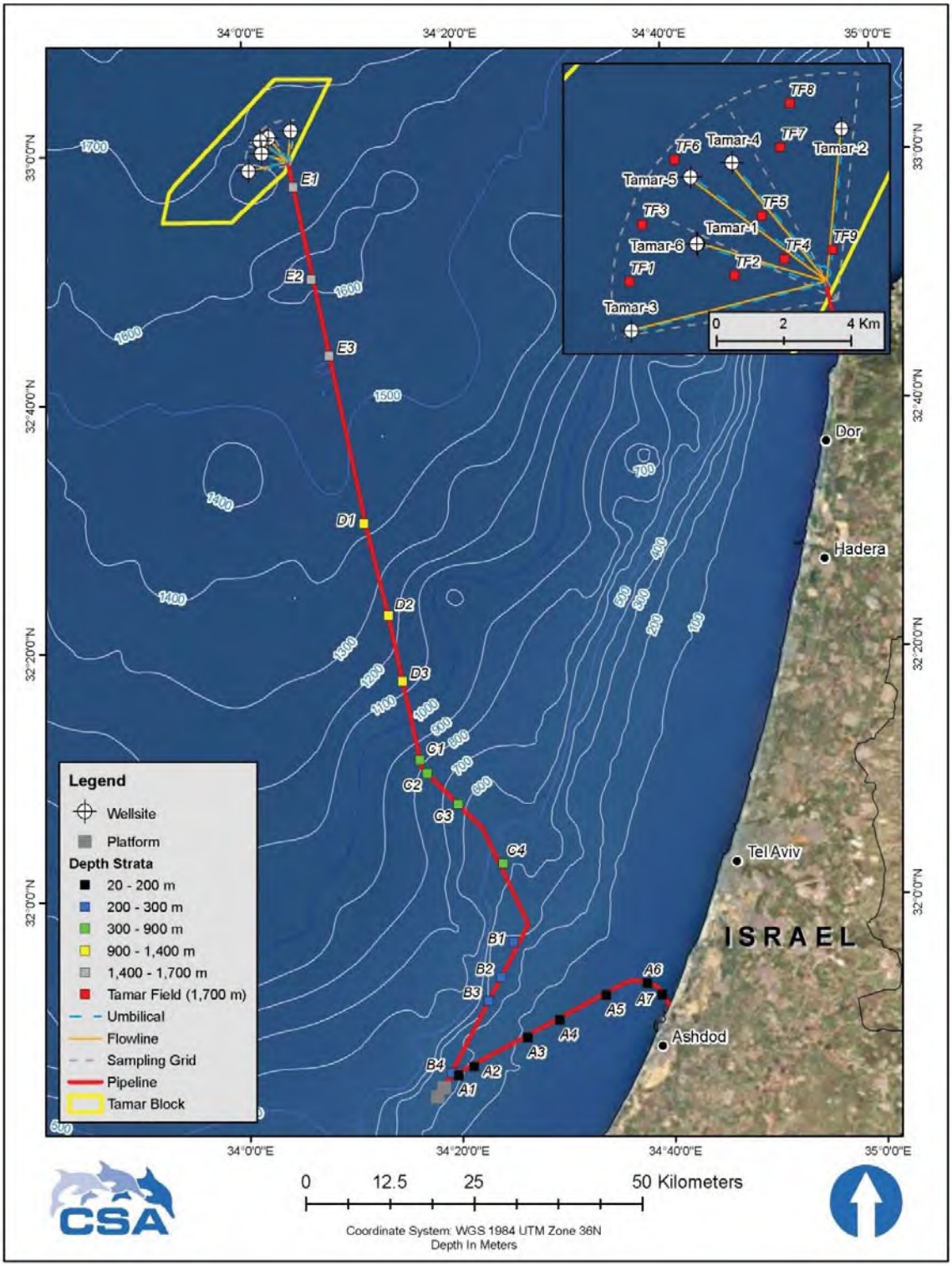

Figure 5. Configuration of sampling strata and locations of sampling stations for the March 2013 Tamar Field and Pipeline Survey.

2.2 SAMPLING PARAMETERS

This section outlines the sampling parameters and analytes from both the February 2014 Tamar Field Background Monitoring Survey and the March 2013 Tamar Field and Pipeline Survey. Both surveys consisted of sampling seafloor sediments and the overlying water column as well as biological sampling using appropriate field techniques, analytical procedures, and quality control (QC) measures. Sampling of the sediments and water column included widely used physical and chemical indicators (**Table 3**). The biological aspects of the sampling program involved assessment of the infaunal communities using box corer sampling methods, and epifaunal communities and seafloor characteristics using a remotely operated vehicle (ROV). **Table 3** lists the physical, chemical, and biological parameters that were sampled during both surveys.

Table 3. Seawater and sediment sampling parameters/analytes.

Analyte	Recommended Procedure	Tamar Field Background Monitoring Survey	Tamar Field and Pipeline Survey
Seawater			
Conductivity/salinity	*In situ* measurement (CTD)	Yes	Yes
Temperature	*In situ* measurement (CTD)	Yes	Yes
Dissolved oxygen (concentration and percent saturation)	*In situ* measurement (CTD)	Yes	Yes
Fluorescence	*In situ* measurement (CTD)	Yes	Yes
Turbidity	*In situ* measurement (CTD) and static measurement (YSI turbidity meter)	Yes	Yes
TOC	Use 250-mL HDPE plastic jars; freeze	Yes	Yes
Total nutrients (nitrogen, phosphorus)	Use 250-mL HDPE plastic jars; freeze; composite sample with TOC	Yes	Yes
Nitrate, nitrite, ammonium, phosphate	Filter through a 0.7-µm filter, Use 250-mL plastic jars; freeze	Yes	No
Chlorophyll *a*	Filter in the field through glass fiber filter; filter stored frozen	Yes	No
Ions (Ca^{2+}, Cl^{-}, K^{+}, Mg^{2+}, Na^{+}, SO_4^{2-}, Sr^{2+})	Filter through a 0.7-µm filter, Use 250-mL plastic jars; freeze	Yes	No
DOC	Filter through a 0.7-µm filter, Use 250-mL plastic jars; freeze	Yes	No
Total suspended solids	Onboard filtration through pre-weighed 1-µm glass fiber filters; filter stored frozen	Yes	Yes
TPH/Alkanes	Use 1-L amber glass containers with Teflon-lined caps; refrigerate, preserve with methylene chloride	Yes	Yes
PAHs	Use 1-L amber glass containers with Teflon-lined caps; refrigerate, preserve with methylene chloride	Yes	Yes
Total metals (Ag, As, Ba, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl, V, and Zn)	Use 1-L plastic jars with trace metal grade nitric acid preservative; refrigerate	Yes	Yes
Dissolved metals (Ag, As, Ba, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl, V, and Zn)	Filter through a 0.45-µm filter. Use 1-L plastic jars with trace metal grade nitric acid preservative; refrigerate	Yes	No
Total Hg	Use fluorinated 500-mL glass jars with ultrapure HCl preservative; refrigerate	Yes	Yes
Dissolved Hg	Filter through a 0.45-µm filter. Use fluorinated 500-mL glass jars with ultrapure HCl preservative; refrigerate	Yes	No
Ra 226 and Ra 228	Use 4-L plastic containers with trace metal grade nitric acid preservative; does not need refrigeration	Yes	Yes
Sediment			
Grain size distribution by particle size analysis	Box core sample; collect in pre-cleaned plastic jar; freeze	Yes	Yes
TOC	Box core sample; collect in pre-cleaned plastic jar; freeze	Yes	Yes
Total metals (Ag, Al, As, Ba, Be, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Sb, Se, Tl, V, and Zn)	Box core sample; collect in pre-cleaned plastic jar; freeze	Yes	Yes
TPH/alkanes	Use glass container with Teflon-lined caps; freeze	Yes	Yes

Table 3. (Continued).

Analyte	Recommended Procedure	Tamar Field Background Monitoring Survey	Tamar Field and Pipeline Survey
PAHs	Use glass container with Teflon-lined caps; freeze	Yes	Yes
Ra 226/228; Th 228	Box core sample; collect in pre-cleaned plastic jar; freeze	Yes	Yes
Infauna	Box core; preserve with 8% formalin; identification and enumeration	Yes	Yes
Epifauna and seafloor characteristics	Underwater video by ROV; visual analysis	No	Yes
Ancillary			
Weather/sea conditions	Observations	Yes	Yes

Ag = silver; Al = aluminum; As = arsenic; Ba = barium; Be = beryllium; Ca = calcium; Cd = cadmium; Cl = chloride; Cr = chromium; CTD = conductivity-temperature-depth (profiler); Cu = copper; DOC = dissolved organic carbon; Fe = iron; HCl = hydrochloric acid; HDPE = high-density polyethylene; Hg = mercury; K = potassium; Mg = magnesium, Ni = nickel; PAH = polycyclic aromatic hydrocarbon; Pb = lead; Ra = radium; ROV = remotely operated vehicle; Sb = antimony; Se = selenium; SO_4 = sulfate; Sr = Strontium; Th = thorium; Tl = thallium; TOC = total organic carbon; TPH = total petroleum hydrocarbons; V = vanadium; Zn = zinc.

February 2014 Tamar Field Background Monitoring Survey

Seawater and sediment analytes and recommended procedures for the February 2014 Tamar Field Background Monitoring Survey can be found in **Table 3**. Hydrographic profiling and seawater sample collection was conducted at five stations. The water column was profiled for conductivity/salinity, temperature, dissolved oxygen (DO), fluorescence, and turbidity. Seawater samples were collected at three water depths (near-surface, mid-depth, and near-bottom) and were analyzed for total organic carbon (TOC), nutrients (total nitrogen [TN], total phosphorus [TP], nitrate, nitrite, ammonium, and phosphate), chlorophyll *a*, ions (Ca^{2+}, Cl^{-}, K^{+}, Mg^{2+}, Na^{+}, SO_4^{2-}, Sr^{2+}), dissolved organic carbon (DOC), total suspended solids (TSS), hydrocarbons (alkanes, total petroleum hydrocarbons [TPH], and polycyclic aromatic hydrocarbons [PAHs]), total and dissolved metals, and radionuclides (radium [Ra] 226 and Ra 228).

A total of 86 sediment/infauna stations were sampled during the February 2014 Tamar Field Background Monitoring Survey. One sample per station was collected and analyzed for grain size, TOC, metals, hydrocarbons, radionuclides, and infauna.

March 2013 Tamar Field and Pipeline Survey

Seawater and sediment analytes and recommended procedures for the March 2013 Tamar Field and Pipeline Survey can be found in **Table 3**. Seawater samples were collected and hydrographic profiles were conducted at nine stations. The water column was profiled for conductivity/salinity, temperature, DO, fluorescence, and turbidity. Seawater samples were collected near-bottom at each station within Tamar Field and analyzed for TSS, TOC, nutrients (TN and TP), total metals, hydrocarbons (alkanes, TPH, PAHs), and radionuclides (Ra 226 and Ra 228). Seawater samples were not collected along the pipeline corridor.

Seafloor sediment samples were collected at 30 sampling stations for the March 2013 Tamar Field and Pipeline Survey. These samples were analyzed for grain size distribution, TOC, total metals, hydrocarbons (alkanes, TPH, and PAHs), radionuclides (Ra 226, Ra 228, and thorium [Th] 228), and infauna. Radionuclides were not collected along the pipeline corridor.

3.0 FIELD METHODS

The following section describes the sampling methods that were conducted within the Tamar Field, and along the Tamar pipeline corridor. Sampling of the Tamar Field was conducted during two surveys from 26 to 31 March 2013 (Tamar Field portion of the March 2013 Tamar Field and Pipeline Survey) and from 9 to 13 February 2014 (February 2014 Tamar Field Background Monitoring Survey). Seawater and sediment sampling occurred during both surveys and video sampling occurred during the March 2013 survey. Sampling of the Tamar pipeline corridor was conducted from 22 to 25 March 2013 and consisted of sediment sampling only. The methods describing the collection of hydrographic profiling data, water column samples, sediment samples, and videographic data are summarized in the following subsections and described in detail in the attached SOW/SAPs (February 2014 Tamar Field Background Survey and MNIEWR/MoEP comments: **Appendix E**; March 2013 Tamar Field and Pipeline Survey visual portion: **Appendix F**; March 2013 Tamar Field and Pipeline Survey sediment and seawater sampling portion **Appendix G**).

3.1 VESSEL OPERATION, NAVIGATION, AND REQUIRED PERSONNEL

Sampling within the Tamar Field occurred using two different vessels. Both survey vessels and navigational equipment were provided by Noble Energy. The M/V *Toisa Wave*, owned and operated by Sealion Shipping Limited, was utilized during the February 2014 Tamar Field Background Monitoring Survey. The M/V *Ares*, owned and operated by EDT Shipping Company Ltd., was used for the March 2013 Tamar Field and Pipeline Survey. Vessel specifications are provided in **Appendices H** and **I**, respectively. Both survey vessels were mobilized with personnel and equipment at the Haifa shorebase in Israel.

Dynamic positioning capabilities were used to accurately maintain the vessel position on station during the collection of all survey data. The vessels used different navigation systems to main vessel positions during sampling:

M/V *Toisa Wave*: QINsy (Quality Integrated Navigation System), a hydrographic data acquisition, navigation, and processing computer software system, was used to interface various data sources with the vessel's differential global positioning system (DGPS) receiver and fathometer.

M/V *Ares*: WinFrog, a computer software and hardware system, was used to interface various data sources with a DGPS receiver. The DGPS and vessel fathometer were connected to an onboard computer equipped with navigation and data acquisition software. An ultra-short baseline transponder (USBL) was attached to an ROV to record its position relative to the vessel position using DGPS. The positions of the ROV track and sample collection locations were recorded and stored by the navigation software.

Prior to starting the surveys, all survey sampling locations (i.e., video transects and seawater/sediment collection stations) were pre-plotted and submitted to the navigator for entry into the navigation software

The survey involved 24-hour operations during the field sampling effort. CSA provided eight personnel (four scientists and four operational technicians) aboard the M/V *Toisa Wave*, and six survey personnel (three scientists and three operational technicians) aboard the M/V *Ares* to conduct the environmental monitoring survey operations. CSA personnel were augmented with Noble Energy's contractors to provide navigators, deck hands, and supervisors as needed for 24-hour operations. CSA personnel prepared sampling equipment, directed data collection, conducted all aspects of sample processing, and arranged for shipment and delivery of samples to respective laboratories.

3.2 REMOTELY OPERATED VEHICLE

The Tamar Field portion of the March 2013 Tamar Field and Pipeline Survey utilized a 150-hp Triton XLS-51, a Noble Energy-contracted ROV owned by Specialist Subsea Systems and operated by Phoenix International, Inc. The Triton XLS is a heavy duty, work class ROV system manufactured by Perry Slingsby Systems and rated to 3,000 m (**Image 1**). Video equipment was not utilized for the February 2014 Tamar Field Background Monitoring Survey.

Image 1. Triton XLS work class remotely operated vehicle.

The ROV system was installed on the M/V *Ares* and included an A-frame and winch with a 3,300-m steel armored umbilical and ROV control center. The computer control system provided auto heading, altitude, depth, pitch, and roll control. Video collection capability was provided by one Kongsberg OE1366 standard-definition color zoom camera and one Kongsberg OE15-100A Enhanced CCD low-light camera mounted on hydraulic pan-and-tilt units with multiple 250-watt lamps. The hydraulic propulsion system consisted of four 15-in. horizontal thrusters and four 12-in. vertical thrusters. Solid syntactic flotation blocks provided neutral trim and a maximum payload capacity of 300 kg. One seven-function manipulator and one five-function manipulator were mounted on the front of the ROV.

A Sea-Bird Electronics (SBE) SBE-19 conductivity-temperature-depth (CTD)/water quality profiler was mounted on the upper front of the ROV above the manipulators and integrated with the ROV instrumentation junction box to provide real-time surface monitoring. GO-FLO water sample bottles (10 L) were mounted across the back of the ROV and hydraulically triggered using the ROV's auxiliary tooling manifold. Box cores were carried in an aluminum frame bracket attached to the port side, forward tray of the ROV and operated using the ROV's auxiliary tooling manifold.

3.3 WATER COLUMN SAMPLING

Water column sampling was conducted to evaluate chemical and physical parameters within the Tamar Field. Hydrographic data, including conductivity (salinity), temperature, DO, fluorescence, and turbidity, were collected throughout the water column with an SBE19*plus* V2 CTD/water quality profiler.

Seawater samples were collected at three discrete depths (near-surface, mid-depth, and near-bottom) at five stations as part of the February 2014 Tamar Field Background Monitoring Survey (**Figure 4**). Nine water samples were collected at near-bottom depths as part of the Tamar Field portion of the March 2013 Tamar Field and Pipeline Survey (**Figure 5**). Water sampling was not conducted along the Tamar pipeline corridor.

All water samples were collected within a single 24-hour period. Water column sampling was conducted to provide seawater for the analysis of TOC, nutrients (TN, TP, nitrate, nitrite, ammonium, and phosphate), ions (Ca^{2+}, Cl^{-}, K^{+}, Mg^{2+}, Na^{+}, SO_4^{2-}, Sr^{2+}), DOC, TSS, hydrocarbons (alkanes, TPH, and PAHs), and radionuclides (Ra 226 and Ra 228). Seawater samples were collected with GO-FLO water sample bottles mounted on a rosette carrousel on board the M/V *Toisa Wave* and mounted on the ROV on board the M/V *Ares* (**Image 2**).

Water samples were transferred into pre-cleaned sample containers and stored as recommended by U.S. Environmental Protection Agency (USEPA) protocols (U.S. Geological Survey, 2000). Analytes sampled for each survey and water sample protocols are summarized in **Table 4**.

Image 2. Rosette sampling system on board the M/V *Toisa Wave* (left) and ROV-mounted GO-FLO water sample bottles on board the M/V *Ares*.

Table 4. Processing and storage requirements for seawater samples collected for analysis during the February 2014 Tamar Field Background Monitoring Survey and March 2013 Tamar Field and Pipeline Survey.

Parameter/ Analyte(s)	Minimum Sample Volume	Container Type and Size	Handling, Storage Conditions, and/or Preservation Method	Holding Time	Tamar Field Background Monitoring Survey	Tamar Field and Pipeline Survey
TOC, total nutrients (TN, TP)	250 mL	250-mL HDPE plastic bottle	Frozen	28 days	Yes	Yes*
DOC, nitrate, nitrite, ammonium, phosphate	250 mL	250-mL HDPE plastic bottle	Filter through 0.7-µm filter and freeze filtrate; ship on ice	28 days	Yes	No
Ions (Ca^{2+}, Cl^-, K^+, Mg^{2+}, Na^+, SO_4^{2-}, Sr^{2+})	250 mL	250-mL HDPE plastic bottle	Filter through 0.7-µm filter and freeze filtrate; ship on ice	28 days	Yes	No
TSS	1 L, unfiltered	1-L plastic bottle	Cool to 4°C; filter in the field and store pre-weighed filter frozen; ship on ice	Indefinite when filtered and frozen	Yes	Yes*
Hydrocarbons (alkanes, total petroleum hydrocarbons and PAHs)	1 L	1-L amber glass bottle	Cool to 4°C; ship on ice	7 days	Yes	Yes*
Total Hg	500 mL	500-mL fluorinated plastic bottle	HCl to pH <2; cool to 4°C; ship on ice	28 days	Yes	Yes*
Dissolved Hg	500 mL	500-mL fluorinated plastic bottle	Filtered through a 0.45µm filter; HNO_3 to pH <2; cool to 4°C; ship on ice	28 days	Yes	No
Total metals other than Hg	1 L	1-L narrow-mouth plastic bottle	HNO_3 to pH <2; cool to 4°C; ship on ice	6 months	Yes	Yes*
Dissolved metals other than Hg	1 L	1-L narrow-mouth plastic bottle	Filtered through a 0.45µm filter; HNO_3 to pH <2; cool to 4°C; ship on ice	6 months	Yes	No
Radionuclides (Ra 226 and Ra 228)	4 L	4-L narrow-mouth plastic bottle	HNO_3 to pH <2; cool to 4°C; ship on ice	N/A	Yes	Yes*

Ca = calcium; Cl = chloride; DOC = dissolved organic carbon; HCl = hydrochloric acid; HDPE = high-density polyethylene; Hg = mercury; HNO_3 = nitric acid; K = potassium; Mg = magnesium; N/A = not applicable (half-life based); Na = sodium; PAH = polycyclic aromatic hydrocarbon; Ra = radium; SO_4 = sulfate; Sr = strontium; TN = total nitrogen; TOC = total organic carbon; TP = total phosphorus; TSS = total suspended solids.
* = not along pipeline.

3.4 SEDIMENT AND INFAUNAL SAMPLING

The Tamar Field and Tamar pipeline corridor were sampled for sediment and infauna. Sediment and infaunal sampling as part of the February 2014 Tamar Field Background Monitoring Survey on the M/V *Toisa Wave* was conducted with a 0.25-m^2 stainless steel box corer (modified Gray-O'Hara type) (**Image 3**). A USBL transponder was attached to the box core to record its position at stations that were located within 100 m of existing infrastructure. The USBL was used to relocate the sample collection to a safe distance away from the existing infrastructure (i.e., pipeline). Sediment and infaunal sampling as part of the March 2013 Tamar Field and Pipeline Survey on the M/V *Ares* was conducted with ROV-mounted box corers or a Smith-McIntyre grab (both 0.0625 m^2). A single box core and subsequent sediment sample was collected at each sampling station in the Tamar Field (**Figure 4**). Multiple ROV-mounted box corers (1 box corer for chemistry and 2 replicate box corers for infauna) were used at each station in the Tamar Field and along the Tamar pipeline corridor as part of the March 2013 Tamar Field and Pipeline Survey (**Figure 5**).

Image 3. Modified Gray-O'Hara box corer used to collect sediment and infauna samples on the M/V *Toisa Wave* (left) and ROV-mounted box corer used to collect sediment and infauna samples on the M/V *Ares* (right).

Each box core sample was evaluated for acceptability on return to deck using the following standard USEPA sediment grab sampling criteria (U.S. Environmental Protection Agency, 2001):

- No sediment touched the top of the sampler or overflowed from the sampler;
- Clear, overlying water was present in the sampler;
- No sign of channelling or sample washout;
- Proper depth was achieved within the substrate for sample collection; and
- No evidence of sediment loss.

If the box core sample did not meet the above criteria, another sample was immediately collected until sampling criteria were met. Acceptable box core samples were subsampled for sediment chemical, geological, and infaunal analyses.

3.4.1 Chemical and Geological Samples

All chemical and geological subsamples were collected from the top 2 cm of sediment outside of the stainless steel insert. Sediment samples were transferred from the box corer with a stainless steel spoon into pre-cleaned sample containers, frozen, and handled/stored as recommended by USEPA protocols. Sediment sampling protocols are summarized in **Table 5**. Sampled parameters included grain size distribution by particle size analysis, TOC, total metals, hydrocarbons (alkanes, TPH, and

PAHs), and radionuclides (Ra 226, Ra 228, and Th 228). Within each sampling stratum, an additional core for sediment grain size was collected to a depth of approximately 15 cm for correlation with the infaunal data.

Table 5. Processing and storage requirements for sediment sampling parameters.

Parameter/ Analyte(s)	Minimum Sample Volume	Container Type and Size	Storage Conditions and/or Preservation Method	Holding Time	Tamar Field Background Monitoring Survey	Tamar Field and Pipeline Survey
Grain size and TOC	200 g (wet)	250-mL wide-mouth plastic jar	Freeze, ship on ice, and store frozen	Indefinite when frozen	Yes	Yes
Total metals	150 g	250-mL wide-mouth plastic jar	Freeze, ship on ice, and store frozen	Indefinite when frozen	Yes	Yes
Hg	150 g	250-mL wide-mouth plastic jar	Freeze, ship on ice, and store frozen	Indefinite when frozen	Yes	Yes
Hydrocarbons (alkanes and PAHs)	150 g	125-mL wide-mouth glass jar	Freeze, ship on ice, and store frozen	28 days	Yes	Yes
Radionuclides (Ra 226, Ra 228, Th 228)	500 g (wet)	500-mL wide-mouth plastic jar	None	Indefinite	Yes	Yes*

Hg = mercury; PAH = polycyclic aromatic hydrocarbon; Ra = radium; Th = thorium; TOC = total organic carbon.
* = not along pipeline.

3.4.2 Infaunal Samples

As part of the February 2014 Tamar Field Background Monitoring Survey, modified Gray-O'Hara box core samples from the Tamar Reservoir and Field were partitioned using a 0.35-m × 0.35-m stainless steel insert to separate the chemical and geological sample from the infaunal sample. Infaunal samples were collected from the top 15 cm of the 0.1225-m^2 surface area of the insert placed in the box corer. As part of the March 2013 Tamar Field and Pipeline Survey, two replicate box core samples were taken at 9 stations within the Tamar Field and at 21 stations along the pipeline corridor for infauna samples.

Samples of infaunal sediment were elutriated and wet-sieved on board through a 0.25-mm mesh sieve with gentle streams of seawater using a flotation technique (barrel technique) that minimizes trauma to the infaunal organisms and facilitates separation from the sediment. The apparatus consisted of a sample mixing barrel fitted with a spillover drain that was positioned above a large spillover barrel. A 12-in. diameter stainless steel 0.25-mm mesh sieve was mounted between the spillover drain and the lower spillover barrel (**Image 4**). The flow rate from the mixing barrel was monitored to prevent overloading on the sieve screen. The sieved sample (containing infaunal organisms, residual sediment, and debris) was consolidated, transferred to a labeled sample container, and preserved with an 8% borax-buffered formalin solution.

Image 4. Macrobenthic infaunal sieving apparatus consisting of an upper mixing barrel and sieve table over a lower spillover barrel.

3.5 VIDEOGRAPHY

Video data provided visually based monitoring of seafloor features near the Tamar Field wellsites and reference locations as part of the March 2013 Tamar Field and Pipeline Survey. Underwater video

and forward-looking sonar acoustic imagery were collected along a total of 40 transects (eight 200-m transects radiating from each of the five completed drillsites at 45° intervals), for a total of approximately 8 km of seafloor surveyed. The track followed by the ROV along the designated transects was recorded using the ROV's onboard navigation system, enabling the ROV to sample the same general areas during subsequent surveys.

Underwater video data were collected using a video camera mounted on the Triton XLS ROV system. The ROV-mounted camera was aimed slightly above vertical to provide a field of view that included the bottom substrate in front of the system. The SOW stipulated the use of lasers mounted on the ROV to provide a field of view reference in the video images, but the lasers were not used during the survey because they were confiscated by Israeli customs officials. The ROV was maneuvered at relatively slow speeds close to the seafloor to ensure the collection of video data that best met survey objectives. Video observations were recorded continuously along each transect to provide information to determine the spatial extent of topographic features relative to the drillsite. Additionally, video data were used to determine presence/absence and relative abundance estimates for epifauna and demersal fishes in the survey area. Bottom features and faunal observations were digitally marked using VisualSoft software to facilitate video data analysis.

3.6 QUALITY CONTROL

As part of both studies, QC measures included the preparation of equipment blanks (rinsates) to determine the potential of contamination of samples by the sampling equipment; preparation of field blanks to determine the potential of sample contamination from containers and general sample handling; preparation and completion of sample/data checklists; equipment performance and data checks; use of chain-of-custody (CoC) processes; reference materials for laboratory analyses; and use of qualified/certified equipment, personnel, and laboratories. Sample duplicates representing at least 10% of the total number of samples were prepared during the Tamar Field portion of the March 2013 Tamar Field and Pipeline Survey.

Cleaning Procedures

To ensure that samples represent natural conditions, sample collection equipment must not cause contamination of the samples and sampling methods must not cause unacceptable changes in samples collected (sampling artifacts). Thus, pre-cleaned sample containers were used to collect all samples. Water samplers, sediment samplers, and sample-processing equipment were thoroughly cleaned according to accepted procedures prior to use in the field. Pre-cleaned sample containers were processed by the distributor following appropriate USEPA protocols as specified in the Office of Solid Waste and Emergency Response (OSWER) Directive 9240.0-05A "Specifications and Guidance for Contaminant-Free Sample Containers".

3.6.1 Quality Control Measures

Equipment Blanks

After the sampling equipment was cleaned, equipment blanks were prepared by pouring deionized water through the equipment and collecting the rinsate in pre-cleaned sample containers. The containers were labeled and shipped to the laboratory in the same fashion as the other samples.

Field Blanks

Field blanks were prepared by pouring analyte-free deionized water into clean sample containers while in the field. The containers were labeled and shipped to the laboratory in the same fashion as the other samples.

Laboratory Quality Control – Sample Splits

Laboratory QC measures included the analysis of randomly selected sample splits from the samples provided.

Sample Duplicates

QC samples collected within the Tamar Field during the March 2013 Tamar Field and Pipeline Survey included duplicate samples for both water and sediment chemistry parameters. Duplicate samples were collected from the same sediment grab sample or Niskin bottle and sent to the primary analytical laboratory in the U.S. (TDI Brooks [College Station, Texas]) and an Israeli (IMI TAMI Institute for Research & Development Ltd. [TAMI]) and U.S. analytical laboratory (ALS Environmental [Kelso, Washington]) for interlaboratory comparison.

Sea-Bird Profiler Data Check

During or soon after a water column profile cast was completed, the SBE hydrographic data was examined by a CSA scientist to check that the collected data were within expected ranges (for the conditions at the study area), the equipment was functioning normally, and the configuration and data files were in good order.

Data and Sample Collection Checklists

Prior to the survey, data and sample checklists were prepared by the Chief Scientist and completed in the field as appropriate for QC. Prior to departing each sampling station, the Chief Scientist or his designee reviewed the checklist and physically examined and confirmed data files, logbooks, and sample containers to ensure that all data and samples required at the station were collected and properly stored.

Sample Preservation and Holding Times

Samples were preserved as specified by applicable regulations or industry practice and transported to the laboratories for analysis under appropriate preservation and handling conditions.

3.6.2 Sample Handling and Transport

After sample collection, standard sample handling protocols were followed to ensure valid results were obtained from the analysis of each sample. To document proper handling, all stages of sample collection, storage, and handling were documented in a field logbook. Pertinent information concerning field activities and sampling were also recorded in the field logbook by the Chief and/or Field Scientist.

All samples were transported or shipped under a CoC process. Proper CoC was maintained for all samples, and a CoC record accompanied all samples. Personnel involved with the custody of the sample(s) signed and maintained tracking forms and ensured that the samples were properly handled, stored, and transported to the analytical laboratory. Sample shipping containers were secured to be leakproof, avoid cross-contamination, and prevent sample loss during shipment.

Sample analysis requests and instructions were provided and either accompanied the physical samples or were sent electronically, or both, for all samples shipped to the laboratories. Transport and shipping were coordinated to ensure compliance with sample holding times. The project team confirmed that all samples were delivered and logged in at each designated laboratory.

3.6.3 Document and Data Security

Vessel navigation and positioning data, along with field data files from CTD/DO profiles, were saved to a computer file and backed up on an external hard drive. All data collected during field operations (navigation and positioning, CTD, acoustic, etc.) were duplicated and stored on two hard drives

(typically, a primary laptop and an external hard drive). This storage occurs as soon as possible after collection but within the same watch or day, depending on the field deployment. Either the Chief Scientist or Operations Lead may ensure that a backup external drive is included in the project mobilization. While on site, backup media are stored separately from the field computer. During return from the field, computer and backup media are transported separately whenever feasible but at least one copy travels in personal possession. Either the Chief Scientist or Operations Lead may ensure that the data drives are delivered to CSA's corporate office in Stuart, Florida. Field notebooks and datasheets are then copied and scanned into a file associated with the job's other data and backed up on the data server. The link to the data is shared with the Project Manager to ensure redundant knowledge for future access. The Chief Scientist verifies that the data are put into CSA's enterprise-class storage system. CSA maintains two copies of the data: one live working copy and one on archival tape for disaster recovery purposes. The link to these data is shared with the Project Manager as well.

4.0 DATA PROCESSING AND LABORATORY METHODS

4.1 HYDROGRAPHIC PROFILES

Digital data files from the SBE19*plus* V2 CTD profiler were processed using SBE proprietary data-processing software. The raw data were converted to a text file, and the desired sections for specific stations extracted and then imported into a spreadsheet prior to plotting. Further processing prepared the data as diagrammatic vertical hydrographic profiles using SigmaPlot and tabular spreadsheet summaries. The hydrographic data collected during the Tamar Field Survey were compared by visual inspection to identify any substantive differences or trends between stations and data from other surveys.

4.2 SEAWATER AND SEDIMENT ANALYSIS

Tables 6 and **7** outline the analytical parameters and laboratory analysis methods, reporting units, and reporting limits of seawater and sediment samples, respectively. As part of the March 2013 Tamar Field and Pipeline Survey, TAMI (Haifa, Israel) performed the analysis of sediment metals, excluding mercury. The Geological Survey of Israel (GSI; Jerusalem, Israel) performed analysis of total seawater metals and sediment mercury. As part of the February 2014 Tamar Field Background Monitoring Survey, ALS Environmental (Kelso, Washington, U.S.) performed the analysis for sediment and seawater metals and seawater ions. During both surveys, the same laboratories were used for the following parameters. TDI Brooks (College Station, Texas, U.S.) performed the analysis of seawater and sediment hydrocarbon samples. Chesapeake Biological Laboratory (Solomons, Maryland, U.S.) performed the analysis of seawater nutrients, TOC, DOC, and TSS. ALS Environmental (Fort Collins, Colorado, U.S.) performed the analysis of sediment and seawater radionuclides. Weatherford Laboratories (Shenandoah, Texas, U.S.) performed the sediment TOC and grain size analyses. Reporting limits or laboratory method detection limits (MDLs) indicate the lowest concentration of a parameter that the laboratory is able to detect under standard conditions. MDLs are dependent upon sample volume and can vary slightly if the sample volume deviates from the standard volume needed to analyze a parameter.

Table 6. Analytical parameters, primary laboratory, analysis methods, reporting units, and reporting limits of quantification for seawater samples.

Parameter/ Analyte	Primary Analytical Laboratory	Digestion/ Extraction Method	Analytical/Detection/ Quantification Method	Quantification Limit [1]	CCC[2]	Units
Arsenic[3]	ALS Environmental – Kelso (February 2014 Tamar Field Background Monitoring Survey)	Red. Ppt	ICP-MS	0.5	36	µg/L
Antimony[3]		20× dilution	ICP-MS	1	500[p]	µg/L
Barium[3]		N/A	ICP-MS	4	200	µg/L
Beryllium[3]		Red. Ppt	ICP-MS	0.02	--	µg/L
Cadmium[3]		Red. Ppt	ICP-MS	0.02	8.8	µg/L
Chromium[3]		Red. Ppt	ICP-MS	0.2	--[4]	µg/L
Copper[3]		Red. Ppt	ICP-MS	0.1	3.1	µg/L
Lead[3]		Red. Ppt	ICP-MS	0.02	8.1	µg/L
Mercury[3]		N/A	Based on USEPA 1631E	0.001	0.94	µg/L
Nickel[3]		Red. Ppt	ICP-MS	0.2	8.2	µg/L
Selenium[3]		N/A	BRAAS	1.0	71	µg/L
Silver[3]		Red. Ppt	ICP-MS	0.02	--	µg/L
Thallium[3]		Red. Ppt	ICP-MS	0.02	--	µg/L
Vanadium[3]		N/A	ICP-OES	4.0	50	µg/L
Zinc[3]		Red. Ppt	ICP-MS	0.5	81	µg/L
Ions		N/A	ICP-AES/Ion Chromatography	4.5 to 60,000	--	µg/L

Table 6. (Continued).

Parameter/ Analyte	Primary Analytical Laboratory	Digestion/ Extraction Method	Analytical/Detection/ Quantification Method	Quantification Limit [1]	CCC[2]	Units
Arsenic	Geological Survey of Israel (March 2013 Tamar Field and Pipeline Survey)	N/A	ICP-MS	7	36	µg/L
Antimony		N/A	ICP-MS	0.2	500[p]	µg/L
Barium		N/A	ICP-MS	0.2	200	µg/L
Beryllium		N/A	ICP-MS	0.5	--	µg/L
Cadmium		N/A	ICP-MS	0.1	8.8	µg/L
Chromium		N/A	ICP-MS	5	--[4]	µg/L
Copper		N/A	ICP-MS	1	3.1	µg/L
Lead		N/A	ICP-MS	0.1	8.1	µg/L
Mercury		N/A	Based on USEPA 1631E	0.01	0.94	µg/L
Nickel		N/A	ICP-MS	0.1	8.2	µg/L
Selenium		N/A	ICP-MS	7	71	µg/L
Silver		N/A	ICP-MS	0.5	--	µg/L
Thallium		N/A	ICP-MS	0.1	--	µg/L
Vanadium		N/A	ICP-MS	2	50	µg/L
Zinc		N/A	ICP-MS	2	81	µg/L
Alkanes	TDI Brooks	Methylene chloride	USEPA 1664/8100/8015 GC-MS	0.069 – 0.277	--	µg/L
TPH		Methylene chloride	USEPA/SW-846 Modified 8100/8015C	13	--	µg/L
PAHs		Methylene chloride	USEPA SW-846/ 8260/GC-MS	0.74 – 2.91	--	ng/L
TN	Chesapeake Biological Laboratory	Persulfate digestion	diazo colorimetric method	0.01	--	mg/L
Ammonium		N/A	USEPA Method 350.2	0.01	--	mg/L
Nitrite		N/A	diazo colorimetric method	0.0175/0.0035	--	mg/L
Nitrate		Enzyme or Cd reduction	diazo colorimetric method	0.0175/0.0035	--	mg/L
Phosphate		N/A	USEPA Method 365.1	0.0025	--	mg/L
TP		Persulfate digestion	ascorbic acid colorimetric method	0.0013	--	mg/L
DOC and TOC		N/A	High-temperature combustion	0.24	--	mg/L
TSS		N/A	Analytical balance	0.01	--	mg/L
Radium 226	ALS Environmental – Ft. Collins	N/A	USEPA Method 903.1	1	--	pCi/L
Radium 228		N/A	USEPA Method 904.0 and SW-846 9320	1	--	pCi/L

Cd = cadmium; DOC = dissolved organic carbon; GC-MS = gas chromatography-mass spectrometry; ICP-AES = inductively coupled plasma-atomic emission spectrometry; ICP-MS = inductively coupled plasma-mass spectrometry; ICP-OES = inductively coupled plasma-optical emission spectrometry; N/A = not applicable; PAH = polycyclic aromatic hydrocarbon; Red. Ppt. = reductive precipitate; TN = total nitrogen; TOC = total organic carbon; TP = total phosphorus; TPH = total petroleum hydrocarbons; TSS = total suspended solids; USEPA = U.S. Environmental Protection Agency.

[1] Limits of quantification are the detection limits for metals, ions, and chlorophyll *a* and reporting limit for alkanes and PAHs.

[2] CCC = Criterion Continuous Concentration (Buchman, 2008); CCC is an estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in unacceptable adverse effect.

[3] Information applicable for both total and dissolved metals for all metals analyzed by ALS-Kelso.

[4] Chromium III = 27.4 µg/L; Chromium VI = 50 µg/L.

p = proposed.

Table 7. Analytical parameters, analysis methods, reporting units, reporting/limits of quantification, and sediment quality guidelines (effects range low [ERL] and effects range median [ERM]; Buchman, 2008) for sediment samples.

Parameter/Analyte	Analytical Laboratory	Digestion/ Extraction Method	Analytical/Detection/ Quantification Method	Quantification Limit	ERL	ERM	Units
Particle size distribution	Weatherford	N/A	Laser diffraction particle size analysis	0.1	--	--	µm
Total organic carbon		N/A	Based on European Standard Norm 1484	5	--	--	ppm

Table 7. (Continued).

Parameter/Analyte	Analytical Laboratory	Digestion/ Extraction Method	Analytical/Detection/ Quantification Method	Quantification Limit	ERL	ERM	Units
Aluminum	ALS Environmental – Kelso (February 2014 Tamar Field Background Monitoring Survey)	HF[1]	ICP-OES	25	--	--	ppm
Antimony		HF[1]	ICP-MS	0.4	--	--	ppm
Arsenic		HF[1]	ICP-MS	4.0	8.2	70	ppm
Barium		HF[1]	ICP-OES	10.0	--	--	ppm
Beryllium		HF[1]	ICP-MS	0.16	--	--	ppm
Cadmium		HF[1]	ICP-MS	0.16	1.2	9.6	ppm
Chromium		HF[1]	ICP-MS	11.6	81	370	ppm
Copper		HF[1]	ICP-MS	0.8	34	270	ppm
Iron		HF[1]	ICP-OES	50	--	--	ppm
Lead		HF[1]	ICP-MS	0.4	46.7	218	ppm
Mercury		HNO_3/H_2SO_4	Based on USEPA 1631E	0.001	0.15	0.71	ppm
Nickel		HF[1]	ICP-MS	1.6	20.9	51.6	ppm
Selenium		HF[1]	ICP-MS	8	--	--	ppm
Silver		HF[1]	ICP-MS	0.16	1	3.7	ppm
Thallium		HF[1]	ICP-MS	0.16	--	--	ppm
Vanadium		HF[1]	ICP-MS	1.6	--	--	ppm
Zinc		HF[1]	ICP-MS	4	150	410	ppm
Aluminum	IMI TAMI Institute for Research & Development Ltd. (March 2013 Tamar Field and Pipeline Survey)	HF[1]	Based on ISO 11885	2	--	--	ppm
Antimony		HF[1]	Based on ISO 11885	1	2	25	ppm
Arsenic		HF[1]	Based on ISO 11885	3	8.2	70	ppm
Barium		HF[1]	Based on ISO 11885	0.5	--	--	ppm
Beryllium		HF[1]	Based on ISO 11885	1	--	--	ppm
Cadmium		HF[1]	Based on ISO 11885	0.5	1.2	9.6	ppm
Chromium		HF[1]	Based on ISO 11885	1	81	370	ppm
Copper		HF[1]	Based on ISO 11885	1	34	270	ppm
Iron		HF[1]	Based on ISO 11885	1	--	--	%
Lead		HF[1]	Based on ISO 11885	5	46.7	218	ppm
Nickel		HF[1]	Based on ISO 11885	1	20.9	51.6	ppm
Selenium		HF[1]	Based on ISO 11885	1	--	--	ppm
Silver		HF[1]	Based on ISO 11885	1	1	3.7	ppm
Thallium		HF[1]	Based on ISO 11885	1	--	--	ppm
Vanadium		HF[1]	Based on ISO 11885	1	--	--	ppm
Zinc		HF[1]	Based on ISO 11885	1	150	410	ppm
Mercury	Geological Survey of Israel (March 2013 Tamar Field and Pipeline Survey)	HNO_3/HF	Based on USEPA 1631E	0.02	0.15	0.71	ppm
Alkanes	TDI Brooks	Methylene chloride	USEPA 1664/8100/8015/GC-MS	0.004 – 0.019	--	--	µg/g
Total petroleum hydrocarbons		Methylene chloride	USEPA/SW-846 Modified 8100/8015C	1.4	--	--	µg/g
Polycyclic aromatic hydrocarbons		Methylene chloride	USEPA SW-846/8260/GC-MS	0.342 – 0.041	552[2] 4,002[3]	3,160[2] 44,792[3]	ng/g
Radium 226	ALS Environmental – Ft. Collins	N/A	USEPA Method 901.1	1	--	--	pCi/g
Radium 228		N/A	USEPA Method 901.1	1	--	--	pCi/g
Thorium 228		N/A	USEPA, EMSL/LV	0.2	--	--	pCi/g

EMSL/LV = Environmental Monitoring Systems Laboratory, Las Vegas; GC-MS = gas chromatography-mass spectrometry; HF = hydrofluoric acid; HNO_3 = nitric acid; H_2SO_4 = sulfuric acid; ICP-MS = inductively coupled plasma-mass spectrometry; ICP-OES = inductively coupled plasma-optical emission spectrometry; ISO = International Organization for Standardization; N/A = not applicable; ppm = parts per million; USEPA = U.S. Environmental Protection Agency.

[1] This digestion procedure results in the release of nearly all the metal content of a sample and it is believed to be a more accurately estimate of the metal concentrations in all sample matrices.

[2] Low molecular weight polycyclic aromatic hydrocarbons.

[3] Total polycyclic aromatic hydrocarbons.

4.2.1 Seawater

The following subsections provide a brief summary of the analytical methods used for each seawater sample parameter as summarized in **Table 6**. Results were used to characterize the environment within the Tamar Field and were compared with Levantine Basin baseline data amassed by CSA over time to identify any deviations from background levels. Results also were compared to the proposed Environmental Quality Standards for the Mediterranean Sea in Israel (also referred to as the Mediterranean Environmental Water Quality Standards [MEQS]) (Ministry of Environmental Protection, 2002), the European Union Commission on Environmental Quality Standards (EUCEQS) for priority substances in the field of water policy (Directive 2008/105/EC) and the proposed amendment (COM[2011]876), and USEPA water quality benchmarks to determine if seawater concentrations in the Tamar Field had the potential to cause adverse ecological effects. The MEQS define the maximum and average concentrations permitted in the marine environment. The EUCEQS are considered to be the most stringent seawater quality standards in the world, having established concentrations above which chronic impacts (annual average concentration [AAC]) and acute impacts (maximum allowable concentration [MAC]) are expected to occur. The USEPA Criterion Continuous Concentrations (CCC) for seawater is an estimate of the highest concentration of a material in water that an aquatic community can be exposed to indefinitely without resulting in unacceptable adverse effects. Radionuclide data were compared to the USEPA-established maximum contaminant level (MCL) for combined Ra 226 and Ra 228 (U.S. Environmental Protection Agency, 1976). The MCL is a maximum permissible level of a contaminant that ensures the safety of the water over a lifetime of consumption and also takes into consideration feasible treatment technologies and monitoring capabilities.

Statistical results also were interpreted in the context of the actual values (means) relative to benchmark values to evaluate their biological relevance. Comparisons were made to toxicity reference values such as the CCC (Buchman, 2008), mean Levantine Basin baseline survey data, proposed MEQS in Israel (Ministry of Environmental Protection, 2002), and EUCEQS for priority substances in the field of water policy (Directive 2008/105/EC and proposed amendment COM (2011)876).

Total Suspended Solids

Acceptable methods for the laboratory determination of TSS include USEPA Method 160.2 and Standard Methods 2540D. TSS in seawater samples was determined by pouring a known volume of seawater (approximately 1 L) through a pre-weighed glass fiber filter of a specified pore size and then weighing the filter again to 0.001 mg after rinsing the filter with deionized water to remove salts and drying in an oven to remove residual water.

Total and Dissolved Organic Carbon

TOC was determined in a Shimadzu TOC-5000 analyzer using a high temperature combustion method. Samples were treated with hydrochloric acid (HCl) and sparged with ultra-pure carrier-grade air to drive off inorganic carbon. High temperature (680°C) combustion on a catalyst bed of platinum-coated alumina balls breaks down organic carbon into carbon dioxide (CO_2). The carbon dioxide was carried by ultra-pure air to a nondispersive infrared detector for quantification.

Nutrients

Seawater nutrient analysis included TN, nitrate, nitrite, ammonium, TP, and phosphate. TN and TP were determined through colorimetric methods in a segmented flow analyzer. TN was determined by the diazo colorimetric method after alkaline persulfate digestion, and TP was determined by the molybdo-phosphoric blue colorimetric method after alkaline persulfate digestion. Initial analysis of samples for nitrate and nitrite is conducted by the enzyme-catalyzed reduction method followed by the cadmium reduction method if the concentration is low. Nitrate to nitrite are measured by a colorimetric method. To determine ammonium, filtered samples are complexed with sodium

potassium tartrate and sodium citrate. The complexed sample reacts with alkaline phenol and hypochlorite, catalyzed by sodium nitroprusside, then measured by a photometric method. To determine phosphate, filtered samples are mixed with a sulfuric acid-antimony-molybdate solution, and subsequently with an ascorbic acid solution, then measured by a photometric method.

Anions and Cations

Chloride and sulfate ions are analyzed by a chromatograph following a large volume serial dilution. A small volume of filtered sample is introduced into a Dionex-120 ion chromatograph. The sample is pumped through a pre-column, separator column, suppressor column, and conductivity detector. Anions are separated in the pre-column and separator column based on their affinity for resin exchange sites in the columns. The suppressor column then converts the sample anions to their acid form. The separated anions are measured by the conductivity detector. The concentration of anions is determined by comparing peak areas of unknowns to a calibration curve generated from known standards.

The analysis of the cations calcium, potassium, magnesium, sodium, and strontium involves multi-elemental determinations by inductively coupled plasma-atomic emission spectrometry (ICP-AES) using sequential or simultaneous instruments. The instruments measure characteristic emission spectra by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific emission spectra are produced by radiofrequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the line spectra are monitored at specific wavelengths by a photosensitive device. Photocurrents from the photosensitive device are processed and controlled by a computer system. A Perkin Elmer Optima 8300 inductively coupled plasma-optical emission spectrometer is used.

The milli equivalents per liter (meq/L) of each cation and anion are then summed and a ratio is evaluated for the cation/anion percent difference (%Diff).

Total and Dissolved Metals

Total metals analyzed during the March 2013 Tamar Field and Pipeline Survey were determined by GSI. Total metals (i.e., metals in unfiltered samples) were analyzed principally by inductively coupled plasma-mass spectrometry (ICP-MS) methods. The analysis was by flow injection ICP-MS using an Elan DRC-e Perkin-Elmer without dilution of samples. Analysis of mercury was by atomic fluorescence spectroscopy with a PS Analytical Millennium System.

Total and dissolved metals analyzed during the February 2014 Tamar Field Background Monitoring Survey were determined by ALS Environmental (Kelso, Washington, U.S.). Metals (i.e., filtered and unfiltered samples) were analyzed principally by ICP-MS methods. The analysis of seawater metals involved reductive precipitation methods to achieve lower detection limits in a high salt matrix. The seawater samples were treated with iron and palladium carriers, pH adjusted, subjected to reducing conditions using sodium tetrahydridoborate (sodium borohydride), and then analyzed by ICP-MS. Barium was analyzed by ICP-AES. Antimony was determined in a 1:20 dilution of seawater in a sample and analyzed by ICP-MS. Selenium in seawater was determined by borohydride reduction and atomic absorption spectrophotometry. Seawater samples analyzed for mercury were prepared for analysis by the addition of bromine monochloride solution and analyzed using a Brooks Rand Model III cold-vapor atomic fluorescence spectrometer.

Hydrocarbons

Hydrocarbon components in seawater were analyzed using solvent extraction and gas chromatographic techniques. Analytical methods for hydrocarbons were similar for the primary analytical and quality assurance laboratory. The analytical method for alkanes was USEPA Method 1664 (solvent extraction; gas chromatography-mass spectrometry [GC-MS]). The analytical method for TPH is USEPA/SW-846 Modified 8100/8015C. Analytical methods for PAHs include

USEPA SW-846/8260, 8270, or equivalent, using an Agilent Model 6890/5973 gas chromatograph-mass spectrometer.

Radionuclides

The Ra 226 in aqueous samples is concentrated and separated by co-precipitation with barium sulfate ($BaSO_4$). Prior to separation, a portion of the sample is removed for ICP-AES determination of the preparation concentration of barium in the sample. The $Ba[Ra]SO_4$ precipitate is dissolved in a basic ethylenediaminetetraacetic acid (EDTA) solution, placed in a 40-mL volatile organic analysis vial, purged of any existing radon (Rn) 222, and stored to allow quantitative in-growth of Rn 222. After in-growth, the radon is purged into an alpha scintillation cell. The short-lived Rn 222 progeny are allowed to come to equilibrium with the parent radon (approximately 4 hours) before the scintillation cell is counted for alpha activity. The 4-hour in-growth period also allows for the decay of other radon isotopes.

The radium isotopes in a water sample are collected by co-precipitation of barium and lead sulfate and purified by re-precipitation out of a basic EDTA solution. This technique is devised so that the beta activity from actinium (Ac) 228, which is produced by decay of Ra 228, can be determined and related to the activity concentration of Ra 228 present in the sample. After a 36-hour period to allow for the in-growth of Ac 228, lead is removed as lead (II) sulfide, and actinium is carried on yttrium (Y) as the hydroxide and mounted as the oxalate, and quickly beta-counted on a gas flow proportional counter to minimize decay of the short-lived Ac 228 (approximately 6 hours).

4.2.2 Sediment

The following subsections provide a brief summary of the analytical methods used for each sediment sample parameter as summarized in **Table 7**. Results were used to characterize the environment within the Tamar Field and along the Tamar pipeline corridor and were compared with Levantine Basin baseline data amassed by CSA over time to identify any deviations from background levels.

Statistical results also were interpreted in the context of the actual values (means) relative to benchmark values to evaluate their biological relevance. Hydrocarbon and metals concentrations were compared to the USEPA sediment quality benchmarks to determine if sediment concentrations in the Tamar Field have the potential to cause adverse ecological effects. A benchmark is a chemical concentration in sediment above which there is the possibility of harm to organisms in the environment. The USEPA recommends benchmark values such as the effects range low (ERL) and effects range median (ERM) to assess the potential risk to fish and other marine life (Long and Morgan, 1990). These sediment quality guidelines are based on marine sediment chemistry paired with sediment toxicity bioassay data. The benchmarks represent points on a continuum of chemical concentrations ranked from lowest (least toxic) to highest (more toxic) concentrations defined as follows:

- ERL is indicative of concentrations below which adverse effects rarely occur; and
- ERM is indicative of concentrations above which adverse effects frequently occur.

Grain Size

Sediment grain size was determined by means of laser (diffraction) particle size analysis using a Malvern 2000 Mastersizer. Particle sizes were computed automatically within the instrument using the Mie Model for light scattering and reported as percent distribution according to size classes representing sand, silt, and clay-sized particles.

Total Organic Carbon

TOC was analyzed by the combustion and gravimetric methods based on European Standard Norm 1484 with an Analytik Jena AG Multi N/C 2000 TOC analyzer. Samples were treated with

acid to remove carbonates and air-dried prior to analysis. Carbon dioxide generated by the combustion of organic matter in the sample was quantitatively measured with an infrared detector and calibrated against prepared standard solutions. The quantity of organic matter in a sediment sample is expressed in parts per million (ppm).

Total Metals

Total metals analyzed during the March 2013 Tamar Field and Pipeline Survey were determined by GSI (mercury) and TAMI (all other metals). Analysis for all sediment metals except mercury was conducted by acid digestion and with Varian Vista AX inductively coupled plasma-atomic absorption spectrometer and calibrated against prepared standard solutions. Mercury analysis of sediments was conducted using cold vapor atomic absorption spectroscopy and calibrated against prepared standard solutions. The sediment subsample was digested in nitric acid, hydrogen peroxide, and hydrofluoric acid with the release of elemental mercury by the addition of stannous chloride.

Perceived problems with metals analysis for the March 2013 samples by TAMI prompted use of an alternate laboratory. Total metals analyzed during the February 2014 Tamar Field Background Monitoring Survey were determined by ALS Environmental (Kelso, Washington, U.S.). Analysis for total metals in sediment samples was conducted by hydrofluoric acid digestion and analyzed by either a Thermo iCAP3500 Duo-View inductively coupled plasma-atomic emission spectrometer or Thermo X-Series inductively coupled plasma-mass spectrometer, calibrated against prepared standard solutions. Mercury analysis of sediments was conducted using purge-and-trap atomic fluorescence spectroscopy. The sediment subsample was digested in a nitric/sulfuric acid mix and diluted to volume with dilute bromine monochloride with the release of elemental mercury by the addition of stannous chloride. Mercury concentrations were measured by atomic fluorescence spectroscopy and calibrated against prepared standard solutions.

Hydrocarbons

Hydrocarbon components in sediments were analyzed by solvent extraction and gas chromatographic techniques. The analytical methods for hydrocarbons included USEPA Method 1664/8100/8015 (solvent extraction; GC-MS) for alkanes, USEPA/SW-846 Modified 8100/8015C for TPH, and USEPA SW-846/8260 or 8270 using an Agilent Model 6890/5973 gas chromatograph-mass spectrometer and calibrated against prepared standard solutions for PAHs.

Radionuclides

For Ra 226, the analysis involved drying and sieving the sample, sealing the sample in a steel can, and allowing 21 days for in-growth of lead (Pb) 214 and bismuth (Bi) 214 progeny. The analysis entailed quantification of the Pb 214 and Bi 214 progeny, assuming secular equilibrium, and reporting the abundance weighted average of the lead and bismuth activities as Ra 226. Assuming secular equilibrium, the gamma emissions from Ac 228, which is produced by decay of Ra 228, are determined and related to the activity concentration of Ra 228 present in the sample. Gamma emissions from radionuclides were detected by a semiconductor germanium crystal, which provided a small electronic pulse for each gamma interaction where the pulse height was proportional to the gamma incident energy. These electronic data were converted to digital data by an analog-to-digital converter and stored in a multichannel buffer. The data collected by the multichannel buffer were subsequently interpreted by a complex software program, generating results in units of radioactivity per unit sample volume.

For Th 228 analysis, samples were dried and ground to a fine particle size. For cases in which there was high organic matter, the samples were placed in a muffle furnace so that any organic matter was removed by combustion. Tracers were added and dissolution was accomplished using nitric, hydrochloric, and hydrofluoric acids. When actinides were being determined, a hydroxide co-precipitation was performed to pre-concentrate actinides and remove constituents that did not form insoluble hydroxides. The hydroxide precipitate was then redissolved and further purification was

performed through various chromatography resins. The purified Th 228 was co-precipitated with lanthanum fluoride and mounted on a filter membrane for quantification by alpha spectroscopy.

4.3 INFAUNA

Infaunal samples were transported to EcoAnalysts, Inc. (Moscow, Idaho, U.S.) for sorting and taxonomic identification. Prior to sorting each infaunal sample, the sample was transferred from formalin to ethyl alcohol. Samples were sorted to major taxonomic groups and then distributed to taxonomists for species identification and enumeration. During the taxonomic process, organisms were identified to the lowest practical taxonomic level by EcoAnalysts, Inc.'s in-house taxonomists. Nematodes were not identified, and oligochaetes and ostracods were only enumerated. Data were recorded on electronic datasheets within the EcoAnalysts, Inc. laboratory information management system and then later output in a Microsoft Excel format.

4.4 STATISTICAL ANALYSIS

Uniform grid sampling forms the basis of detecting, mapping, and describing seafloor patterns and characteristics while also being conducive to limited forms of spatial analysis. Depending on the spatial configuration of the sampling area, there is the potential to establish the predictability of values from place to place in the study area which in turn can form a basis for hypothesizing causation. Short of manipulative experiments, embedding regular spatial organization to the sampling process provides a first order means of measuring and visualizing patterns of seafloor characteristics.

Data interpretation of the survey results were conducted using geostatistical techniques, starting with the computation of semivariance. Semivariance is half the variance of the differences between all possible points spaced a constant distance apart. Computing semivariance for each distance +1 increment of the grid provides a basis for expressing how variance changes with space and thus, the relatedness between points on the seafloor. Points that are close to each other tend to be similar and have a low variance. However, as points are compared to increasingly distant points, the semivariance increases. Finding the distance where the semivariance stabilizes defines the spacing for subsequent samples (spatial independence). Moreover, mapping the effect of directionality, if any, on semivariance may reveal patterns of seafloor characteristics intrinsic to natural processes versus those of drilling activities. Once the semivariance is computed, a process called "kriging" was used to create a response surface of any parameter sampled in a uniform manner. Kriging is an interpolation method where the surrounding measured values are weighted to derive a predicted value for an unmeasured location. Weights are based on the distance between the measured points, the un-sampled locations, and the spatial organization of parameter values among the measured points; this allows characterization of the variance, or the precision, of predictions at any given point. Included as a potential covariate in the interpretation of survey data was proximity to existing structures and locations (provided in a map format).

A variety of statistical routines were applied to the resulting infaunal datasets using PRIMER v.6 (Clarke and Gorley, 2006) software to calculate several univariate community structure indices, including Shannon's H′ (base 2), Pielou's evenness value (J′), and Fisher's log-series *alpha* (Fisher et al., 1943). Fisher's log-series model of species abundance has been widely used, particularly by entomologists and botanists (Magurran, 1988). Taylor's (1978) studies of the properties of this index found that Fisher's log-series model was the best index for discriminating among subtly different sites, which is appropriate for the seafloor sites in these surveys which were notably monotypic.

5.0 RESULTS AND DISCUSSION

5.1 ENVIRONMENTAL CONDITIONS

Weather conditions during the February 2014 Tamar Field Background Monitoring Survey were variable (**Table 8**). Sea state varied from less than 0.5 to 1.5 m wave height. Wind direction was primarily from the northeast, and wind speed ranged from 2 to 21 knots. Currents were generally from the southwest and ranged from 0.4 to 1.0 knots.

Table 8. Wind, current, air temperature, and wave height conditions encountered during the February 2014 Tamar Field Background Monitoring Survey conducted from 9 to 13 February 2014. All parameters were recorded at approximately 12:30 each day of the survey.

Date	Wind Direction and Speed	Current Direction and Speed	Air Temperature (°C)	Wave Height (m)
9 February 2014	070° – 11 kn	357° – 0.6 kn	17	0.5
10 February 2014	335° – 8 kn	317° – 0.9 kn	18	0.5
11 February 2014	variable – 2 kn	340° – 0.6 kn	21	<0.5
12 February 2014	030° – 8 kn	015° – 0.4 kn	16	<0.5
13 February 2014	070° – 21 kn	036° – 1 kn	11	1.5

Environmental conditions were not recorded daily during the March 2013 Tamar Field and Pipeline Survey; however, records indicate that the sea state varied between calm to 2 m wave height from the west-northwest. Wind speeds during this earlier survey ranged from calm to 15 knots and direction was variable.

5.2 VIDEOGRAPHY

A video survey of the Tamar Field centered on the five completed wells (Tamar-2 through Tamar-6) was conducted from 22 to 25 March 2013. No video survey was conducted along the pipeline in March 2013 or anywhere within the field during the February 2014 Tamar Field Background Monitoring Survey. The video data were reported by CSA (2013a) and submitted by Noble Energy to MoEP and MNIEWR. Video at the Tamar SW-1 wellsite was collected during pre- and post-drill surveys and results from these surveys can be found in the Tamar SW Pre-Drill (CSA Ocean Sciences Inc., 2013d) and Tamar SW Post-Drill reports (CSA Ocean Sciences Inc., 2014).

The seafloor of the entire survey area was characterized as relatively flat topography and soft bottom substrate (**Image 5**). A substantial amount of drilling infrastructure was present on the seafloor near the drillsites. A moderate amount of disturbed sediment was observed, especially near the wellheads (**Image 6**). These disturbances likely were caused by well drilling and completion, pipelaying, and ROV activities. The areal extent of these disturbances was small (less than 10 m each) when compared to the geographic size of the survey area, and no substantial impact on benthic communities was likely. Coordinates of observed fauna and seafloor features are provided in **Appendix J**.

Anthropogenic debris (i.e., trash bags, glass bottles, assorted plastics) was observed within the survey area, as were possible drilling muds and cuttings near several of the drillsites (**Image 7**). No hard bottom substrate or chemosynthetic communities were observed within the survey area.

Apparent biological activity, including the presence of motile biota and what appeared to be evidence of their bioturbation (i.e., biologically maintained burrows and mounds), was observed and mapped within the survey area (**Figures 6** to **10**).

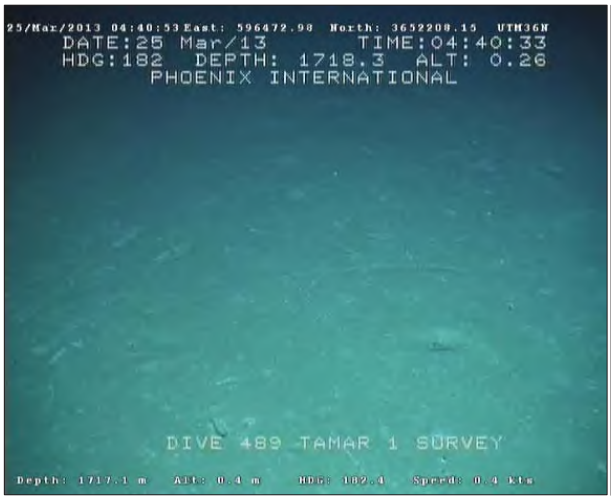

Image 5. The Tamar Field survey area was characterized by smooth and relatively flat soft bottom substrate, as seen in this image from the Tamar-1 survey.

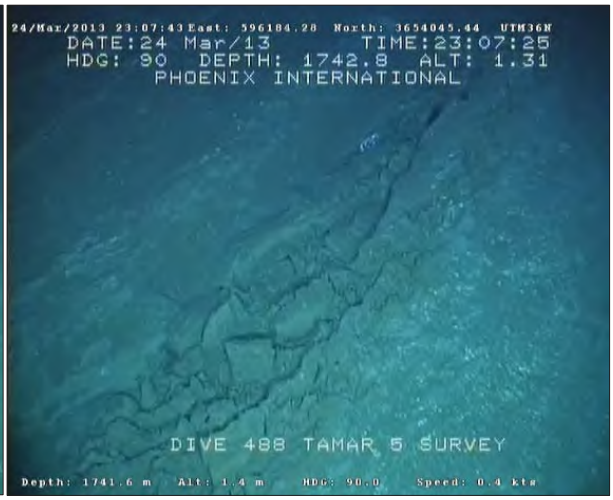

Image 6. Disturbed sediment near the Tamar-5 drillsite.

Image 7. Possible drill cuttings on the seafloor near the Tamar-1 drillsite.

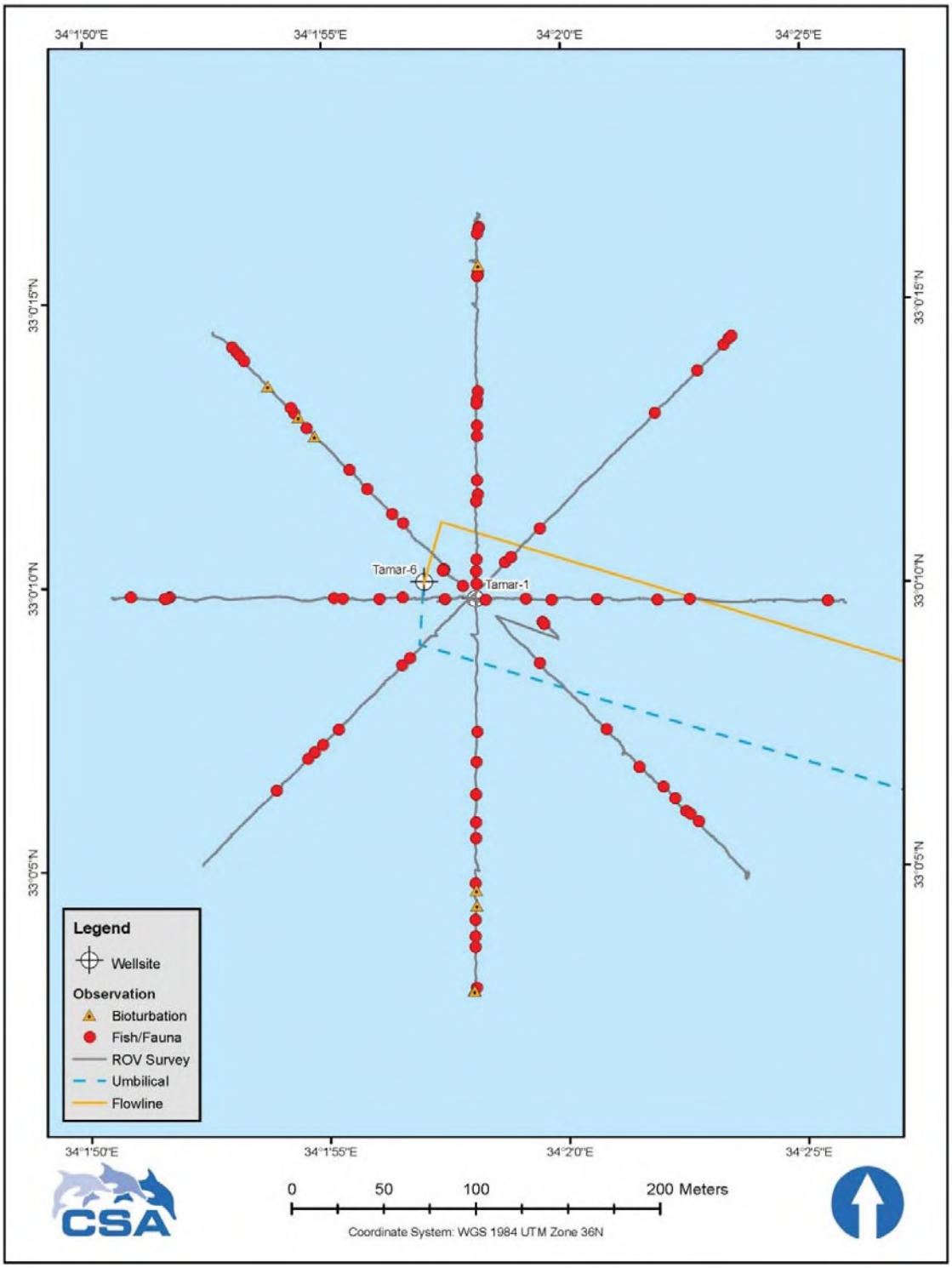

Figure 6. Locations of observations of biological activity along the ROV track around the Tamar-1 and Tamar-6 drillsites.

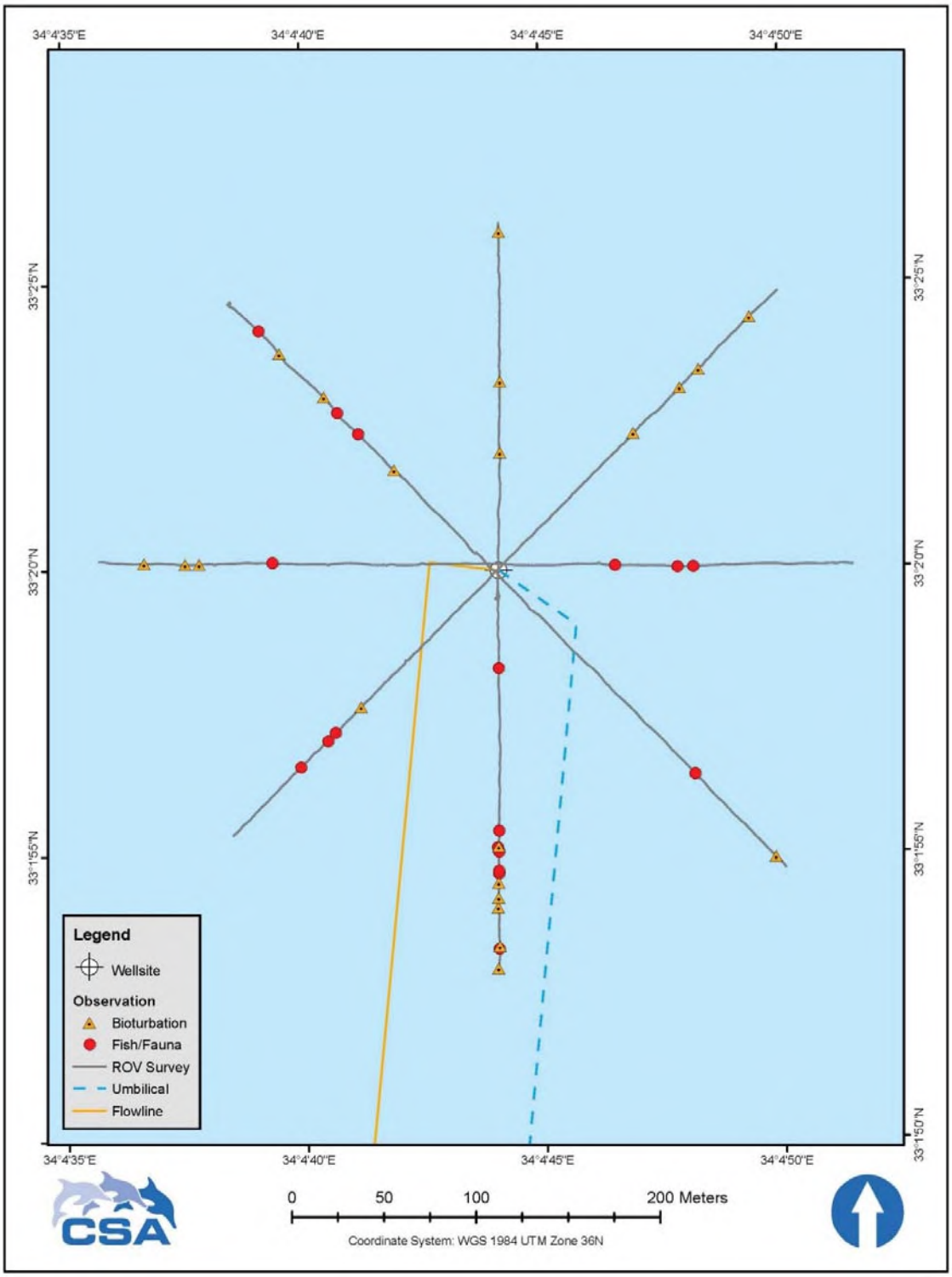

Figure 7. Location of observations of biological activity along the ROV track around the Tamar-2 drillsite.

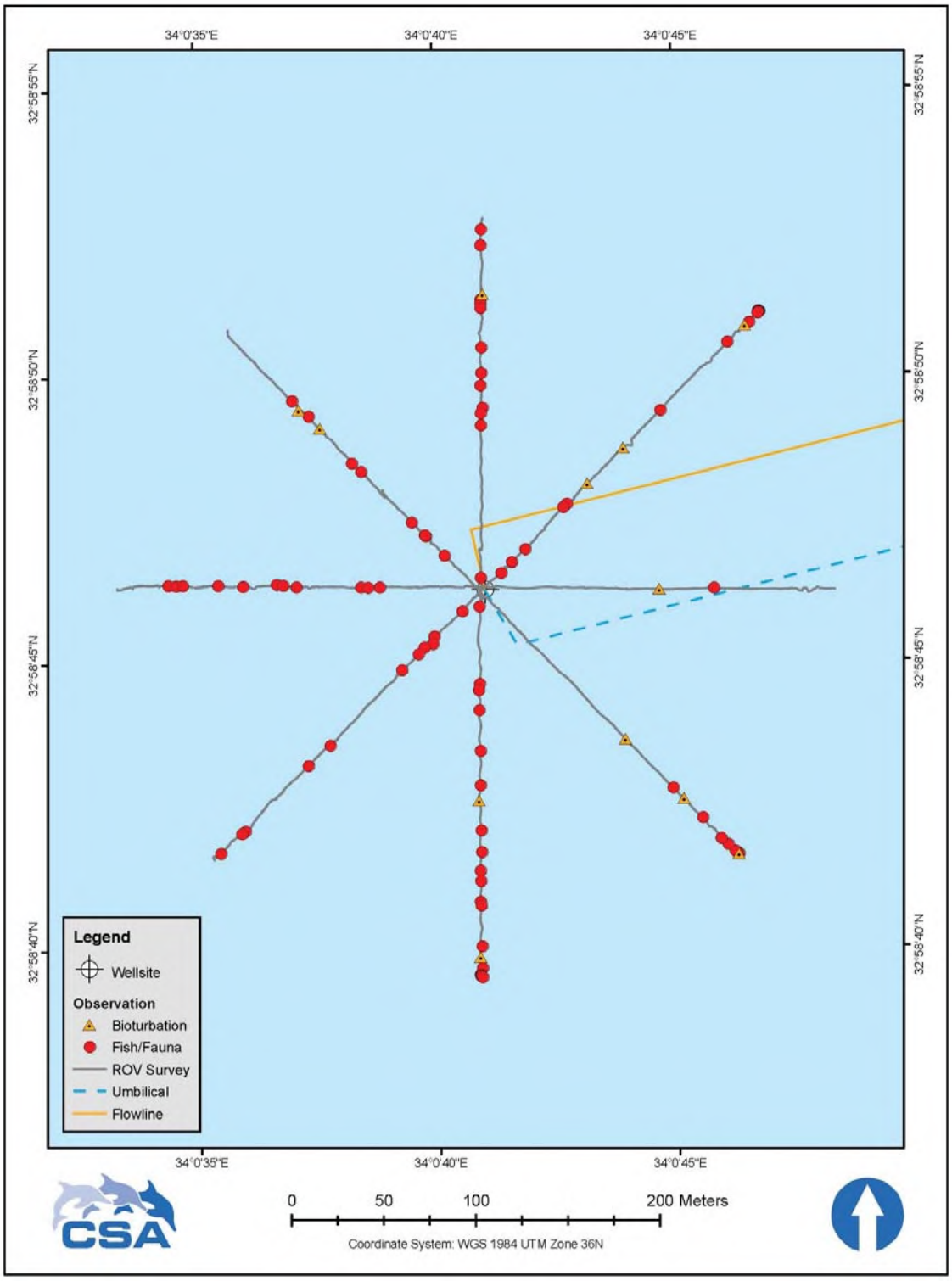

Figure 8. Location of observations of biological activity along the ROV track around the Tamar-3 drillsite.

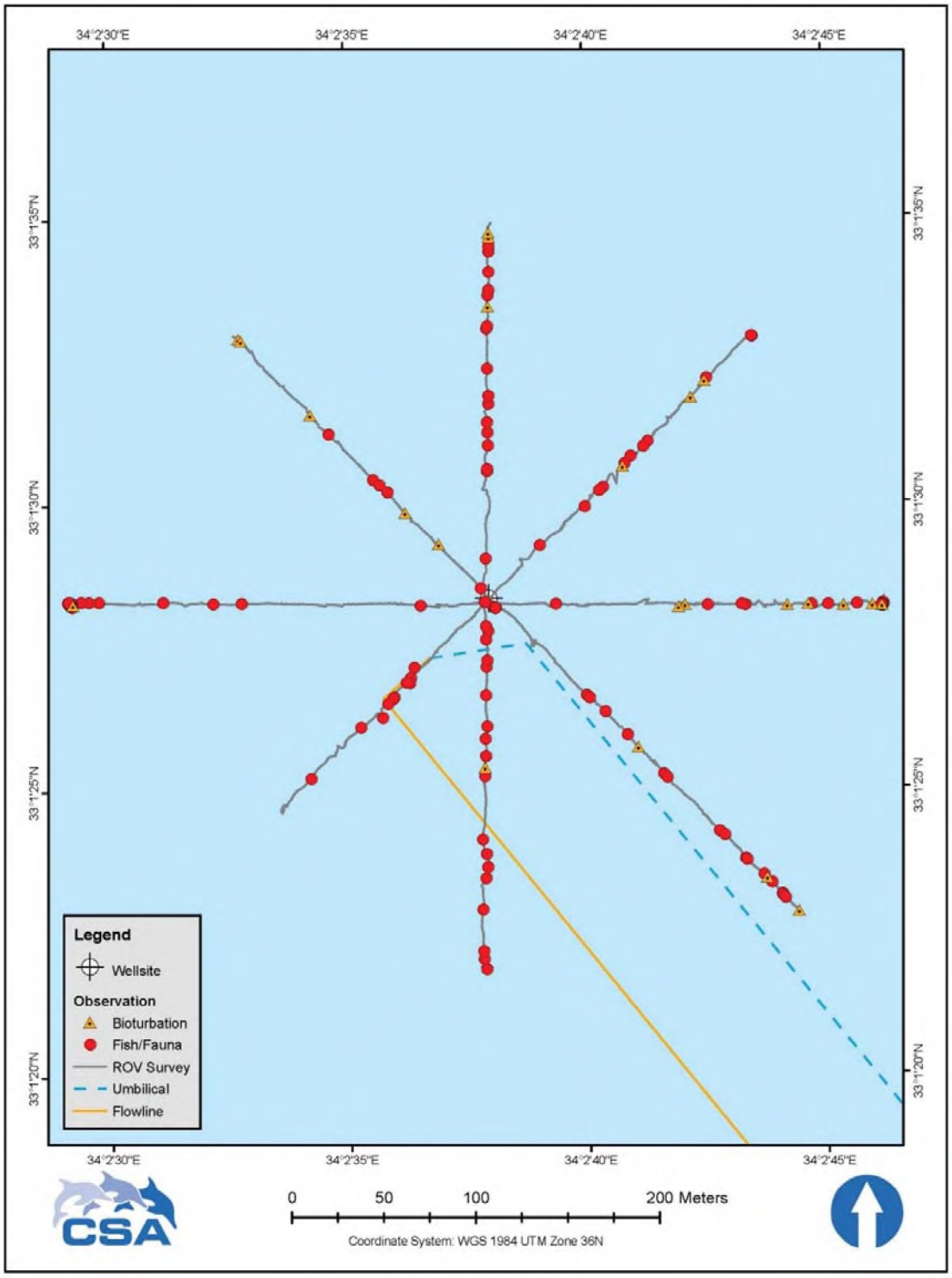

Figure 9. Location of observations of biological activity along the ROV track around the Tamar-4 drillsite.

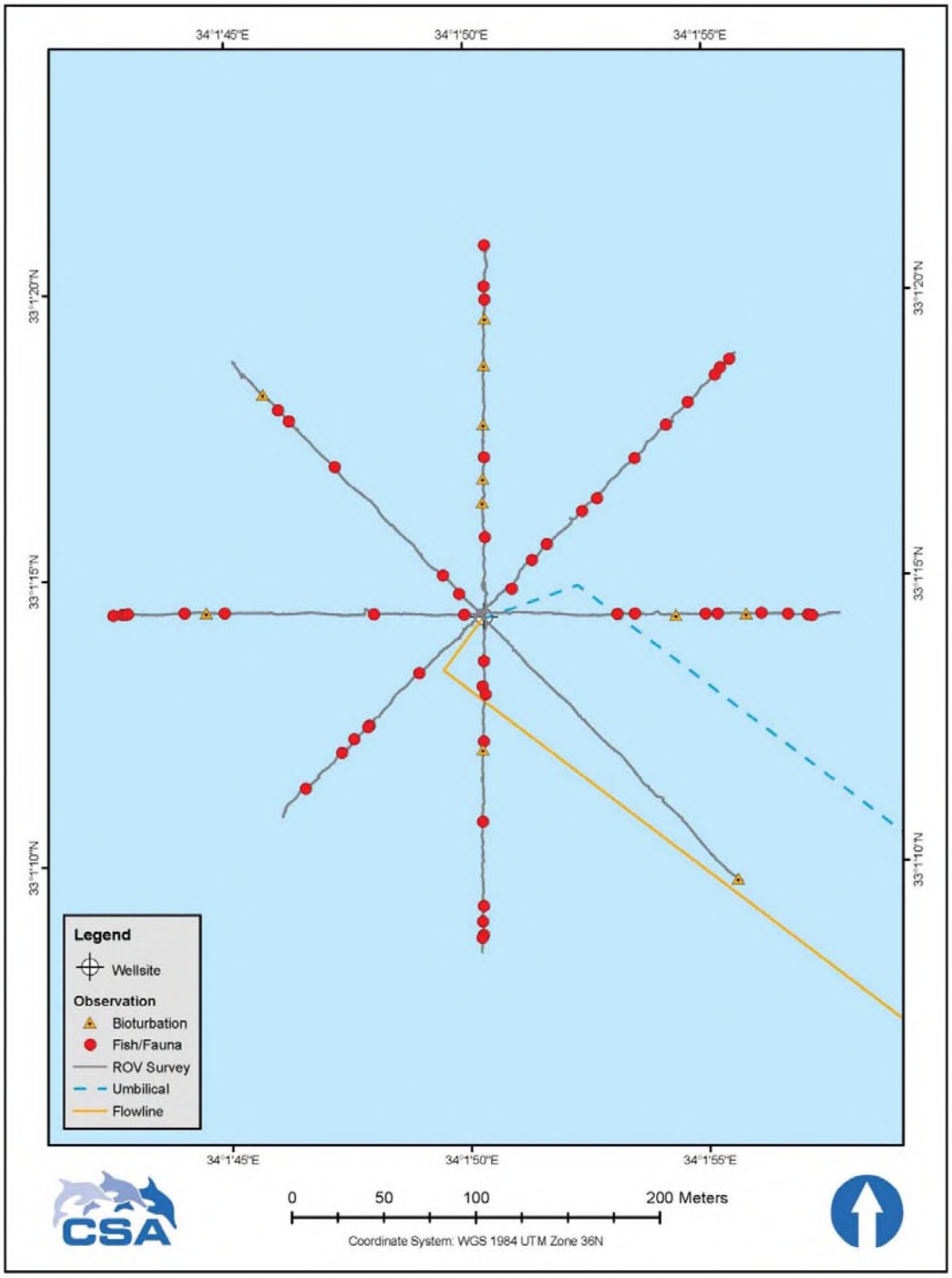

Figure 10. Location of observations of biological activity along the ROV track around the Tamar-5 drillsite.

The organisms most commonly observed during the video survey were fish (e.g., tripod fish, *Bathypterois* sp.; **Image 8**) and shrimp (**Image 9**). One crab was seen in an area of disturbed sediment near the Tamar-3 wellhead. Many of the fishes observed during the video survey could not be identified by video analysis (e.g., **Image 10**) because of their positioning relative to the camera or small body size. In all, 29 fishes and 336 shrimp were observed during the video surveys. Relative abundances of fishes and shrimp averaged 0.36 and 4.2 individuals per 100 m of transect, respectively (**Table 9**).

Image 8. A tripod fish (*Bathypterois* sp.) perched on its elongated tail and pelvic fin rays observed during the Tamar-4 survey.

Image 9. A shrimp resting on the bottom of the seafloor during the Tamar-4 survey.

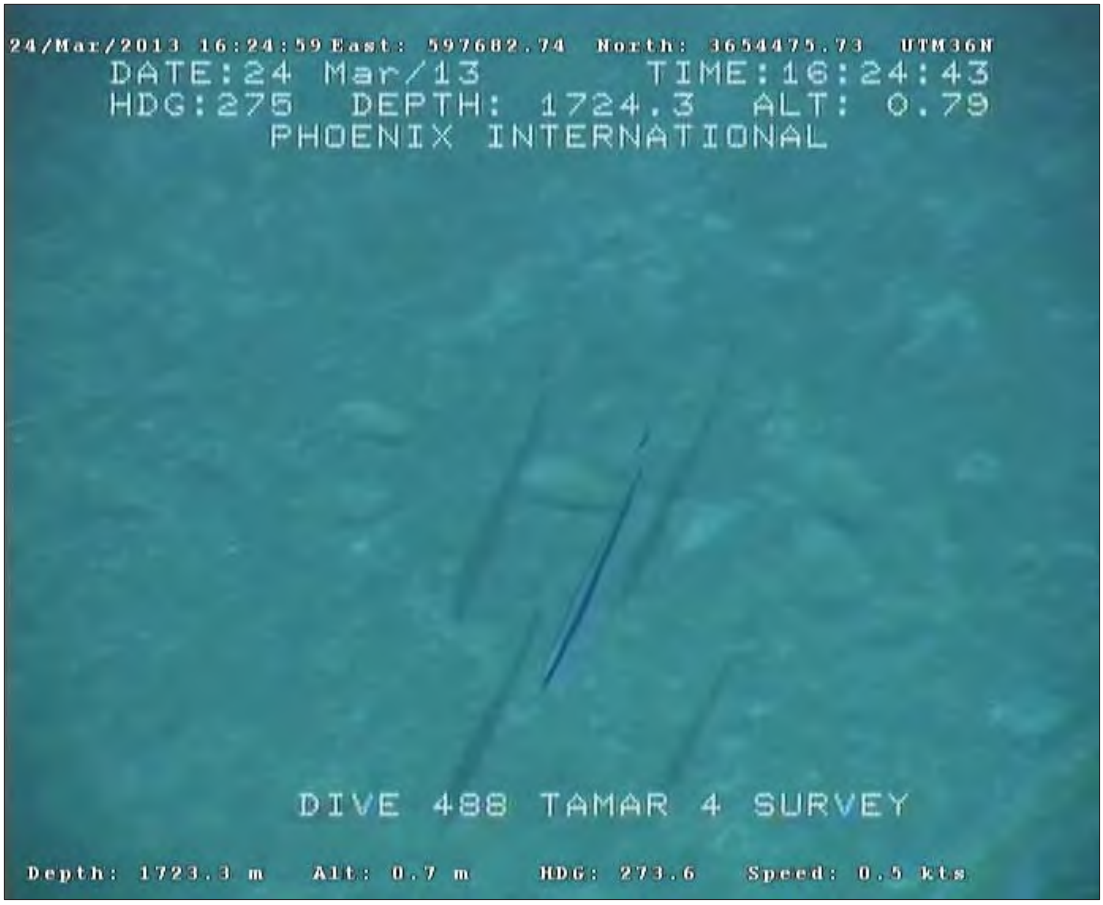

Image 10. An unidentified fish swimming towards the ROV during the Tamar-4 survey.

Table 9. Total and average numbers of fishes and shrimp observed at each drillsite during the March 2013 Tamar Field and Pipeline Survey.

Drillsite	Number of Transects	Fishes		Shrimp	
		Number Observed	Average (individuals per 100 m of transect)	Number Observed	Average (individuals per 100 m of transect)
Tamar-1 and -6	8	7	0.44	83	5.19
Tamar-2	8	3	0.19	15	0.94
Tamar-3	8	2	0.13	80	5
Tamar-4	8	16	1	97	6.06
Tamar-5	8	1	0.06	61	3.81
Total	**40**	**29**	**--**	**336**	**--**
Average			**0.36**	**--**	**4.2**

Apparent bioturbation was commonly observed along all video transects and included patterned burrows (small groupings) (**Image 11**) and small (approximately 15 to 30 cm) conical mounds (**Image 12**) likely formed by deposit-feeding worms (Polychaeta).

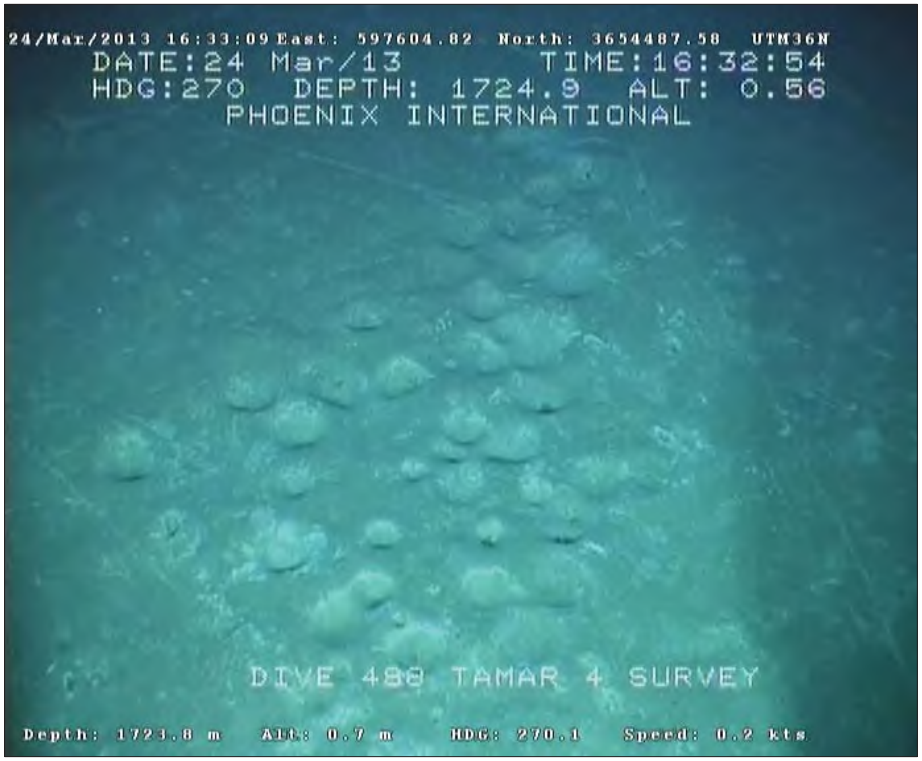

Image 11. Apparent bioturbation such as this small group of burrows seen in the Tamar-4 survey area was commonly observed.

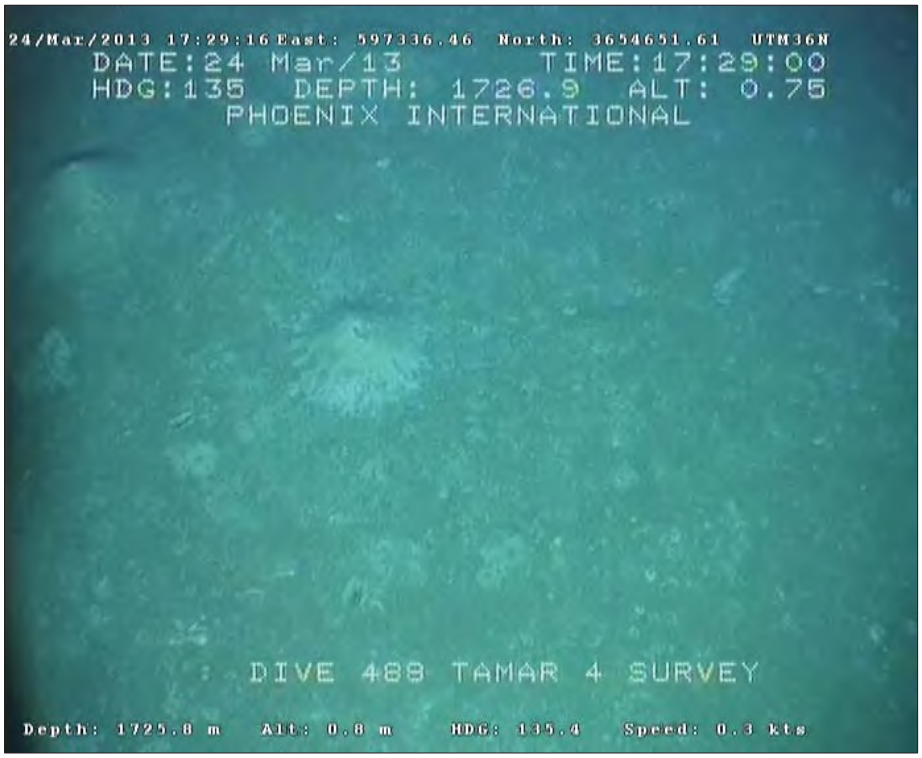

Image 12. Conical mounds likely formed by deposit-feeding worms (Polychaeta) such as these seen during the Tamar-4 survey were common within the survey area.

5.3 HYDROGRAPHIC DATA

This section contains detailed results from the February 2014 Tamar Field Background Monitoring Survey and the March 2013 Tamar Field and Pipeline Survey. Results from the February 2014 survey are presented first because they constitute a more complete picture of the environmental conditions within the Tamar Field. Results from the March 2013 Tamar Field and Pipeline Survey were also previously reported by CSA (2013b) which was submitted by Noble Energy to MoEP and MNIEWR.

February 2014 Tamar Field Background Monitoring Survey

All hydrographic data for the Tamar Field Background Monitoring Survey were collected between 10:30 and 20:00 on 13 February 2014. Four stations (B08, C01, D17, and H09) were sampled around the perimeter of the field and one station (E11) was sampled from the middle of the field (**Figure 4**). Hydrographic profiles of temperature, salinity, DO, turbidity, and fluorescence were recorded continuously from the near-surface (top 10% of the water column), mid-depth, and near-bottom (bottom 10% of the water column) both descending and ascending. Profiles from each station located on the perimeter of the field are shown in **Figure 11** (ascending data are presented because historically they are less susceptible to effects of transition through the air-water interface during lowering). The profile from the station located from the center of the field is shown in **Figure 12**. All stations have nearly identical profiles, indicating no difference in water column hydrographic parameters throughout the region.

As observed during previous surveys, surface waters were cool and isothermal (approximately 18°C) to a depth of 100 m, then decreased to 15°C through the thermocline, and gradually stabilized to 14°C through the remainder of the water column to the seafloor (**Figures 11** and **12**). Salinity was recorded near the surface at 39.3 and gradually stabilized with increasing water depth to 38.8 at the seafloor (**Figures 11** and **12**). Turbidity was low (0.10 to 0.15 nephelometric turbidity units [NTU]) throughout the water column.

As seen previously, the water column was well oxygenated at the surface (7.5 mg/L) and gradually stabilized to 6.0 mg/L throughout the water column to the seafloor (**Figures 11** and **12**). Fluorescence, an indicator of photosynthetic activity, peaked at a depth of approximately 100 m with a concentration of approximately 0.32 mg/m^3.

March 2013 Tamar Field and Pipeline Survey

During the March 2013 Tamar Field and Pipeline Survey, all hydrographic profiles were collected in a 24-hour period between 21:29 on 25 March 2013 and 18:00 on 26 March 2013. Nine stations were sampled within the developed portion of the reservoir among existing infrastructure consisting of wellsites (Tamar-1 to Tamar-6), flowlines, and umbilicals (**Figure 5**). Hydrographic profiles of temperature, salinity, DO, turbidity, and fluorescence were recorded continuously from the near-surface (top 10% of the water column), mid-depth, and near-bottom (bottom 10% of the water column). All nine stations had virtually identical hydrographic profiles; therefore, the profile of one station (TF7) is shown in **Figure 13** as representative of the survey region.

Surface waters were cool and isothermal (17°C), then water temperatures decreased through the thermocline and stabilized to 14°C through the remainder of the water column to the seafloor. Salinity varied between 38.7 and 39.1 through the halocline (salinity gradient) and gradually stabilized with increasing water depth to 38.7 at the seafloor. Turbidity was low (0.10 to 0.15 NTU) throughout the water column.

The water column was well oxygenated at the surface (7.4 mg/L) and through the surface-mixed layer before stabilizing to approximately 5.7 mg/L above the seafloor (**Figure 13**). Fluorescence peaked at a depth of approximately 175 m with a concentration of approximately 0.35 mg/m^3.

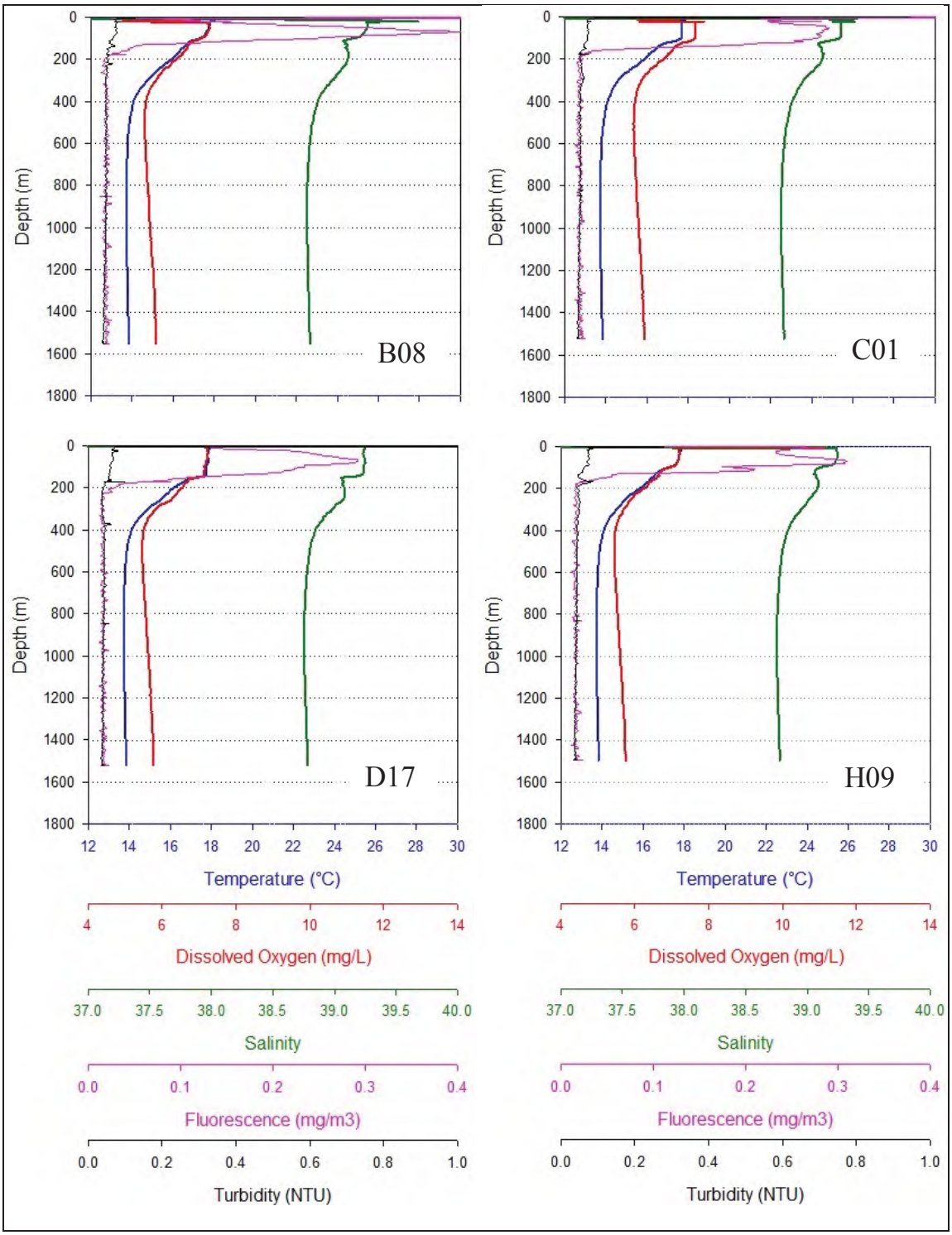

Figure 11. Hydrographic profiles of the water column collected between 10:30 and 20:00 on 13 February 2014 at four stations (B08, C01, D17, H09) located on the perimeter of Tamar Field.

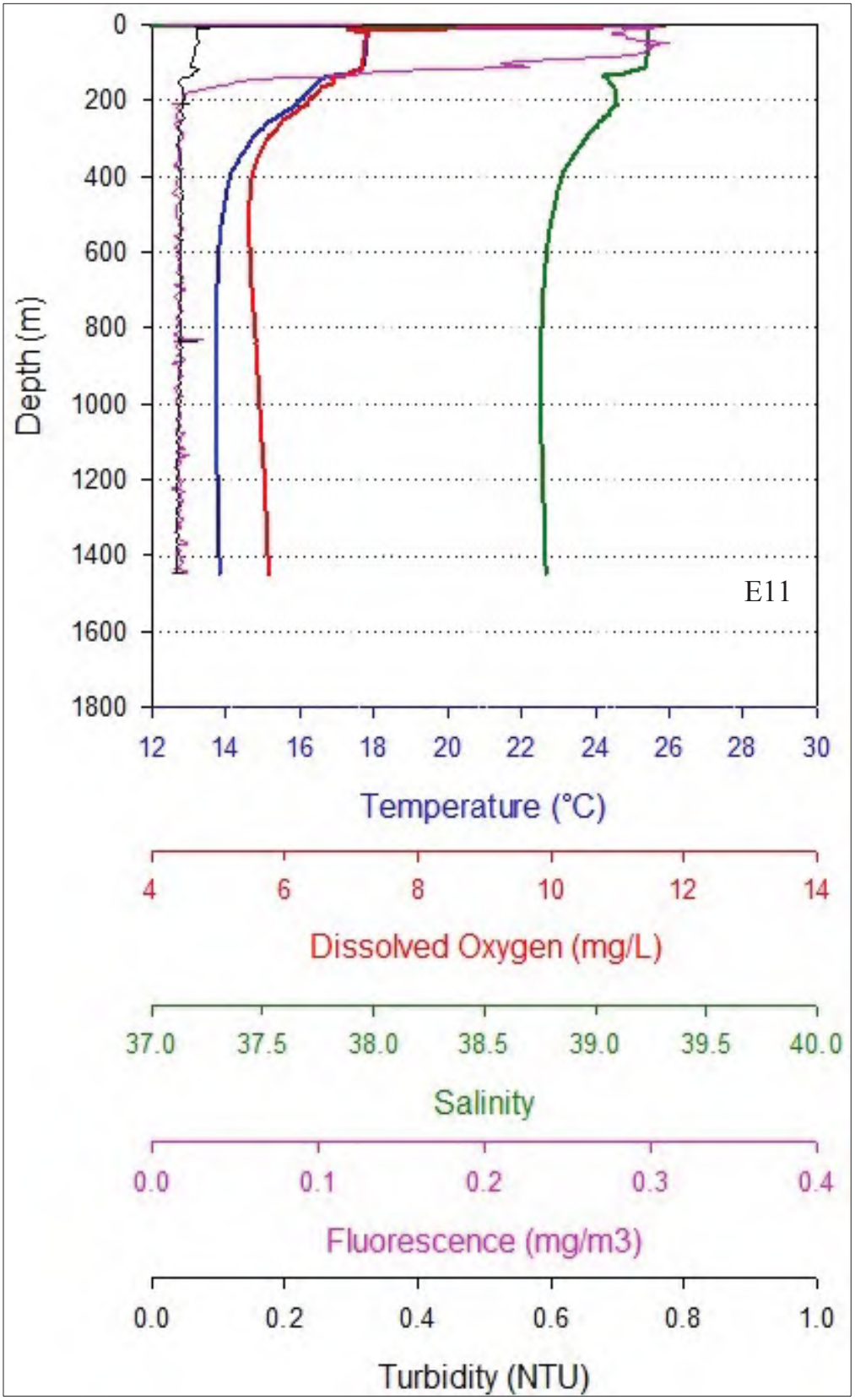

Figure 12. Hydrographic profile of the water column collected at approximately 17:30 on 13 February 2014 at a station located in the middle of the field (E11).

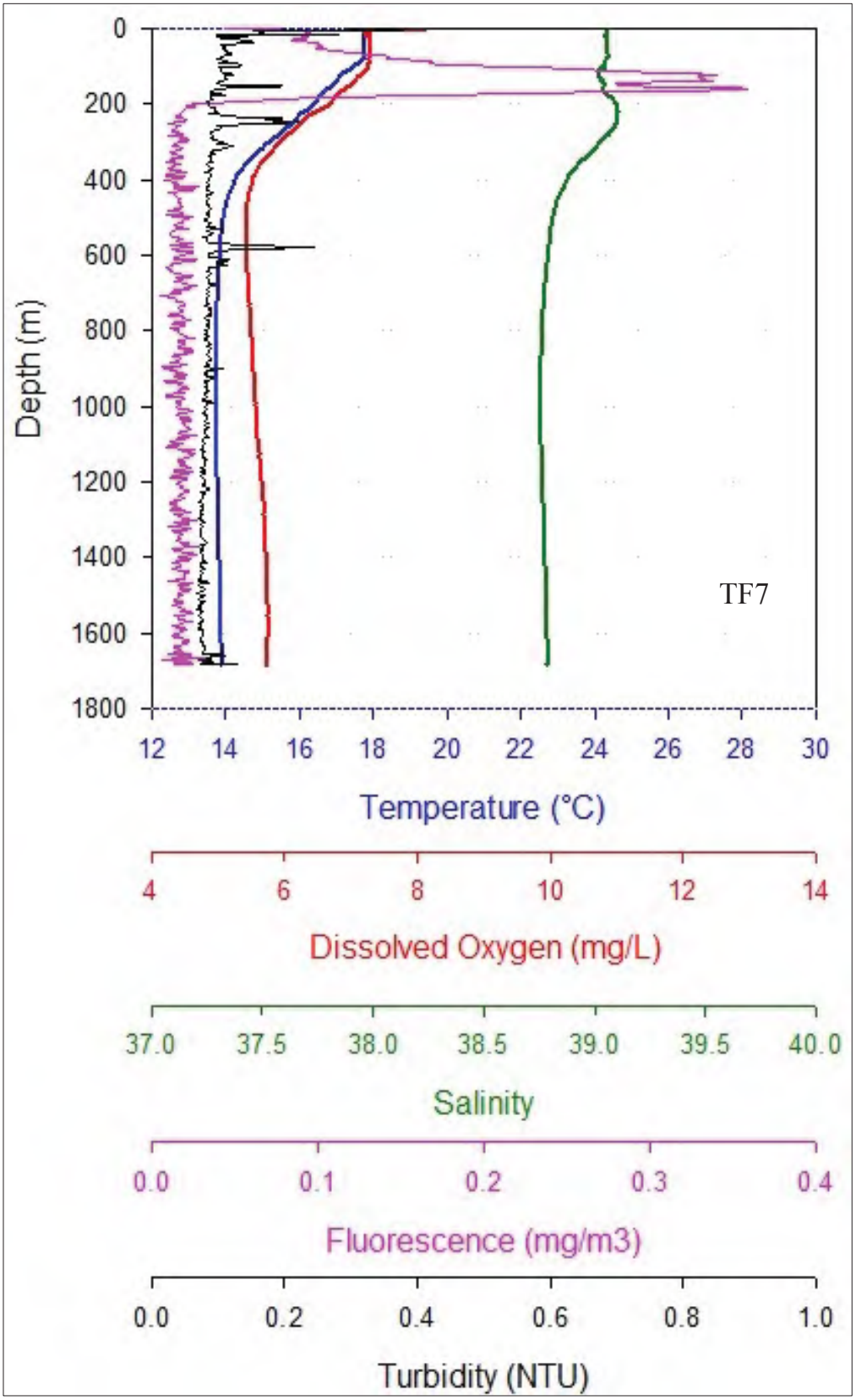

Figure 13. Hydrographic profile of the water column collected at 07:00 on 26 March 2013 at Station TF7.

Similarity in Hydrographic Profiles Between Surveys

Hydrographic water profiles recorded during the March 2013 Tamar Field and Pipeline Survey and the February 2014 Tamar Field Background Monitoring Survey are nearly identical. This finding is not surprising as both surveys were conducted during approximately the same season, although one year apart. The similarity indicates that the hydrographic conditions within the Tamar Field are uniform geographically as well as temporally.

The photosynthetic maximum at 100 to 175 m is typically due to an optimal combination of nutrient and light availability at those depths that promotes phytoplankton growth. Above this layer, nutrient availability for phytoplankton growth is generally limiting, while below this layer, a reduction in light penetration inhibits phytoplankton growth. Increased grazing by zooplankton and other faunal organisms may also reduce the phytoplankton community in the upper layers of the water column. The slight difference in the depth of the photosynthetic maximum between surveys is likely due to minor interannual variations in environmental conditions.

The near-surface depression of DO during both surveys may be attributed to photoinhibition (i.e., sunlight decreasing photosynthesis). The DO stabilization at water depths below 400 m is typical of the Levantine Basin because the amount of organic material sinking from the surface waters is low, which limits microbial respiration at depth (Krom, 1995).

5.4 SEAWATER AND SEDIMENT ANALYSIS

This section contains detailed results from both the February 2014 Tamar Field Background Monitoring Survey and the March 2013 Tamar Field and Pipeline Survey. Again, results from the February 2014 survey are presented first because they constitute a more complete picture of the environmental conditions within the Tamar Field. Results from the March 2013 Tamar Field and Pipeline Survey have been previously reported by CSA (2013a,b), which was submitted by Noble Energy to MoEP and MNIEWR. A comparison of pre- and post-drill conditions at the Tamar SW-1 wellsite (CSA Ocean Sciences Inc., 2013d, 2014), and description of the findings from the ongoing monitoring at the Mari-B/Tamar Platforms (CSA Ocean Sciences Inc., 2013e) are outside the scope of this field survey.

5.4.1 Seawater

Seawater samples were collected at the near-surface, mid-depth, and near-bottom during the February 2014 Tamar Field Background Monitoring Survey. Seawater samples were collected only at the near-bottom strata during the March 2013 Tamar Field and Pipeline Survey. No seawater samples were collected along the pipeline route into Israel during either survey.

Total Suspended Solids

February 2014 Tamar Field Background Monitoring Survey

TSS concentrations averaged 6.7 ± 1.6 mg/L in the near-surface, 5.2 ± 0.6 mg/L at mid-depth, and 5.7 ± 0.8 mg/L at the near-bottom during the February 2014 survey. Values generally were similar among the four water stations located on the perimeter of the field and the station located in the center of the field (**Table 10**).

Table 10. Station concentrations of total suspended solids (TSS) in seawater samples collected throughout the water column during the February 2014 Tamar Field Background Monitoring Survey.

Location	Station	Depth	TSS (mg/L)
Perimeter of Tamar Field	B08	Near-Surface	5.8
		Mid-Depth	5.3
		Near-Bottom	6.0
	C01	Near-Surface	7.1
		Mid-Depth	4.1
		Near-Bottom	6.2
	D17	Near-Surface	5.7
		Mid-Depth	5.3
		Near-Bottom	4.7
	H09	Near-Surface	5.6
		Mid-Depth	5.4
		Near-Bottom	4.9
Center of Tamar Field	E11	Near-Surface	9.3
		Mid-Depth	5.7
		Near-Bottom	6.6

March 2013 Tamar Field and Pipeline Survey

TSS concentrations at the near-bottom averaged 13.4 ± 22.0 mg/L during the March 2013 Tamar Field and Pipeline Survey. The high TSS concentration at Station TF1 (72.0 mg/L) is likely due to the resuspension of sediments near the seafloor due to ROV operations (**Table 11**). The removal of this station decreases the near-bottom average to 6.1 ± 1.3 mg/L, which is within one standard deviation of the February 2014 survey results.

Table 11. Station concentrations of total suspended solids (TSS) in seawater samples collected from near-bottom water during the March 2013 Tamar Field and Pipeline Survey.

Station	TSS (mg/L)
TF1	72.0
TF2	7.8
TF3	7.2
TF4	7.4
TF5	5.6
TF6	4.3
TF7	4.9
TF8	6.1
TF9	5.6

Similarity in TSS Concentrations Between Surveys

TSS concentrations in the near-bottom samples generally were similar among stations and surveys (**Table 12**). Concentrations from within the Tamar Field were slightly higher (0.4 to 0.9 mg/L) than stations located at the perimeter of the field; however, all values were well below the Levantine Basin average concentrations. This finding indicates that TSS concentrations within the Tamar Field are uniform geographically as well as temporally.

Similar to previous surveys, TSS levels recorded from the survey area were higher than those reported for northeastern Mediterranean surface waters, which have been reported to range from 0.6 to 1.7 mg/L (Yilmaz et al., 1998). The eastern Mediterranean Sea is known as a highly oligotrophic

body of water with high water column transparency. Historically, the low TSS levels and high water transparency expected in the eastern Mediterranean are attributed to low water column productivity and low terrestrial inputs from riverine discharges. Deepsea near-bottom water generally has few suspended solids due to few disturbances stirring up the sediment on the seafloor; small particles transported from the surface usually are entrained in subsurface currents or pycnoclines (i.e., density gradient).

Table 12. Average concentrations (± standard deviation) of total suspended solids (TSS) in seawater samples collected during the March 2013 Tamar Field and Pipeline Survey and the February 2014 Tamar Field Background Monitoring Survey. Levantine Basin averages are provided for comparison.

Survey	Location	Depth	TSS (mg/L)
March 2013	Inside Tamar Field*	Near-Bottom	6.1 ± 1.3
February 2014	Perimeter of Tamar Field	Near-Surface	6.7 ± 1.6
		Mid-Depth	5.2 ± 0.6
		Near-Bottom	5.7 ± 0.8
	Center of Tamar Field	Near-Surface	9.3
		Mid-Depth	5.7
		Near-Bottom	6.6
Levantine Basin Average**		Near-Surface	9.8 ± 7.7
		Mid-Depth	9.9 ± 7.1
		Near-Bottom	9.6 ± 8.2

*The anomalous high TSS concentration for TF1 has been removed from the average and standard deviation because the result was due to sampling error.
**Average and standard deviation calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.

Nutrients

Seawater nutrient analysis consisted of TOC, TN, TP, nitrite, nitrate, ammonium, and phosphate during the February 2014 Tamar Field Background Monitoring Survey. Only TN and TP were analyzed during the March 2013 Tamar Field and Pipeline Survey.

February 2014 Tamar Field Background Monitoring Survey

Nutrient concentrations in seawater samples were low and nearly uniform throughout the water column and survey area (**Table 13**). TOC concentrations were slightly higher in the near-surface (0.70 ± 0.10 mg/L) than in the near-bottom (0.51 ± 0.08 mg/L). TN concentrations were slightly higher in the mid-depth (0.17 ± 0.01 mg/L) than in the near-surface (0.12 ± 0.01 mg/L) or at near-bottom (0.15 ± 0.01 mg/L). Concentrations of nitrite, nitrate, TP, and phosphate were negligible throughout the survey region. There was no appreciable difference between stations located at the perimeter of the reservoir and the station located at the center of the field.

Table 13. Station concentrations of total organic carbon (TOC), total nitrogen (TN), nitrite (NO_2), nitrate (NO_3), ammonium (NH_4), total phosphorus (TP), and phosphate (PO_4) in seawater samples collected throughout the water column during the February 2014 Tamar Field Background Monitoring Survey.

Location	Station	Depth	Concentration (mg/L)						
			TOC	TN	NO_2	NO_3	NH_4	TP	PO_4
Perimeter of Tamar Field	B08	Near-Surface	0.65	0.12	0.0007	0.035	0.001	0.010	0.003
		Mid-Depth	0.47	0.16	0.0007	0.081	0.001	0.015	0.008
		Near-Bottom	0.49	0.17	0.0007	0.075	0.001	0.011	0.007
	C01	Near-Surface	0.87	0.11	0.0007	0.039	0.001	0.007	0.004
		Mid-Depth	0.72	0.18	0.0007	0.080	0.001	0.016	0.007
		Near-Bottom	0.63	0.16	0.0007	0.072	0.001	0.012	0.007
	D17	Near-Surface	0.69	0.11	0.0007	0.065	0.001	0.007	0.006
		Mid-Depth	0.55	0.15	0.0007	0.074	0.001	0.011	0.007
		Near-Bottom	0.41	0.14	0.0007	0.023	0.001	0.012	0.003
	H09	Near-Surface	0.62	0.13	0.0008	0.040	0.001	0.010	0.004
		Mid-Depth	0.50	0.17	0.0007	0.070	0.003	0.019	0.007
		Near-Bottom	0.48	0.14	0.0008	0.063	0.001	0.013	0.007
Center of Tamar Field	E11	Near-Surface	0.68	0.14	0.0007	0.033	0.001	0.009	0.004
		Mid-Depth	0.48	0.17	0.0007	0.073	0.001	0.012	0.007
		Near-Bottom	0.54	0.15	0.0007	0.067	0.001	0.013	0.007

March 2013 Tamar Field and Pipeline Survey

Near-bottom nutrient concentrations during the March 2013 Tamar Field and Pipeline Survey were low and uniform throughout the survey area (**Table 14**). TN concentrations averaged 0.17 ± 0.04 mg/L, while TP concentrations averaged 0.01 ± 0.002 mg/L.

Table 14. Station concentrations of total nitrogen (TN) and total phosphorus (TP) in seawater samples collected near the seafloor during the March 2013 Tamar Field and Pipeline Survey.

Station	TN (mg/L)	TP (mg/L)
TF1	0.20	0.009
TF2	0.13	0.012
TF3	0.14	0.013
TF4	0.14	0.013
TF5	0.26	0.009
TF6	0.14	0.009
TF7	0.16	0.009
TF8	0.17	0.011
TF9	0.20	0.011

Similarity in Nutrient Concentrations Between Surveys

Concentrations of TN and TP were similar between the two surveys (**Table 15**). TOC, nitrite, nitrate, ammonium, and phosphate were not analyzed during the March 2013 Tamar Field and Pipeline Survey; therefore no comparison can be made regarding these five nutrients. All nutrient concentrations generally were similar regardless of whether the sample was collected inside the field or on its perimeter. This finding indicates that like other water column constituents discussed previously, TSS concentrations within the Tamar Field are uniform geographically as well as temporally. Concentrations of all nutrients were also well below the Levantine Basin average and the proposed Mediterranean Sea water quality standards in Israel (MEQS).

The eastern Levantine Basin has extremely low levels of nutrients, and the region is considered "ultra-oligotrophic." Nitrate and phosphate concentrations in surface waters in the eastern Mediterranean are one-half their concentrations in the western basin (Bethoux et al., 1992). This severe nutrient deficit in the Mediterranean Sea is because the distant Atlantic Ocean inflow brings in nutrient-depleted surface waters and there is very little nutrient input from rivers in the eastern Levantine Basin (Krom, 1995).

TOC in the form of carbohydrates, oils, proteins, and amino acids is a natural component of the water column in the marine environment, typically resulting from the mineralization of organic matter and biological activity. Generally, TOC levels are the net result of mineralization of organic matter (i.e., transformation of organic material to inorganic forms), uptake and respiration (oxidation into carbon dioxide) by microorganisms, and releases from organisms in the water column.

Table 15. Average concentrations (± standard deviation) of total organic carbon (TOC), total nitrogen (TN), nitrite (NO_2), nitrate (NO_3), total phosphorus (TP), and phosphate (PO_4) in seawater samples collected during the March 2013 Tamar Field and Pipeline Survey and the February 2014 Tamar Field Background Monitoring Survey. Mean (± standard deviation) Levantine Basin baseline survey data and the proposed Mediterranean Sea water quality standards (MEQS) in Israel are provided for comparison (Ministry of Environmental Protection, 2002). Levantine Basin average and standard deviation is calculated from pre-drill and environmental baseline surveys conducted prior to September 2013.

Survey	Location	Depth	Concentration (mg/L)						
			TOC	TN	NO_2	NO_3	NH_4	TP	PO_4
March 2013	Inside Tamar Field	Near-Bottom	N/A	0.17 ± 0.01	N/A	N/A	N/A	0.011 ± 0.002	N/A
February 2014	Perimeter of Tamar Field	Near-Surface	0.71 ± 0.11	0.12 ± 0.01	0.001 ± 0.000	0.045 ± 0.013	0.001 ± 0.000	0.008 ± 0.002	0.004 ± 0.001
		Mid-Depth	0.56 ± 0.11	0.17 ± 0.01	0.001 ± 0.000	0.076 ± 0.005	0.002 ± 0.001	0.015 ± 0.003	0.007 ± 0.000
		Near-Bottom	0.50 ± 0.09	0.15 ± 0.01	0.001 ± 0.000	0.058 ± 0.024	0.001 ± 0.000	0.012 ± 0.001	0.006 ± 0.001
	Center of Tamar Field	Near-Surface	0.68	0.14	0.0007	0.033	0.001	0.009	0.004
		Mid-Depth	0.48	0.17	0.0007	0.073	0.001	0.012	0.007
		Near-Bottom	0.54	0.15	0.0007	0.067	0.001	0.013	0.007
Levantine Basin Average		Near-Surface	1.72 ± 0.14	0.44 ± 0.49	N/A	N/A	N/A	0.008 ± 0.004	N/A
		Mid-Depth	0.89 ± 0.22	0.48 ± 0.47	N/A	N/A	N/A	0.014 ± 0.002	N/A
		Near-Bottom	0.84 ± 0.14	0.48 ± 0.48	N/A	N/A	N/A	0.011 ± 0.002	N/A
Proposed MEQS in Israel			N/A	1.0	N/A	N/A	0.5	0.1	N/A

N/A = data not available.

Ions

Cation and anion concentrations were analyzed only in seawater samples from the February 2014 Tamar Field Background Monitoring Survey. Ions were not included in the analysis of seawater samples collected during the March 2013 Tamar Field and Pipeline Survey.

Results of major ion composition analysis in seawater samples collected from several stations in the Tamar Field are presented in **Figure 14** and **Table 16**. The cation/anion balance for all water samples are within the acceptable ±5% analytical difference for seawater samples (**Table 16** and **Figure 15**). All ion concentrations were similar to worldwide and Mediterranean Sea averages with the exception of sulfate, which was slightly elevated over Mediterranean Sea averages at a few locations (**Table 16**). Sulfate is a major component of seawater, accounting for approximately 8% of its ionic composition; in the Tamar Field, it accounts for 7% to 10% of the ionic composition of seawater. The two stations with the highest sulfate concentrations occur in the near-surface or mid-depth, indicating that these slightly higher than average levels are unlikely to be due to drilling and/or production activities occurring in the field.

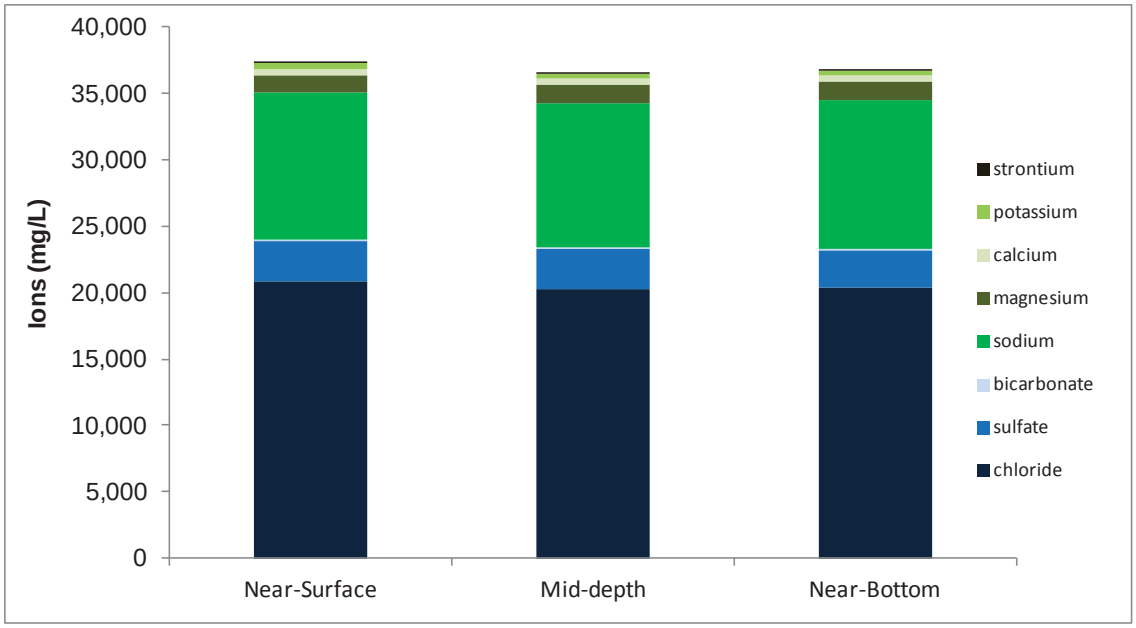

Figure 14. Ionic concentration and composition of seawater collected from near-surface, mid-depth, and near-bottom within the Tamar Field. Shades of blue represent anion concentrations (chloride, sulfate, bicarbonate); shades of green represent cation concentrations (sodium, magnesium, calcium, potassium, strontium).

Table 16. Major ion composition and ionic balance of seawater samples collected within the Tamar Field.

Location	Station	Depth	Anions (mg/L)			Cations (mg/L)					Ionic Balance		
			Chloride	Sulfate	Bicarbonate	Sodium	Magnesium	Calcium	Potassium	Strontium	Anion (meq/L)	Cation (meq/L)	% Difference
Perimeter of Tamar Field	B08	Near-Surface	21,800	3,250	132	11,200	1,390	466	441	8.36	685.24	636.12	3.70
		Mid-Depth	20,100	2,580	127	10,900	1,350	443	427	7.98	623.23	618.27	0.40
		Near-Bottom	21,100	2,480	131	11,400	1,380	468	441	8.45	649.44	644.09	0.40
	C01	Near-Surface	21,300	2,570	129	11,000	1,350	455	432	8.24	656.92	623.35	2.60
		Mid-Depth	20,500	2,910	129	11,300	1,380	460	442	8.26	641.43	639.56	0.10
		Near-Bottom	21,100	2,710	128	11,500	1,410	463	451	8.32	654.17	651.11	0.20
	D17	Near-Surface	19,700	3,750	121	10,800	1,320	433	425	7.77	636.19	611.08	2.00
		Mid-Depth	19,300	2,700	120	10,200	1,250	422	399	7.49	603.03	578.00	2.10
		Near-Bottom	20,100	2,980	124	10,900	1,340	442	429	7.94	631.50	617.63	1.10
	H09	Near-Surface	19,900	2,790	128	11,100	1,360	454	434	8.17	621.98	628.71	0.50
		Mid-Depth	20,500	2,910	127	11,000	1,350	457	432	8.21	641.39	623.63	1.40
		Near-Bottom	18,100	2,530	126	10,800	1,320	449	423	8.11	565.75	611.83	3.90
Center of Tamar Field	E11	Near-Surface	21,300	3,130	128	10,900	1,340	457	429	8.26	668.56	618.39	3.90
		Mid-Depth	21,100	3,610	129	11,300	1,380	465	437	8.24	672.93	639.68	2.50
		Near-Bottom	21,400	3,110	131	11,600	1,410	459	454	8.23	671.02	655.33	1.20
Worldwide Average[1]			19,000	2,649	140	10,556	1,272	400	380	13	N/A	N/A	N/A
Mediterranean Sea Average[2]			21,200	2,950	120 – 161[3]	11,800	1,403	423	463	5 – 7.5[3]	N/A	N/A	N/A

N/A = not available.
[1] Libes, 2011.
[2] Al-Mutaz, 2000.
[3] Millero, 2005.

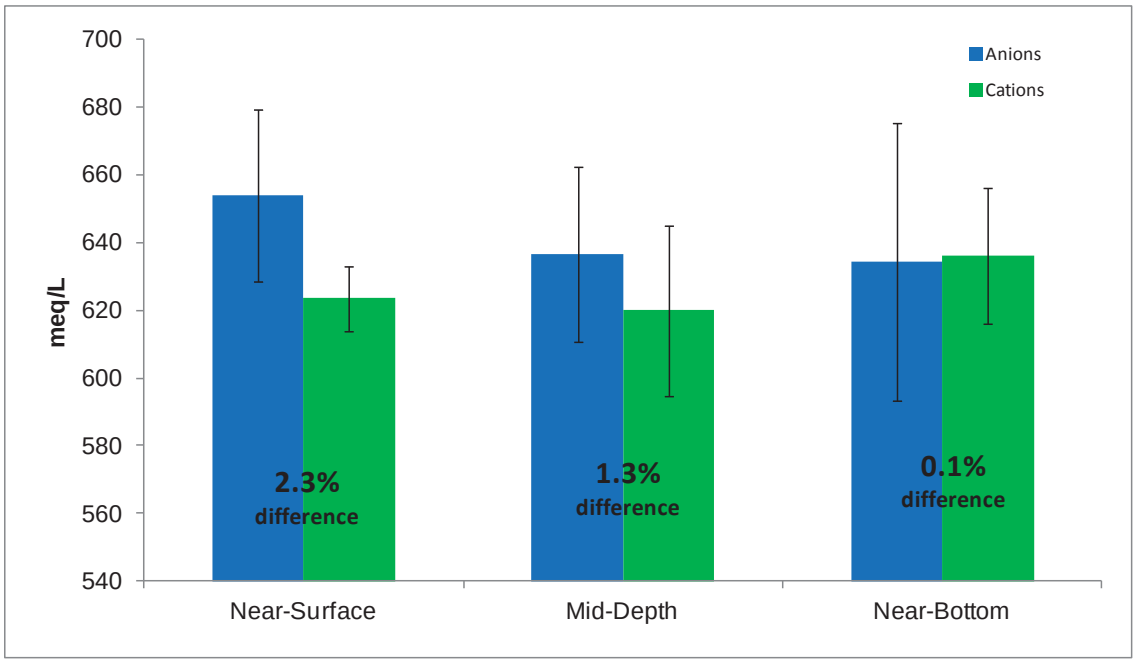

Figure 15. Averages (± standard deviation) of the sum of anions and cations in seawater collected from the near-surface, mid-depth, and near-bottom within the Tamar Field. The percent difference between anions and cations in water samples are all below the ±5% threshold for analytical acceptability.

Metals

Total and dissolved metals concentrations in seawater were analyzed by ALS Environmental in Kelso, Washington, U.S. for the February 2014 Tamar Field Background Monitoring Survey. Total metals concentrations in seawater were analyzed by GSI in Jerusalem, Israel for the March 2013 Tamar Field and Pipeline Survey. Dissolved metals were not analyzed from the March 2013 survey.

February 2014 Tamar Field Background Monitoring Survey

Total and dissolved metals concentrations in seawater were either below or just above the method reporting limit for the analytical laboratory (**Tables 17** and **18**). Values were similar among the four water stations located on the perimeter of the field and the station located in the center of the field. Concentrations generally were similar between total and dissolved metals fractions. This finding indicates that metals concentrations, when detectable, will be bio-available.

Dissolved zinc concentrations were higher than total zinc concentrations (**Tables 17** and **18**), which is contrary to what would be expected. The equipment and field blanks (composed of deionized water) for total zinc had concentrations of 1.0 and 7.6 µg/L, respectively. The equipment and field blanks for dissolved zinc concentrations were 2.5 and 8.3 µg/L, respectively. The zinc concentrations in the field blanks were relatively high for both the total and dissolved fraction. While this does not explain why the dissolved fraction was higher than the total fraction, it does suggest a potential source of zinc contamination that may have affected the results.

March 2013 Tamar Field and Pipeline Survey

Total metals concentrations in seawater were below the method reporting limit for the analytical laboratory, except for barium, which had a low concentration at each station (**Table 19**).

Similarity in Metals Concentrations Between Surveys

Average (± standard deviation) metals concentrations for the March 2013 Tamar Field and Pipeline Survey and the February 2014 Tamar Field Background Monitoring Survey are reported in **Table 20**. **Table 20** also compares these values to Israel's MEQS (Ministry of Environmental Protection, 2002), EUCEQS for priority substances in the field of water policy (Directive 2008/105/EC and proposed amendment COM (2011)876), and toxicity reference values (marine CCCs from Buchman, 2008). Where the USEPA's National Recommended Water Quality Criteria (NRWQC) (Buchman, 2008) are not available for a metal, criteria from other countries (e.g., New Zealand) are provided for reference. All seawater total and dissolved metals concentrations were below Israel's MEQS, EUCEQS, and CCC reference values, indicating there are no seawater metals concentrations of concern within the region. Metals concentrations were also similar to concentrations reported elsewhere within the Levantine Basin (**Table 20**). Similarity among surveys and locations indicates that metals concentrations, when detected, are bio-available dissolved fractions and that concentrations are uniform geographically as well as temporally within the Tamar Field. Analytical laboratory data sheets for seawater metals are provided in **Appendix K**.

Table 17. Total metals concentrations (µg/L) in seawater collected during the February 2014 Tamar Field Background Monitoring Survey, with the analytical laboratory's (ALS Environmental) method detection limit.

Location	Station	Depth	Ag	As	Ba	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	V	Zn
Perimeter of Tamar Field	B08	Near-Surface	<0.03	1.5	8.6	<0.03	<0.03	<0.3	0.2	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Mid-Depth	<0.03	1.4	7.5	<0.03	<0.03	<0.3	0.2	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Near-Bottom	<0.03	1.5	11.1	<0.03	<0.03	0.3	0.2	0.015	0.3	0.06	<1.0	<1.0	<0.03	<4.0	0.9
	C01	Near-Surface	0.04	1.5	8.4	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.07	<1.0	<1.0	0.04	<4.0	4.9
		Mid-Depth	<0.03	1.5	16.9	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.03	<1.0	<1.0	<0.03	4.6	1.1
		Near-Bottom	<0.03	1.5	11.7	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.04	<1.0	<1.0	<0.03	<4.0	<0.7
	D17	Near-Surface	<0.03	1.5	8.4	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Mid-Depth	<0.03	1.5	11.0	<0.03	<0.03	0.3	0.2	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	4.0	<0.7
		Near-Bottom	<0.03	1.5	11.4	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.04	<1.0	<1.0	<0.03	<4.0	1.0
	H09	Near-Surface	<0.03	1.5	8.2	<0.03	<0.03	<0.3	0.2	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Mid-Depth	<0.03	1.5	12.7	<0.03	<0.03	0.3	0.1	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	<4.0	0.9
		Near-Bottom	<0.03	1.5	11.6	<0.03	<0.03	0.3	0.2	<0.001	0.3	<0.03	<1.0	<1.0	<0.03	<4.0	0.7
Center of Tamar Field	E11	Near-Surface	<0.03	1.5	8.2	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Mid-Depth	<0.03	1.5	11.3	<0.03	<0.03	0.3	0.1	<0.001	0.3	0.03	<1.0	<1.0	<0.03	<4.0	<0.7
		Near-Bottom	<0.03	1.5	11.4	<0.03	<0.03	0.3	0.2	<0.001	0.3	0.04	<1.0	<1.0	<0.03	<4.0	0.8
Method reporting limit of laboratory			0.03	0.7	4.0	0.03	0.03	0.3	0.1	0.001	0.3	0.03	1.0	1.0	0.03	4.0	0.7

Ag = silver; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Hg = mercury; Ni = nickel; Pb = lead; Sb = antimony; Se = selenium; Tl = thallium; V = vanadium; Zn = zinc.

Table 18. Dissolved metals concentrations (µg/L) in seawater collected during the February 2014 Tamar Field Background Monitoring Survey, with the analytical laboratory's (ALS Environmental) method reporting limit.

Location	Station	Depth	Ag	As	Ba	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	V	Zn
Perimeter of Tamar Field	B08	Near-Surface	<0.03	1.5	8.6	<0.03	<0.03	0.3	0.4	<0.001	0.3	0.05	<1.0	<1.0	<0.03	<4.0	4.9
		Mid-Depth	<0.03	1.5	12.7	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.10	<1.0	<1.0	<0.03	<4.0	2.0
		Near-Bottom	<0.03	1.5	11.1	<0.03	<0.03	0.3	0.4	<0.001	0.3	0.07	<1.0	<1.0	<0.03	<4.0	1.9
	C01	Near-Surface	<0.03	1.5	9.2	0.06	<0.03	0.3	0.8	<0.001	0.3	0.14	<1.0	<1.0	<0.03	<4.0	3.0
		Mid-Depth	<0.03	1.6	11.5	<0.03	<0.03	0.3	0.4	<0.001	0.4	0.10	<1.0	<1.0	<0.03	<4.0	2.7
		Near-Bottom	<0.03	1.5	11.2	<0.03	<0.03	0.3	0.4	<0.001	0.3	0.10	<1.0	<1.0	<0.03	<4.0	3.9
	D17	Near-Surface	<0.03	1.5	9.5	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.05	<1.0	<1.0	<0.03	<4.0	4.0
		Mid-Depth	<0.03	1.5	12.3	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.05	<1.0	<1.0	<0.03	<4.0	3.1
		Near-Bottom	<0.03	1.5	12.0	<0.03	<0.03	0.3	0.3	<0.001	0.4	0.05	<1.0	<1.0	<0.03	4.1	2.2
	H09	Near-Surface	<0.03	1.5	9.9	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.06	<1.0	<1.0	<0.03	<4.0	3.7
		Mid-Depth	<0.03	1.5	12.4	<0.03	<0.03	0.3	0.4	<0.001	0.3	0.03	<1.0	<1.0	<0.03	<4.0	2.0
		Near-Bottom	<0.03	1.5	12.8	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.05	<1.0	<1.0	<0.03	4.1	2.4
Center of Tamar Field	E11	Near-Surface	<0.03	1.5	9.8	<0.03	<0.03	0.3	0.3	<0.001	0.4	0.07	<1.0	<1.0	<0.03	<4.0	1.9
		Mid-Depth	<0.03	1.4	12.1	<0.03	<0.03	<0.3	0.3	<0.001	0.4	0.05	<1.0	<1.0	<0.03	<4.0	1.6
		Near-Bottom	<0.03	1.5	11.8	<0.03	<0.03	0.3	0.3	<0.001	0.3	0.06	<1.0	<1.0	<0.03	<4.0	2.4
Method reporting limit of laboratory			0.03	0.7	4.0	0.03	0.03	0.3	0.1	0.001	0.3	0.03	1.0	1.0	0.03	4.0	0.7

Ag = silver; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Hg = mercury; Ni = nickel; Pb = lead; Sb = antimony; Se = selenium; Tl = thallium; V = vanadium; Zn = zinc.

Table 19. Total metals concentrations (µg/L) in seawater collected during the March 2013 Tamar Field and Pipeline Survey, with the analytical laboratory's (Geological Survey of Israel) method reporting limit.

Station	Ag	As	Ba	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	V	Zn
TF1	<0.1	<7.0	10	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF2	<0.1	<7.0	10	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF3	<0.1	<7.0	10	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF4	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF5	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF6	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF7	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF8	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
TF9	<0.1	<7.0	9	<0.5	<0.1	<10	<1.0	<0.02	<1.0	<0.1	<0.2	<7.0	<0.1	<10	<2.0
Method reporting limit of laboratory	0.5	7	0.2	0.5	0.1	10	1	0.02	0.1	0.1	0.2	7	0.1	10	2

Ag = silver; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Hg = mercury; Ni = nickel; Pb = lead; Sb = antimony; Se = selenium; Tl = thallium; V = vanadium; Zn = zinc.

Table 20. Average (± standard deviation) metals concentrations (µg/L) in seawater from the March 2013 Tamar Field and Pipeline Survey and February 2014 Tamar Field Background Monitoring Survey (with comparisons to toxicity reference values, Criterion Continuous Concentrations [CCC]) (Buchman, 2008), mean Levantine Basin baseline survey data, proposed Mediterranean Environmental Water Quality Standards (MEQS) in Israel (Ministry of Environmental Protection, 2002), and European Commission Environmental Quality Standard (EUCEQS) for priority substances in the field of water policy (Directive 2008/105/EC and proposed amendment COM(2011)876). Beryllium, cadmium, silver, selenium, thallium, and vanadium are not included in this table because all averages were less than the laboratories detection limit, and therefore less than established environmental characterization values.

Analytical Fraction	Survey	Location	Depth	Concentration (µg/L)								
				As	Ba	Cr	Cu	Hg	Ni	Pb	Sb	Zn
Total Metals	March 2013	Inside Tamar Field	Near-Bottom	<7.0	9.3 ± 0.5	<10.0	<1.0	<0.02	<1.0	<0.1	<0.2	<2.0
	February 2014	Perimeter of Tamar Field	Near-Surface	1.5 ± 0.0	8.4 ± 0.2	0.3 ± 0.0	0.2 ± 0.1	0.004 ± 0.007	0.3 ± 0.0	0.05 ± 0.03	<1.0	1.5 ± 2.3
			Mid-Depth	1.5 ± 0.1	12.0 ± 3.9	0.3 ± 0.0	0.2 ± 0.1	<0.001	0.3 ± 0.0	0.03 ± 0.00	<1.0	0.7 ± 0.4
			Near-Bottom	1.5 ± 0.0	11.5 ± 0.3	0.3 ± 0.0	0.2 ± 0.0	<0.001	0.3 ± 0.0	0.05 ± 0.01	<1.0	0.7 ± 0.3
		Center of Tamar Field	Near-Surface	1.5	8.2	0.3	0.2	<0.001	0.3	0.03	<1.0	<0.7
			Mid-Depth	1.4	11.3	0.3	0.1	<0.001	0.3	0.03	<1.0	<0.7
			Near-Bottom	1.5	11.4	0.3	0.2	<0.001	0.3	0.04	<1.0	0.8
	Levantine Basin Average		Near-Surface	1.31 ± 0.17	9.11 ± 1.59	0.34 ± 0.39	0.29 ± 0.11	0.5 ± 0	0.77 ± 1.02	0.07 ± 0.05	0.55 ± 0.15	7.19 ± 12.56
			Mid-Depth	1.35 ± 0.15	11.8 ± 0.43	0.2 ± 0.08	0.22 ± 0.04	0.5 ± 0	1.65 ± 1.9	0.04 ± 0.02	0.6 ± 0.24	1.03 ± 0.69
			Near-Bottom	1.32 ± 0.15	13.12 ± 2.27	0.18 ± 0.06	0.18 ± 0.04	0.5 ± 0	1.09 ± 0.76	0.04 ± 0.04	0.5 ± 0.0	0.98 ± 0.72

Table 20. (Continued).

Analytical Fraction	Survey	Location	Depth	Concentration (µg/L)								
				As	Ba	Cr	Cu	Hg	Ni	Pb	Sb	Zn
Dissolved Metals	February 2014	Perimeter of Tamar Field	Near-Surface	1.5 ± 0.0	9.3 ± 0.5	0.3 ± 0.0	0.5 ± 0.2	<0.001	0.3 ± 0.0	0.08 ± 0.04	<1.0	3.9 ± 0.8
			Mid-Depth	1.5 ± 0.1	12.2 ± 0.5	0.3 ± 0.0	0.4 ± 0.1	<0.001	0.3 ± 0.1	0.07 ± 0.04	<1.0	2.5 ± 0.5
			Near-Bottom	1.5 ± 0.0	11.8 ± 0.8	0.3 ± 0.0	0.4 ± 0.1	<0.001	0.3 ± 0.1	0.07 ± 0.02	<1.0	2.6 ± 0.9
		Center of Tamar Field	Near-Surface	1.5	9.8	0.3	0.3	<0.001	0.4	0.07	<1.0	1.9
			Mid-Depth	1.4	12.1	<0.3	0.3	<0.001	0.4	0.05	<1.0	1.6
			Near-Bottom	1.5	11.8	0.3	0.3	<0.001	0.3	0.06	<1.0	2.4
	Levantine Basin Average		Near-Surface	1.27 ± 0.08	8.98 ± 0.43	0.25 ± 0.08	0.42 ± 0.15	0.6 ± 0.24	0.65 ± 0.35	0.08 ± 0.05	0.5 ± 0	5.1 ± 5.5
			Mid-Depth	1.33 ± 0.27	11.8 ± 0.28	0.28 ± 0.13	0.3 ± 0.09	0.5 ± 0	0.88 ± 0.66	0.05 ± 0.02	0.5 ± 0	14.63 ± 28.28
			Near-Bottom	1.35 ± 0.1	12.28 ± 0.92	0.25 ± 0.08	0.23 ± 0.05	0.5 ± 0	0.78 ± 0.7	0.05 ± 0.03	0.5 ± 0	2.18 ± 2.39
	Proposed MEQS in Israel		Mean	36	N/A	10	5	0.16	10	5	N/A	40
			Maximum	69	N/A	20	10	0.4	50	20	N/A	100
	EUCEQS (Directive 2008/105/EC and proposed amendment COM(2011)876)		MAC	N/A	N/A	N/A	N/A	0.07	34.0	14	N/A	N/A
			AAC	N/A	N/A	N/A	N/A	N/A	8.6	1.3	N/A	N/A
	CCC Value[3]			36	200 BC	50	3.1	0.94	8.2	8.1	500[p]	81

As = arsenic; Ba = barium; Cr = chromium; Cu = copper; Hg = mercury; Ni = nickel; Pb = lead; Sb = antimony; Zn = zinc.
[1]Concentrations lower than reported method detection limits may be due to slight variations in analyzed sample volumes.
[2]Levantine Basin baseline data mean calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.
[3]Sources of CCC toxicity reference values: primary entry is the U.S. Ambient Water Quality Criteria; BC = British Columbia Water Quality Guidelines.
[p] = proposed.
-- = concentration not determined; AAC = annual average concentration; CCC = Criterion Maximum Concentration; MAC = maximum allowable concentration; N/A = parameter not analyzed.

Hydrocarbons

February 2014 Tamar Field Background Monitoring Survey

Seawater TPH concentrations were low, but detectable, throughout the survey region (**Table 21**). Higher concentrations of TPH generally were found in near-surface water samples in comparison to mid-depth or near-bottom samples. Seawater PAH concentrations were also low, with many PAHs below the laboratory's MDL. PAHs were dominated by phenanthrene and naphthalene compounds.

March 2013 Tamar Field and Pipeline Survey

Seawater TPH concentrations were below the analytical laboratory's detection limit (**Table 22**). Seawater PAH concentrations were also low, with the majority of PAHs below the laboratory's detection limit. PAHs were dominated by phenanthrene and naphthalene compounds.

Relatively high concentrations of PAHs, compared to the rest of the survey area, were found in the near-bottom seawater sample at station TF6 (**Table 22**). The TPH concentration was not detected at this station. The location of station TF6 is approximately 1 km northwest from the nearest wellsite (Tamar-5) (**Figure 4**), indicating that it is likely far enough away and not in the downstream direction of bottom currents to be influenced by this wellsite; therefore, it is not possible to interpret the cause of elevated PAH concentrations at this location.

Similarity in Hydrocarbon Concentrations Between Surveys

Average hydrocarbon concentrations for the March 2013 Tamar Field and Pipeline Survey and February 2014 Tamar Field Background Monitoring Survey are reported in **Table 23**. TPH concentrations during the February 2014 survey were similar to and within one standard deviation of the Levantine Basin average throughout the water column. TPH concentrations were higher during the February 2014 survey than during the March 2013 survey; however, the explanation for this is unknown. During the March 2013 survey, water samples were collected in close proximity (within 1 km) to existing infrastructure, while water samples collected during the February 2014 survey generally were collected more than 5 km away from the existing infrastructure and on the perimeter of the reservoir (with the exception of station E11). TPH analysis on equipment and field blanks for these sample produced concentrations of 25 and 30 μg/L, respectively. While concentrations within these blanks were higher than the March 2013 samples, and indicate that some contamination from the water column or ship may have taken place, these concentrations are not high enough to account for the difference between surveys. It must be noted that TPH concentrations reported for the February 2014 survey are extremely low and do not indicate a level of environmental concern.

PAH concentrations were similar between surveys with the exception of the relatively high values reported for Station TF6 during the March 2013 Tamar Field and Pipeline Survey. All applicable values are below the CCC (Buchman, 2008) (**Table 23**). Naphthalene and fluoranthene averages are below the MAC and AAC of the EUCEQS (**Table 23**). The analytical laboratory's detection limit of benzo(b)fluoranthene, benzo(k,j)fluoranthene, benzo(a)pyrene, Ideno(1,2,3-c,d)pyrene is above that of the MAC and benzo(g,h,i)perylene is above that of the MAC and AAC of EUCEQS. The laboratory only detected these samples at Station TF6 during the March 2013 Survey (**Table 22**). Average PAH concentrations for both surveys were low and do not indicate any source of environmental concern. Analytical laboratory data sheets for seawater hydrocarbons are provided in **Appendix L**.

Table 21. Hydrocarbon concentrations in seawater from the February 2014 Tamar Field Background Monitoring Survey. Total petroleum hydrocarbons (TPH) and the U.S. Environmental Protection Agency priority polycyclic aromatic hydrocarbons (PAHs) are represented.

Location	Station	Depth	TPH (µg/L)	PAH (ng/L)															
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Anthracene	Phenanthrene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene/Triphenylene	Benzo(b)fluoranthene	Benzo(k,j)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
Perimeter of Tamar Field	B08	Near-Surface	41.1	6.60	<1.3	<1.5	1.25	<0.8	8.84	4.87	3.42	<0.8	<0.9	<2.6	<2.7	<2.1	<1.5	<1.2	<2.7
		Mid-Depth	77.7	6.61	<1.3	<1.5	1.16	0.42	7.29	3.06	2.30	0.70	0.27	<2.6	<2.7	<2.1	<1.5	<1.2	<2.7
		Near-Bottom	22.7	4.89	<1.3	<1.6	1.14	<0.8	5.86	2.47	2.16	<0.8	<0.9	<2.6	<2.7	<2.1	<1.5	<1.2	<2.7
	C01	Near-Surface	49.5	4.71	<1.2	<1.5	0.48	<0.8	2.74	0.86	1.54	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Mid-Depth	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Near-Bottom	9.6	3.83	<1.2	<1.5	0.75	<0.8	3.42	0.88	1.61	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
	D17	Near-Surface	89.1	5.87	0.80	2.01	1.25	<0.8	8.21	4.12	2.83	0.83	0.32	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Mid-Depth	33.5	6.29	0.77	2.30	1.19	<0.8	7.42	3.20	2.21	0.74	0.24	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
		Near-Bottom	41.2	6.56	<1.2	<1.5	1.34	<0.8	8.90	3.86	2.22	<0.8	<0.8	<2.5	<2.6	<2	<1.4	<1.2	<2.6
	H09	Near-Surface	66.5	7.19	<1.2	<1.5	1.54	<0.8	10.81	4.59	2.19	0.98	0.28	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Mid-Depth	45.2	5.59	<1.3	<1.6	0.93	<0.8	5.59	2.06	1.25	0.78	0.16	<2.6	<2.7	<2.1	<1.5	<1.2	<2.7
		Near-Bottom	19.5	5.68	<1.3	<1.6	1.17	<0.8	6.99	2.60	1.57	0.84	0.18	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
Center of Tamar Field	E11	Near-Surface	20.4	5.15	<1.2	<1.5	0.93	<0.8	5.12	2.40	2.81	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Mid-Depth	53.2	5.00	<1.2	<1.5	0.86	<0.8	5.84	2.15	1.58	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Near-Bottom	52.3	5.34	<1.3	<1.6	0.93	<0.8	6.76	2.89	2.25	0.75	0.24	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8

N/A = data not available.

Table 22. Hydrocarbon concentrations in seawater from the March 2013 Tamar Field and Pipeline Survey. Total petroleum hydrocarbons (TPH) and the U.S. Environmental Protection Agency priority polycyclic aromatic hydrocarbons (PAHs) are represented.

Station	TPH (µg/L)	PAH (ng/L)															
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Anthracene	Phenanthrene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene/Triphenylene	Benzo(b)fluoranthene	Benzo(k,j)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
TF1	<10.0	6.79	<1.2	<1.4	0.42	<0.8	1.45	<1.1	<1.4	<0.7	<0.8	<2.4	<2.5	<1.9	<1.4	<1.1	<2.5
TF2	<10.0	5.25	<1.2	<1.5	0.39	<0.8	1.57	<1.1	0.51	<0.8	<0.8	<2.5	<2.6	<2	<1.4	<1.2	<2.6
TF3	<10.0	5.01	<1.2	<1.4	0.37	<0.8	1.06	<1.1	0.25	<0.7	<0.8	<2.4	<2.5	<1.9	<1.4	<1.1	<2.5
TF4	<10.0	6.32	<1.2	<1.5	0.37	<0.8	1.15	<1.1	0.35	<0.8	<0.8	<2.5	<2.6	<2	<1.4	<1.2	<2.6
TF5	<10.0	7.49	<1.2	<1.5	0.42	<0.8	1.20	<1.1	0.34	<0.7	<0.8	<2.4	<2.5	<1.9	<1.4	<1.1	<2.5
TF6	<10.0	6.17	<1.2	<1.4	1.58	3.09	14.72	21.50	17.65	13.14	9.57	12.87	5.39	10.15	4.78	1.48	5.80
TF7	<10.0	5.45	<1.2	<1.5	0.41	<0.8	1.08	<1.1	0.20	<0.8	<0.8	<2.4	<2.6	<2	<1.4	<1.2	<2.6
TF8	<10.0	6.04	<1.2	<1.4	0.48	<0.8	1.37	<1.1	0.28	<0.7	<0.8	<2.4	<2.5	<1.9	<1.4	<1.1	<2.5
TF9	<10.0	5.60	<1.2	<1.5	<0.8	<0.8	1.01	<1.1	0.19	<0.8	<0.8	<2.5	<2.6	<2	<1.4	<1.2	<2.6

Table 23. Average (± standard deviation) hydrocarbon concentrations in seawater from the March 2013 Tamar Field and Pipeline Survey and February 2014 Tamar Field Background Monitoring Survey area (with comparisons to toxicity reference values (Criterion Continuous Concentrations [CCC]), mean Levantine Basin baseline survey data, and European Commission Environmental Quality Standards (EUCEQS) for priority substances in the field of water policy (Directive 2008/105/EC and proposed amendment COM(2011)876).

Survey	Location	Depth	TPH (µg/L)	PAH (ng/L)															
				Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Anthracene	Phenanthrene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene/Triphenylene	Benzo(b)fluoranthene	Benzo(k,j)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
March 2013	Inside Tamar Field	Near-Bottom	<10.0	6.0 ± 0.8	<1.2	<1.5	0.6 ± 0.4	<0.8	2.7 ± 4.5	<1.1	2.4 ± 6.1	<0.8	<0.8	<2.4	<2.0	<1.4	<1.4	<1.2	<2.5
February 2014	Perimeter of Tamar Field	Near-Surface	61.6 ± 21.2	6.1 ± 1.1	<1.3	<1.6	1.1 ± 0.5	<0.8	7.7 ± 3.5	3.6 ± 1.9	2.5 ± 0.8	0.9 ± 0.1	0.3 ± 0.0	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
		Mid-Depth	52.1 ± 22.9	6.2 ± 0.5	<1.3	<1.6	1.1 ± 0.1	<0.8	6.8 ± 1.0	2.8 ± 0.6	1.9 ± 0.6	0.7 ± 0.0	0.2 ± 0.1	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
		Near-Bottom	23.3 ± 13.2	5.2 ± 1.2	<1.3	<1.6	1.1 ± 0.3	<0.8	6.3 ± 2.3	2.5 ± 1.2	1.9 ± 0.4	<0.8	<0.9	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
	Center of Tamar Field	Near-Surface	20.4	5.15	<1.2	<1.5	0.93	<0.8	5.12	2.40	2.81	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Mid-Depth	53.2	5.00	<1.2	<1.5	0.86	<0.8	5.84	2.15	1.58	<0.8	<0.8	<2.5	<2.6	<2	<1.5	<1.2	<2.6
		Near-Bottom	52.3	5.34	<1.3	<1.6	0.93	<0.8	6.76	2.89	2.25	0.75	0.24	<2.6	<2.8	<2.1	<1.5	<1.2	<2.8
EUCEQS (Directive 2008/105/EC and proposed amendment COM(2011)876		MAC	N/A	130,000	N/A	N/A	N/A	N/A	N/A	120	N/A	N/A	N/A	0.17	0.17	0.17	0.17	N/A	0.17
		AAC	N/A	2,000	N/A	N/A	N/A	N/A	N/A	6.3	N/A	N/A	N/A	17.0	17.0	27.0	N/A	N/A	0.82
CCC[1]			N/A	1,400	N/A	N/A	N/A	40,000	4,600	11,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Levantine Basin Baseline Data[2]		Near-Surface	61.31 ± 144.49	9.43 ± 13.42	0.37 ± 0.29	0.56 ± 0.51	1.04 ± 2.19	0.26 ± 0.21	2.66 ± 2.92	0.76 ± 0.9	1.69 ± 2.87	0.25 ± 0.18	0.27 ± 0.2	0.8 ± 0.61	0.83 ± 0.64	1.13 ± 0.92	0.46 ± 0.38	0.36 ± 0.28	0.76 ± 0.65
		Mid-Depth	24.23 ± 31.94	7.08 ± 8.23	0.39 ± 0.27	0.51 ± 0.35	0.4 ± 0.36	0.27 ± 0.19	1.69 ± 2.01	0.65 ± 0.54	1.02 ± 1.36	0.27 ± 0.18	0.27 ± 0.18	0.85 ± 0.56	0.89 ± 0.59	1.24 ± 0.86	0.5 ± 0.32	0.4 ± 0.26	0.76 ± 0.57
		Near-Bottom	30.54 ± 32.07	6.85 ± 8.19	0.38 ± 0.28	0.5 ± 0.37	0.44 ± 0.52	0.23 ± 0.18	1.43 ± 1.41	0.58 ± 0.48	0.94 ± 1.31	0.24 ± 0.17	0.27 ± 0.19	0.81 ± 0.58	0.85 ± 0.61	1.18 ± 0.88	0.47 ± 0.34	0.36 ± 0.27	0.81 ± 0.61

[1] Proposed Criterion Continuous Concentration (CCC) in marine surface waters (Buchman, 2008).
[2] Mean calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.
AAC = annual average concentration; MAC = maximum allowable concentration; N/A = data not available.

Radionuclides

February 2014 Tamar Field Background Monitoring Survey

Radionuclide concentrations were low or non-detectable throughout the survey region during the February 2014 Tamar Field Background Monitoring Survey (**Table 24**). Concentrations generally were similar between water stations located on the perimeter of the field and at the water station located at the center of the field.

Table 24. Radionuclide concentration for radium (Ra) 226, Ra 228, and combined concentrations in seawater samples collected during the February 2014 Tamar Field Background Monitoring Survey.

Location	Station	Depth	Concentration (pCi/L)		
			Ra 226	Ra 228	Combined Ra 226 and Ra 228
Perimeter of Tamar Field	B08	Near-Surface	0.15	0.20	0.35
		Mid-Depth	0.30	0.00	0.30
		Near-Bottom	0.18	0.00	0.18
	C01	Near-Surface	0.23	0.14	0.37
		Mid-Depth	0.09	0.12	0.21
		Near-Bottom	0.21	0.00	0.21
	D17	Near-Surface	0.11	0.00	0.11
		Mid-Depth	0.11	0.46	0.57
		Near-Bottom	0.16	0.22	0.38
	H09	Near-Surface	0.11	0.01	0.12
		Mid-Depth	0.06	0.12	0.08
		Near-Bottom	0.12	0.00	0.12
Center of Tamar Field	E11	Near-Surface	0.23	0.09	0.32
		Mid-Depth	0.08	0.01	0.09
		Near-Bottom	0.03	0.00	0.03

March 2013 Tamar Field and Pipeline Survey

Radionuclide concentrations were low or non-detectable throughout the survey region during the March 2013 Tamar Field and Pipeline Survey (**Table 25**).

Table 25. Radionuclide concentration for radium (Ra) 226, Ra 228, and combined concentrations in seawater samples collected during the March 2013 Tamar Field and Pipeline Survey.

Station	Concentration (pCi/L)		
	Ra 226	Ra 228	Combined Ra 226 and Ra 228
TF1	0.11	0.20	0.31
TF2	0.11	0.21	0.32
TF3	0.16	0.08	0.24
TF4	0.06	0.00	0.06
TF5	0.10	0.33	0.43
TF6	0.11	0.11	0.22
TF7	0.06	0.00	0.06
TF8	0.03	0.01	0.04
TF9	0.31	0.05	0.36

Similarity in Radionuclide Concentrations Between Surveys

Average concentrations of seawater radionuclide concentrations (Ra 226 and Ra 228) were similar between the March 2013 Tamar Field and Pipeline Survey and February 2014 Tamar Field Background Survey and are provided in **Table 26**.

Table 26. Mean (± standard deviation) and combined mean concentrations of radionuclides (radium [Ra] 226 and Ra 228) in seawater from the Tamar Field. Levantine Basin baseline survey data are provided for comparison.

Survey	Location	Concentration (pCi/L)			
		Depth	Ra 226	Ra 228	Combined Ra 226 and Ra 228
March 2013	Inside Tamar Field	Near-Bottom	0.12 ± 0.08	0.11 ± 0.12	0.23 ± 0.14
February 2014	Perimeter of Tamar Field	Near-Surface	0.15 ± 0.06	0.09 ± 0.10	0.24 ± 0.14
		Mid-Depth	0.14 ± 0.11	0.18 ± 0.20	0.29 ± 0.21
		Near-Bottom	0.17 ± 0.04	0.06 ± 0.11	0.22 ± 0.11
	Center of Tamar Field	Near-Surface	0.23	0.09	0.32
		Mid-Depth	0.08	0.01	0.09
		Near-Bottom	0.03	0.00	0.03
Levantine Basin Average*		Near-Surface	0.13 ± 0.09	0.2 ± 0.13	N/A
		Mid-Depth	0.17 ± 0.1	0.16 ± 0.1	N/A
		Near-Bottom	0.13 ± 0.1	0.16 ± 0.13	N/A

N/A = data not available.
*Mean calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.

Radium, naturally present in formation rock, co-precipitates with other alkaline earth elements, such as barium, and is associated with metal sulfates in drill cuttings (Veil and Smith, 1999). However, due to the high natural concentration of sulfate in the ocean, radium has a low solubility in seawater (Neff, 2005) and is unlikely to contribute to seawater radioactivity. The USEPA (1976) established an MCL for combined Ra 226 and Ra 228 at 5 pCi/L. Combined Ra 226 and Ra 228 concentrations in seawater from the both surveys were well below this threshold. The MCL is a maximum permissible level of a contaminant that ensures the safety of the water over a lifetime of consumption and also takes into consideration feasible treatment technologies and monitoring capabilities. The data indicate that radium levels in seawater throughout the Tamar Field are extremely low and well below levels of concern. Analytical laboratory data sheets for seawater radionuclides are provided in **Appendix M**.

5.4.2 Sediment

All sediment samples collected during previous surveys within the Tamar Field were included in the analysis. If a grid cell contained multiple samples from previous surveys, the values were averaged to obtain a representative value for that grid cell. For both new and previous data, the averaged value was attributed to the center point of the grid cell for analytical and comparative purposes. Previous surveys conducted within the reservoir and field consisted of the March 2013 Tamar Field and Pipeline Survey (CSA Ocean Sciences Inc., 2013b), September 2013 Tamar-7 Pre-Drill Survey, and February 2014 Tamar SW Post-Drill Survey (CSA Ocean Sciences Inc., 2014). Tamar SW Pre-Drill Survey sediment data were not included in the analysis because they were collected prior to the drilling of the Tamar SW-1 wellhead and therefore may not represent current environmental conditions within the region. It was beyond the scope of this report to compare pre- and post-drill differences at the Tamar SW-1 wellsite, although this comparison is detailed within the Tamar SW Post-Drill Survey report (CSA Ocean Sciences Inc., 2014).

Sediment sampling during the February 2014 Tamar Field Background Monitoring Survey occurred only within grid cells that were not previously sampled. The center point of each previously unsampled grid cell was sampled. Sediment sampling along the Tamar pipeline corridor was conducted in March 2013 and was reported in the March 2013 Tamar Field and Pipeline Survey report (CSA Ocean Sciences Inc., 2013b). Analytical results from along the pipeline corridor are included here for completeness. The more recent sediment results from the Tamar Field will be presented first and the results from along the pipeline will be presented second for each parameter.

Concentration scales for each kriged surface geospatial map provided in the following sections were based on the number of standard deviations from the Tamar Field mean of each metal. Concentrations below or above 2.5 standard deviations generally fall within the 99% CL of the survey area, and therefore can be regarded as ambient concentrations that were not significantly different from each other. Blue color gradients (less than 0.5 to 2.5 standard deviations from the mean) on the following maps are all within a 99% CL threshold. It is important to recognize that any interpretation of blue-colored data (i.e., within the 99% CL) is for descriptive purposes only as these values are not statistically significant. Concentrations that are above the 99% CL threshold indicate areas that may have been affected by anthropogenic activities (i.e., drilling) or point to anomalous characteristics of the seafloor, and may be considered statistically (but potentially not biologically) significant.

Particle Size

Tamar Field

Figures 16 and **17** summarize the particle size distribution and sediment types within the Tamar Field. Tabulated results by grid cell and pipeline station, and laboratory results are provided in **Appendix N**. All samples, including those in close proximity to existing development, were predominately composed of very fine silt and clay (approximately 80%, combined; **Figure 16**) and thus were classified as silty clay (**Figure 17**).

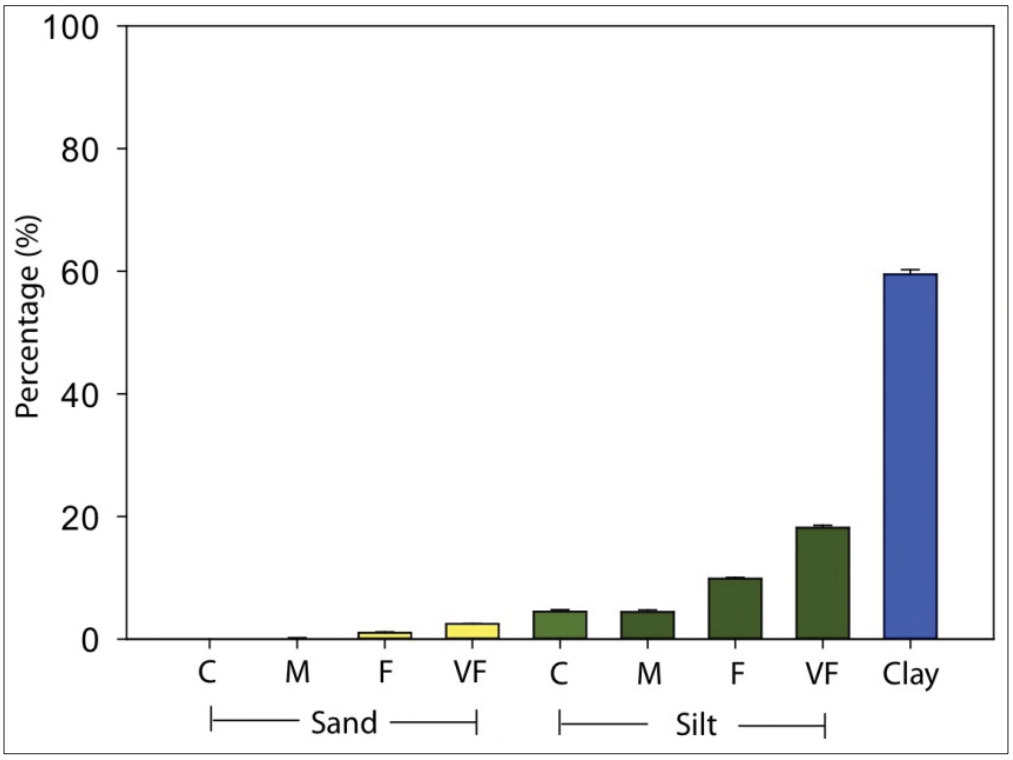

Figure 16. Particle size distribution (Wentworth scale; average + standard deviation) within the Tamar Field. C = coarse; M = medium; F = fine; VF = very fine. Yellow = sand fractions; blue = silt fractions; green = clay fractions.

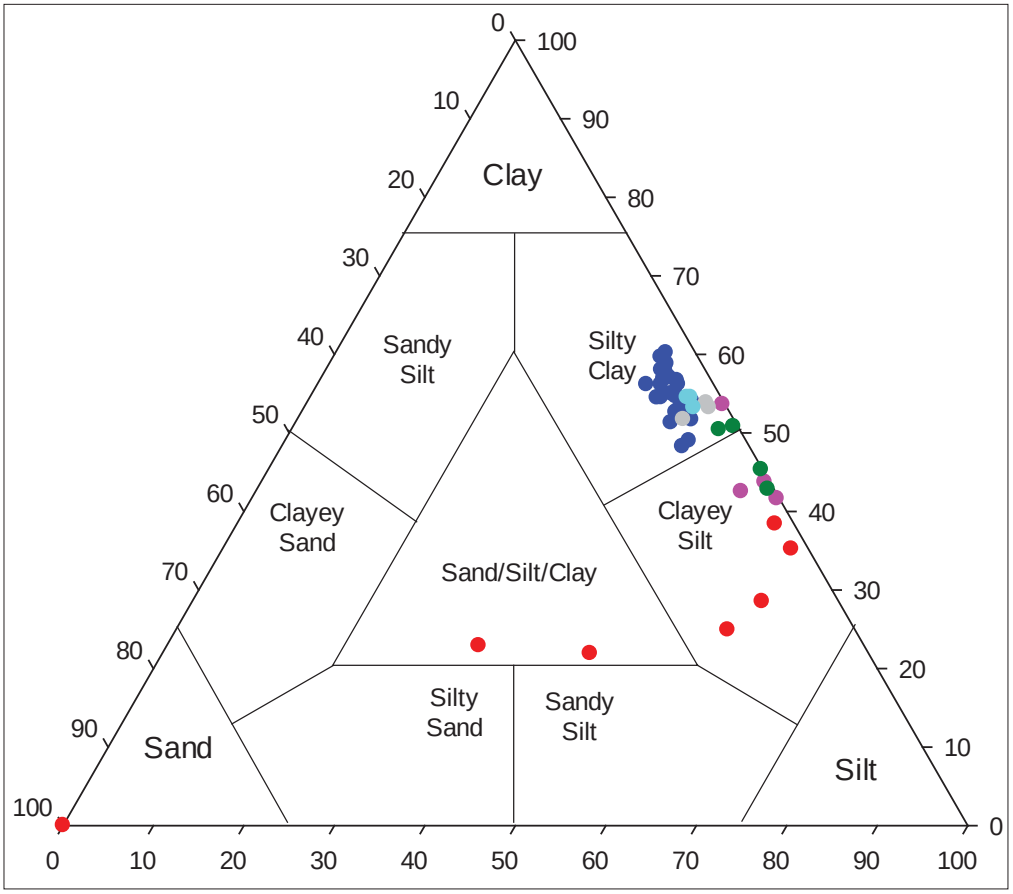

Figure 17. Individual grid cell and pipeline station particle size classifications (Shepard, 1954) for sediment samples collected within the Tamar Field, and pipeline corridor. Blue = Tamar Field; cyan = 1,400 to 1,700 m water depth; gray = 900 to 1,400 m water depth; green = 300 to 900 m water depth; pink = 200 to 300 m water depth; red = 20 to 200 m water depth.

Tamar Pipeline Corridor

Figures 17 and **18** summarize the particle size distribution and sediment type from along the Tamar pipeline corridor. Stations located in water depths between 20 and 200 m had high percentages of fine sand (**Figure 18**) with increased proximity to the Israeli shoreline. Classification of these stations ranged from clayey-silt in a water depth of 200 m to predominately sand in a water depth of 20 m (**Figure 17**). Stations located in water depths between 200 and 1,700 m were predominately composed of clay with a high silt fraction (**Figure 18**). Classifications of these stations were either clayey-silt or silty clay (**Figure 17**), depending on which fraction dominated.

Similarities in Particle Size

Particle size generally was uniform within the Tamar Field and along the pipeline corridor until a water depth of approximately 70 m from the Israeli shoreline (Station A4; **Figure 4**). Otherwise, particle size characteristics within this region were as expected for deepwater sediments located far from riverine discharges and terrigenous sediment sources. Station A4 marked the point at which seafloor sediment composition transitioned from predominately clays and silts to silts and fine sands, as would be expected within close proximity to the shoreline.

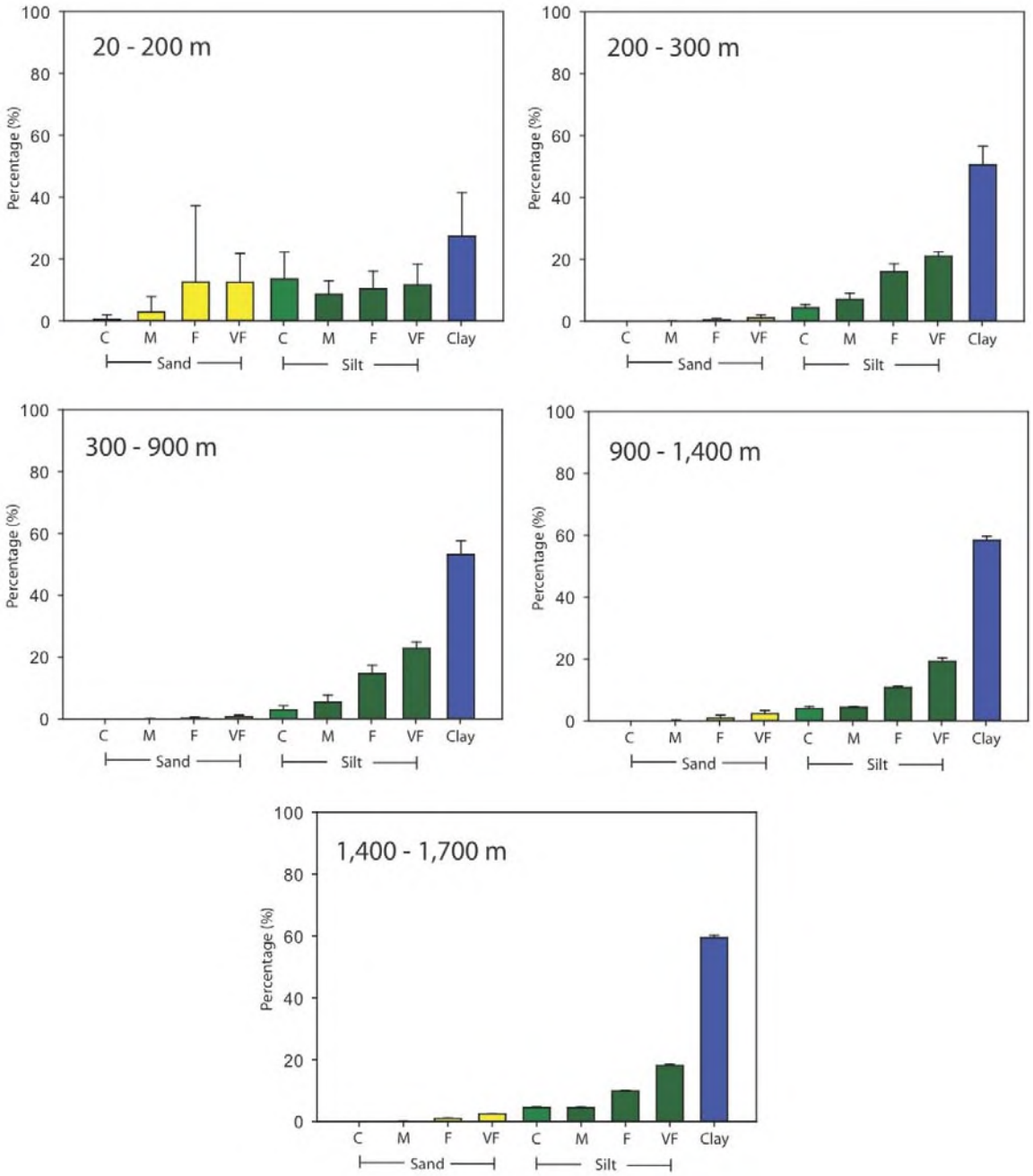

Figure 18. Particle size distribution (Wentworth scale; average + standard deviation) along the Tamar pipeline corridor, by water depths. C = coarse; M = medium; F = fine; VF = very fine. Yellow = sand fractions; blue = silt fractions; green = clay fractions.

Total Organic Carbon

Tamar Field

Tabulated values and analytical results for individual grid cell and pipeline corridor TOC concentrations are provided in **Appendix O**. High-resolution sediment TOC concentrations within the Tamar Field and are illustrated in **Figure 19**. Sediment TOC concentrations throughout the survey region were low (0.60% ± 0.07%) and were within the 99% confidence limit (CL) of the average for the field. Sediment TOC concentrations within the Tamar Field were also within the 99% CL of the average TOC concentration of the Levantine Basin (**Figure 20**).

Tamar Pipeline Corridor

Average TOC concentrations in sediments collected from the Tamar pipeline corridor are shown in **Figure 21**. Sediment TOC concentrations were low (0.06% to 0.07%) throughout the survey area and were comparable to the average concentration for the Levantine Basin. TOC concentrations were lowest in the 20 to 200 m zone, which is typical of sandy sediments. TOC was highest in the 200 to 300 m depth range, then declined steadily with depth (200 to 1,700 m) as expected given that there is a greater chance that carbon may remineralize before arriving at the seafloor as water depth increases.

Similarities in Total Organic Carbon Concentrations

Average TOC concentrations were low throughout the Tamar Field (0.60% ± 0.07%) and along the Tamar pipeline corridor (0.53% ± 0.14%). These low values were similar to those reported by others within the Levantine Basin (Almogi-Labin et al., 2009; Kholeif, 2010; Kröncke et al., 2003). TOC concentrations reflect the general condition of the deepsea environment and the highly oligotrophic nature of the eastern Mediterranean Sea in particular. Overall, the findings indicate that drilling activities have not increased sediment TOC concentrations throughout the survey area.

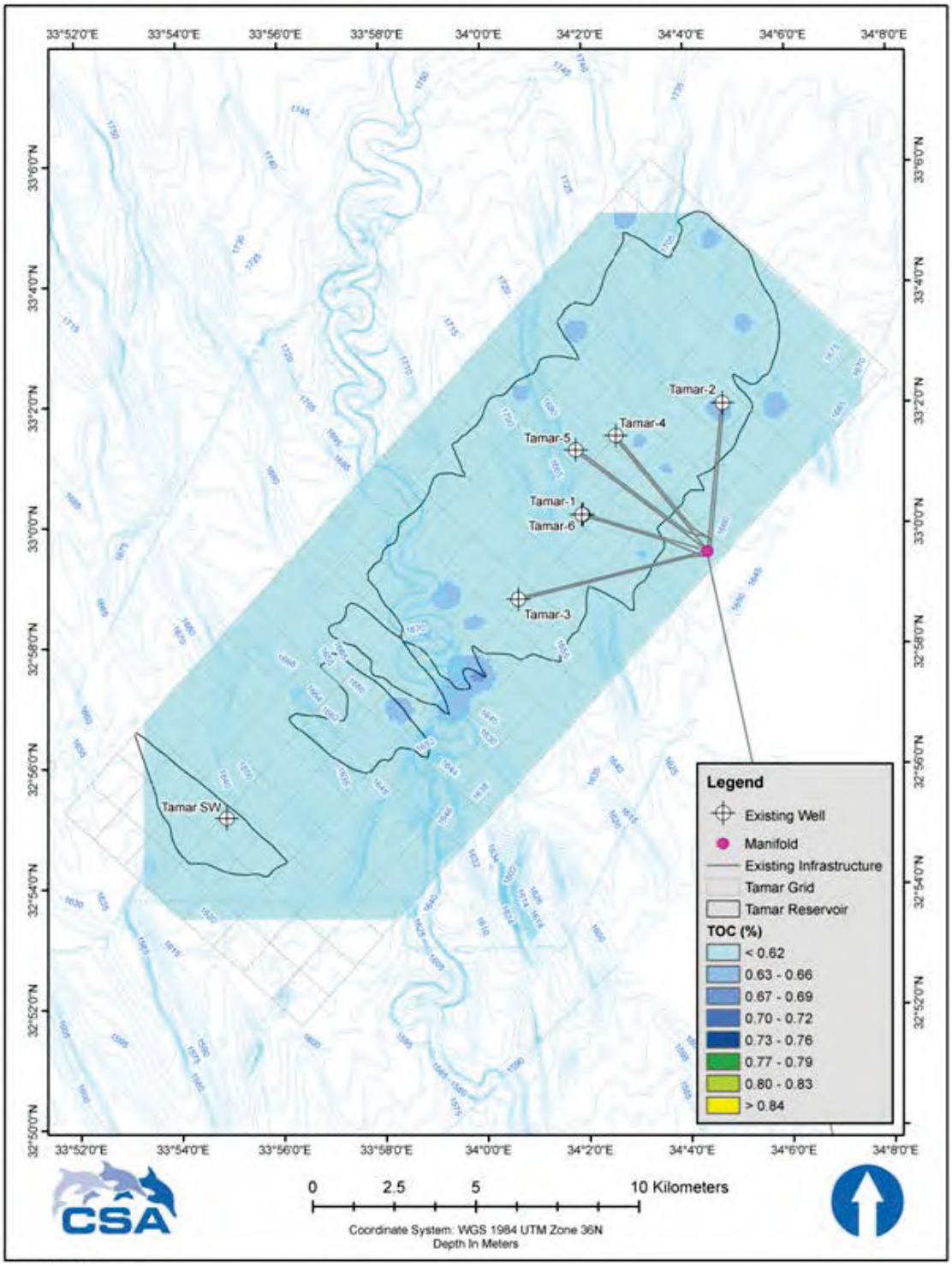

Figure 19. Kriged surface of sediment total organic carbon (TOC) concentrations within the Tamar Field. Concentrations represented by shades of blue were within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

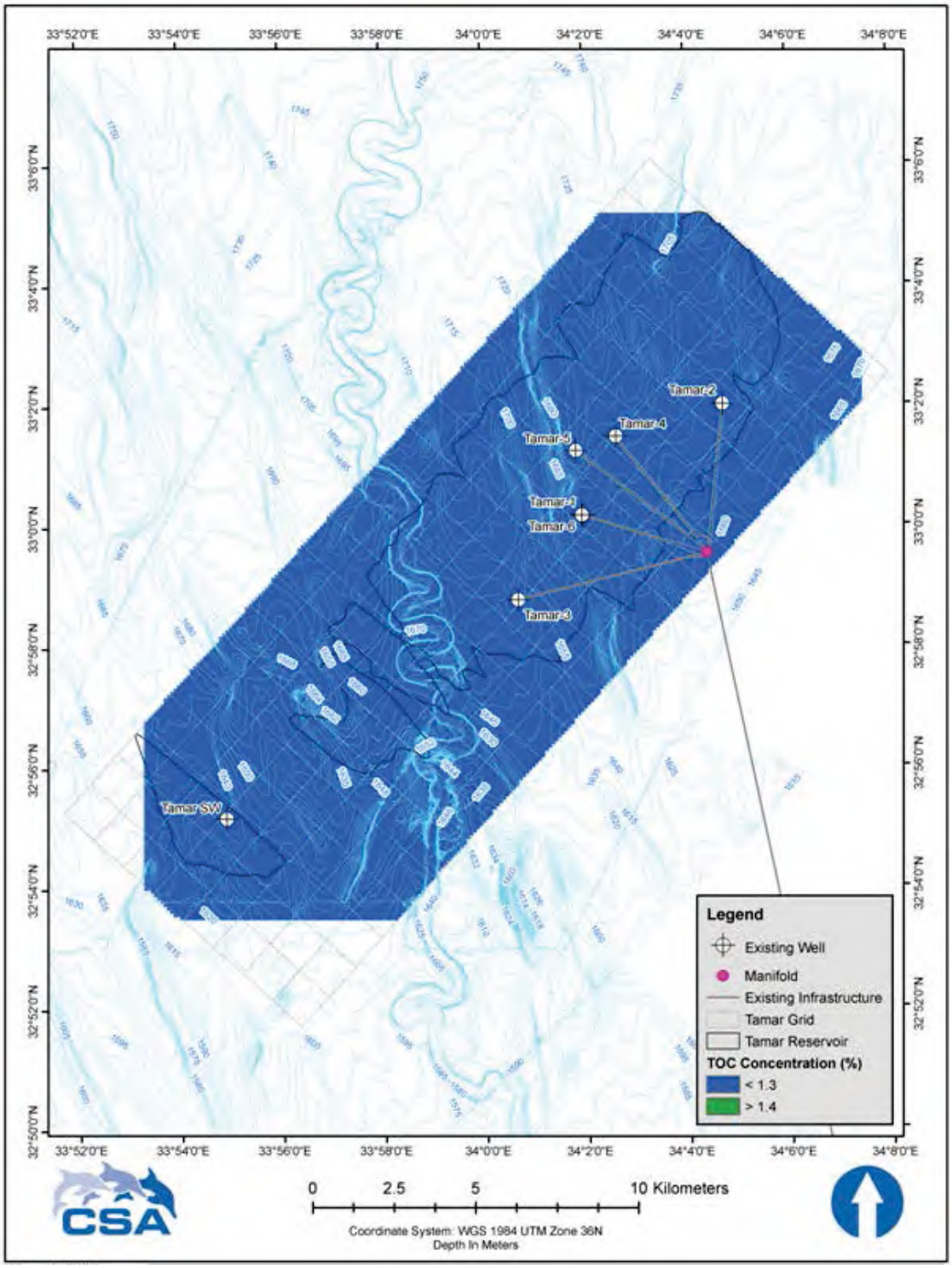

Figure 20. Sediment total organic carbon (TOC) concentrations within the Tamar in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Dark green represents values that are greater than 2.5 SD from that average. Levantine Basin averages were calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

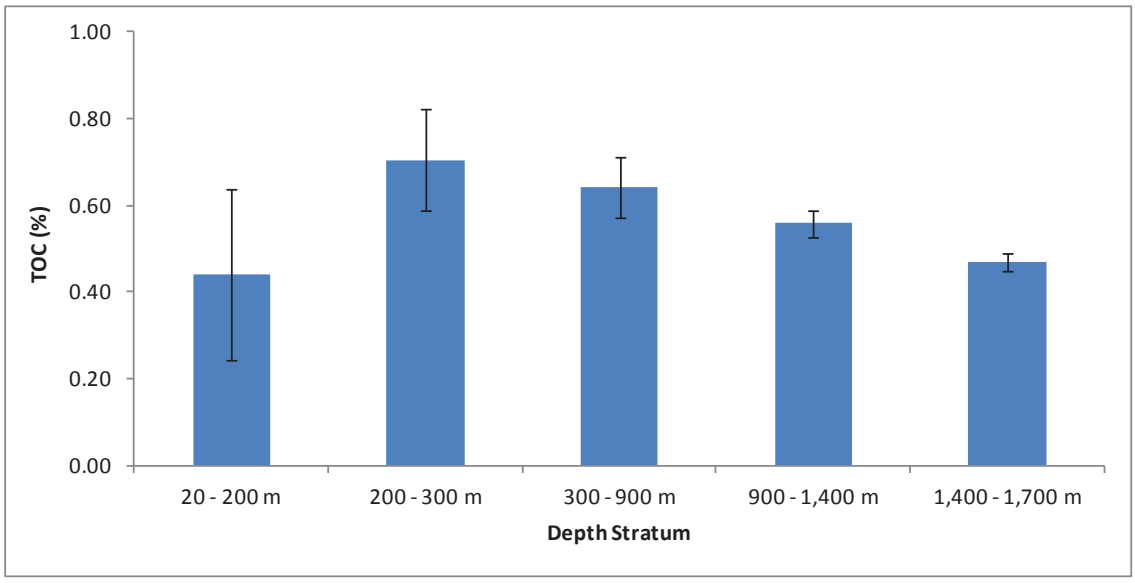

Figure 21. Mean percent total organic carbon (TOC) composition (± standard deviation) of seafloor sediments collected along the Tamar pipeline corridor in March 2013.

Metals

Tamar Field

Tabulated values and analytical results for individual grid cell and pipeline station sediment metals concentrations are provided in **Appendix P**. **Figures 22** to **36** are high-resolution sediment metals concentrations (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, thallium, vanadium, and zinc) within the Tamar Field. Selenium and silver concentrations generally were not detectable within the region (more than 75% were non-detects); therefore, figures are not provided for these metals. Most metals concentrations were within the 99% CL of the Tamar Field mean (**Figures 22** to **36**), with the exception of barium (**Figure 25**) and lead (**Figure 31**).

Barium concentrations throughout the Tamar Field were elevated resulting in a situation where barium concentrations as high as 884 ppm were within the 99% CL of the region (**Figure 25**). Comparison of barium concentrations within the field to the Levantine Basin average shows a clearer picture of the state of barium concentrations within the region (**Figure 37**). Elevated barium concentrations around Tamar-1/Tamar-6, Tamar-3, Tamar-4, Tamar-5, and Tamar SW-1 is not unexpected because barite is a compound normally added to drilling mud as a weighing material to add density in order to control and balance formation pressure and increase stability of the wellbore. However, the high levels of barium in the north section of the field and reservoir centered on grid cells B09 and C09 were unexpected. These cells were located more than 2.9 km from the nearest wellsite (**Appendix C**) and occurred in concentrations much higher than expected for this distance, especially as forecast concentrations were lower between this location and the nearest wellsites. Laboratory error has been ruled out through examination of the analytical laboratory's QC procedures, as has sampling error because there were no sources of barium on board the vessel to potentially contaminate samples. It is impossible to know the source of the high barium concentration, although it is likely not directly related to drilling activities at the existing Tamar wellsites. Barium is not considered a toxic chemical; therefore, there are no established toxicity thresholds for this metal. High concentrations of barium within the region are not expected to negatively impact the environment within the region.

Concentrations of lead were elevated above the 99% CL of the Tamar Field mean in close proximity (approximately 1 km) to the manifold (**Figure 31**). Lead is a component of drilling mud (approximately 136 ppm) and barite (approximately 165 ppm) and has been found in cuttings (approximately 133 ppm), so its presence in the field and reservoir was not surprising. Interestingly, lead concentrations were also slightly elevated (but below the 99% CL) in the area of the inexplicitly high barium concentrations of grid cells B09 and C09. The slightly elevated lead signature in this region may indicate that the barium anomaly may have been derived from the surface, given that drilling muds and cuttings are relatively high in lead. Lead concentrations, while elevated in comparison to the Tamar Field, were not elevated in comparison to the Levantine Basin average and are within the 99% CL threshold of this metal (**Figure 38**). Lead concentrations throughout the field and reservoir, even in areas with slightly elevated concentrations, were well below the ERL and ERM values for lead (46.7 and 218 ppm, respectively). A concentration below an ERL represents a minimal effects range where biological effects are very rarely observed, while a concentration above an ERM represents a range where biological effects are likely to be observed (Long and Morgan, 1990).

Cadmium concentrations were within the 99% CL of the Tamar Field mean (**Figure 27**); however, slightly elevated cadmium concentrations, relative to the rest of the field mean, were clustered on the eastern portion of the field though not directly around the five wellsites in the region. Cadmium is a component of the drilling mud and barite used in drilling and plugging activities within the Tamar Field (less than 2 ppm). Studies have shown that cadmium in barite has very low solubility, leaches only slightly into the seawater, and has very limited availability to marine organisms (Trefry and Smith, 2003; Neff, 2007). Similarly, after deposition to the seafloor, cadmium remains bound in barite, does not leach into sediment pore water, and remains unavailable to marine organisms. It is impossible to determine the source of the cadmium, especially because the elevated barium signature (**Figure 25**) does not spatially overlap with the cadmium concentrations (**Figure 27**). Besides being within the 99% CL of the Tamar Field mean, cadmium concentrations in the eastern portion of the field and reservoir were well below the ERM value (9.6 ppm) and ERL value (1.2 ppm) for cadmium (Long and Morgan, 1990). Concentrations of cadmium were within the 99% CL of the Levantine Basin average (**Figure 39**). Cadmium concentrations may reflect either extremely low level anthropogenic enrichment or natural patchiness within seafloor sediments of the region. In either case, the findings indicate that cadmium concentrations within the field were not significantly different from Tamar Field averages or Levantine Basin averages, and were well under concentrations of environmental concern.

Concentrations of aluminum and other trace metals vary naturally in ambient seafloor sediments, primarily due to differences in sediment grain sizes. Clay sediments are composed primarily of aluminosilicates and typically have higher concentrations of metals. However, sediments classified as silt or sand are composed primarily of quartz and fragments of carbonate shell, which dilute ambient metals concentrations (Herut and Sandler, 2006). Aluminum concentrations are assumed to correlate linearly with other metals concentrations when there is no anthropogenic input (Trefry and Smith, 2003; Trefry et al., 2013). All sediment metals concentrations (with the exception barium, as described previously) were within the 99% CL of the Levantine Basin mean (**Figure 40**). Additionally, normalization of metals concentrations with sediment grain size, achieved by performing a regression of each metal against aluminum, also showed that metals concentrations in the Tamar Field were generally within the 99% prediction interval of the Levantine Basin (**Figures 41** and **42**). Figures for selenium and silver are not shown because concentrations generally were below the laboratory's detection limit. A figure for thallium is not shown because regression values are similar to other metal regressions (i.e., vanadium).

Concentrations of all metals within the field and reservoir were below ERL and ERM values with the exception of arsenic, copper, and nickel (**Table 27**). However, these three metals are naturally found in high concentrations throughout the Levantine Basin. Concentrations above the ERL should be considered ambient for arsenic and copper, and concentrations above the ERM should be considered ambient for nickel (**Table 27**).

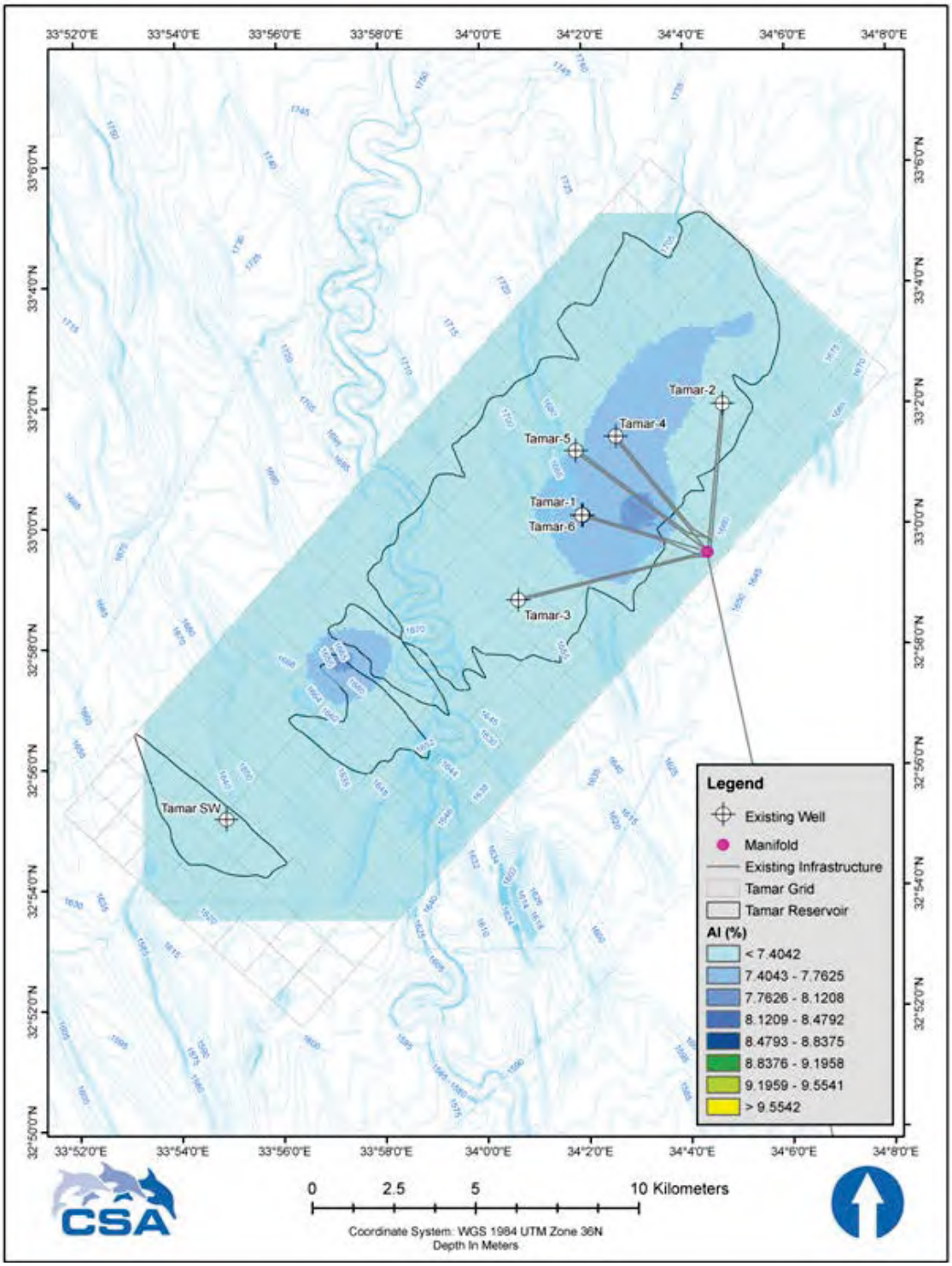

Figure 22. High-resolution sediment aluminum concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

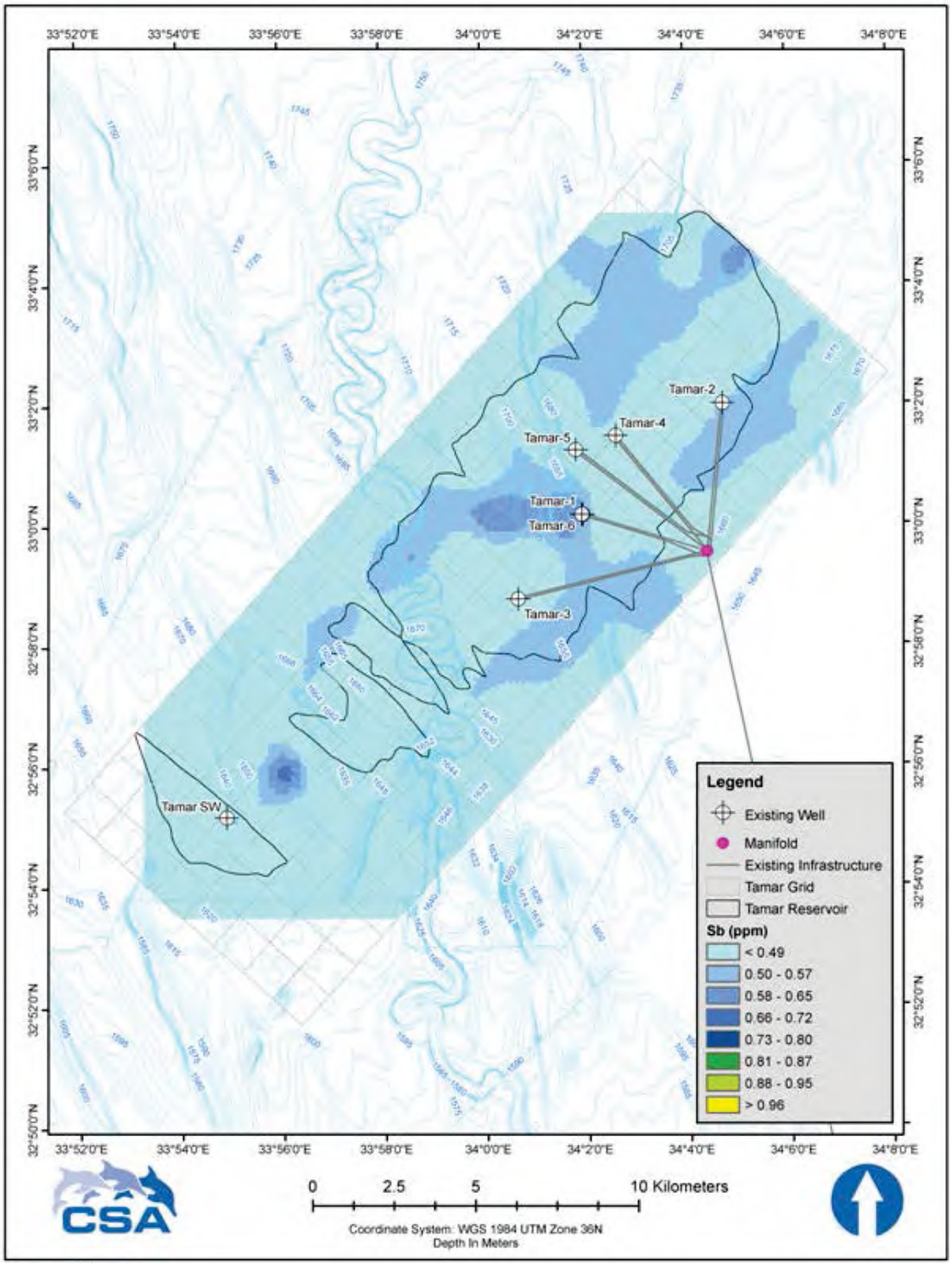

Figure 23. High-resolution sediment antimony concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

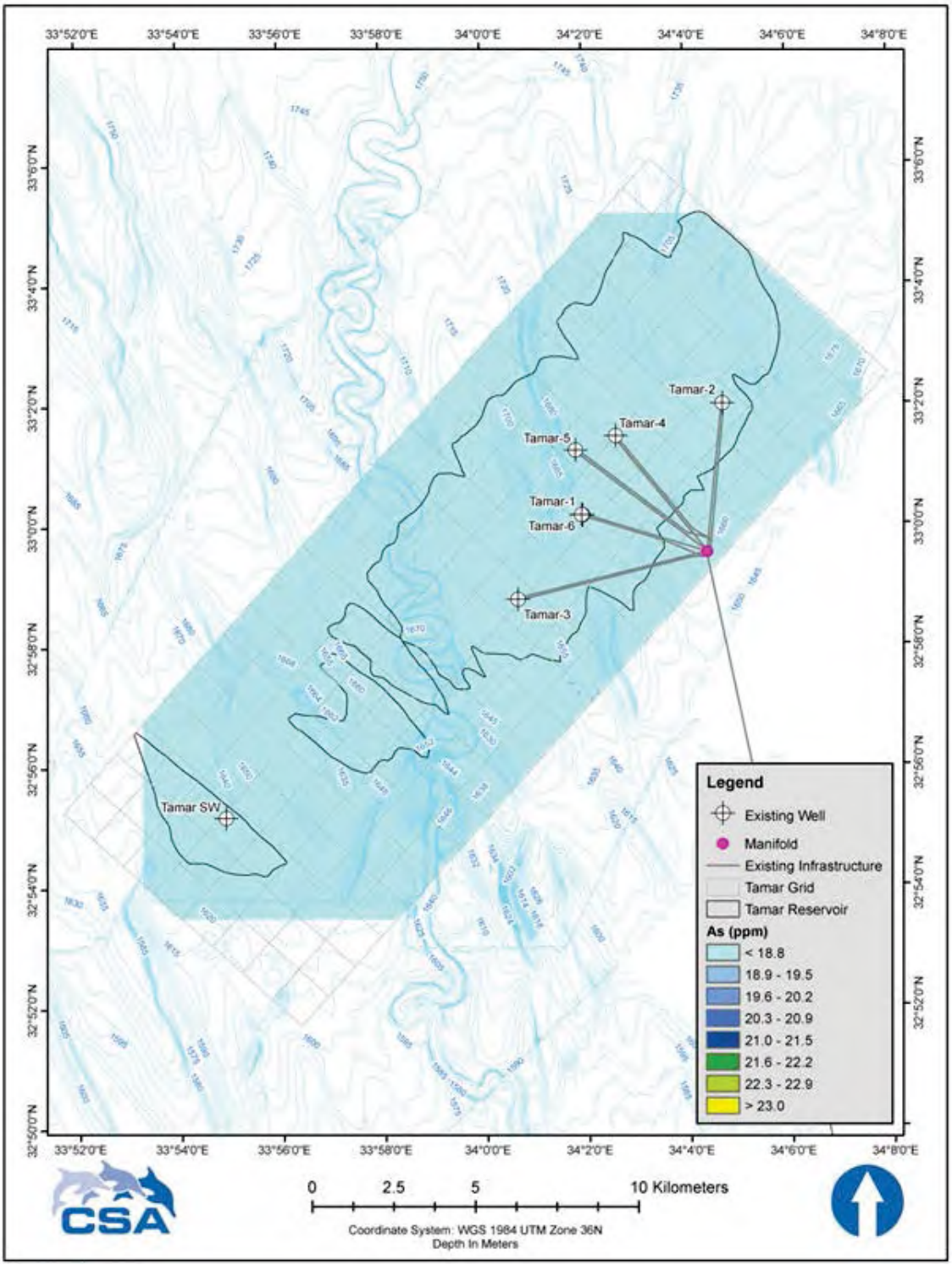

Figure 24. High-resolution sediment arsenic concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

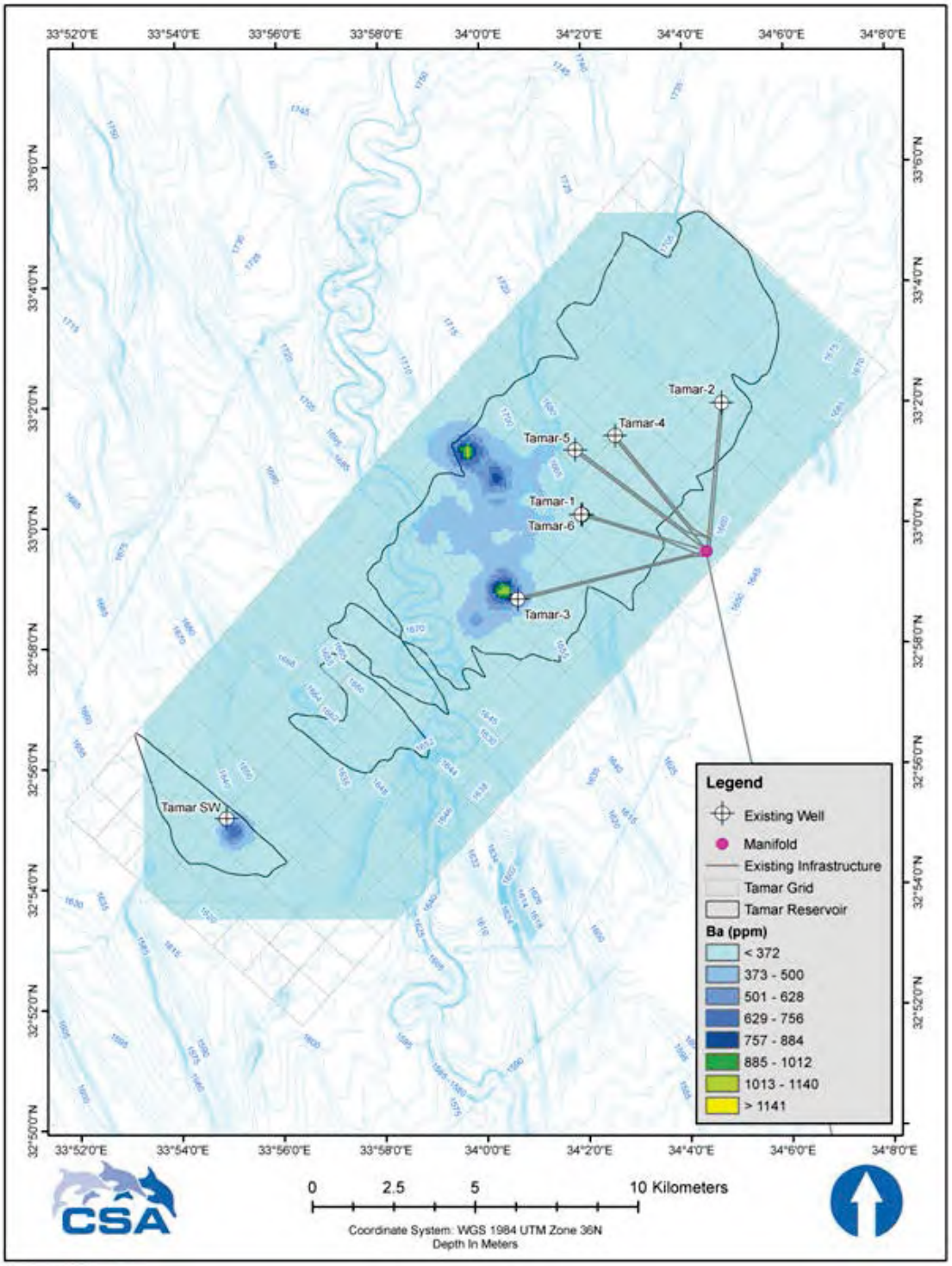

Figure 25. High-resolution sediment barium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

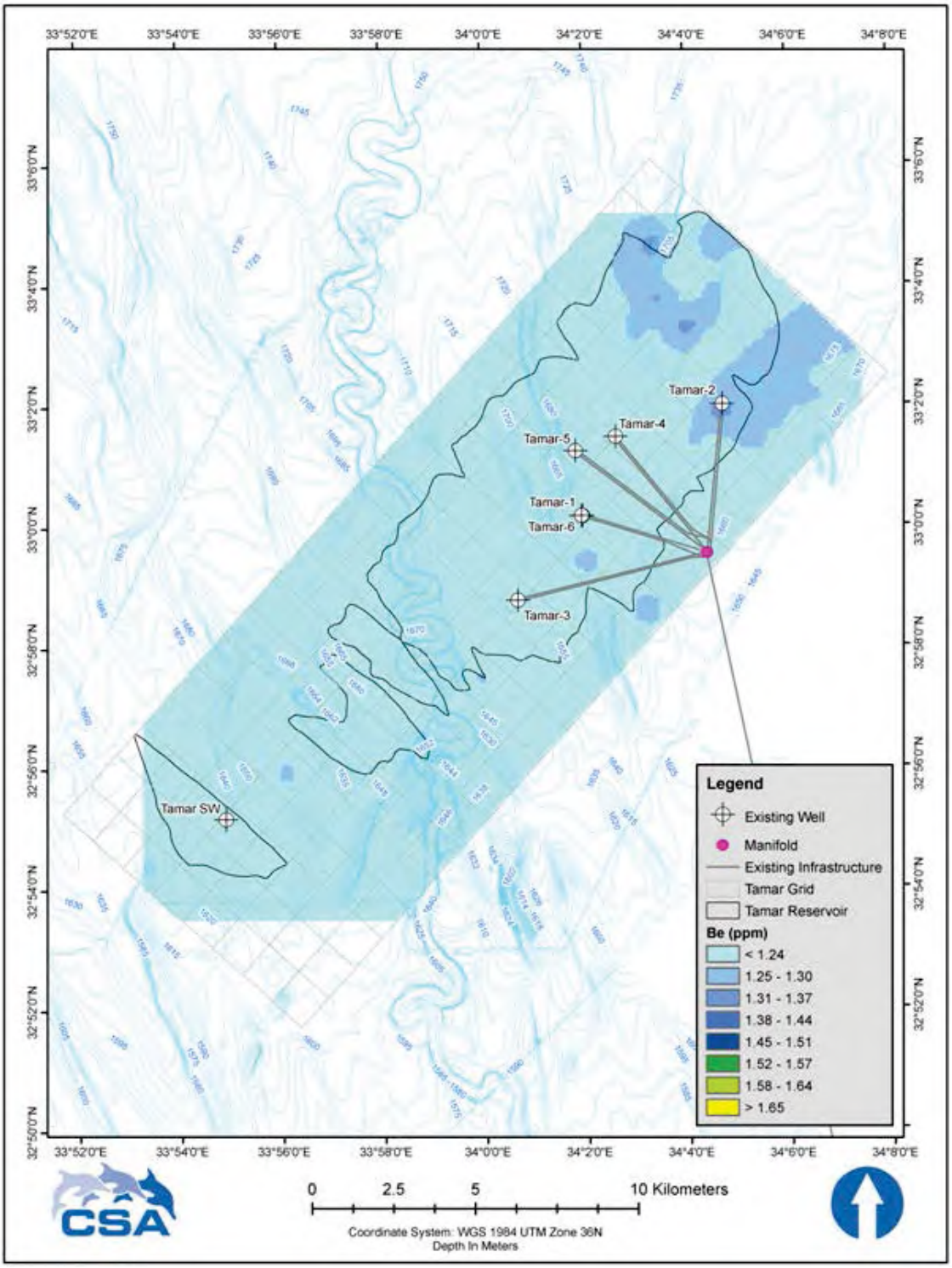

Figure 26. High-resolution sediment beryllium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

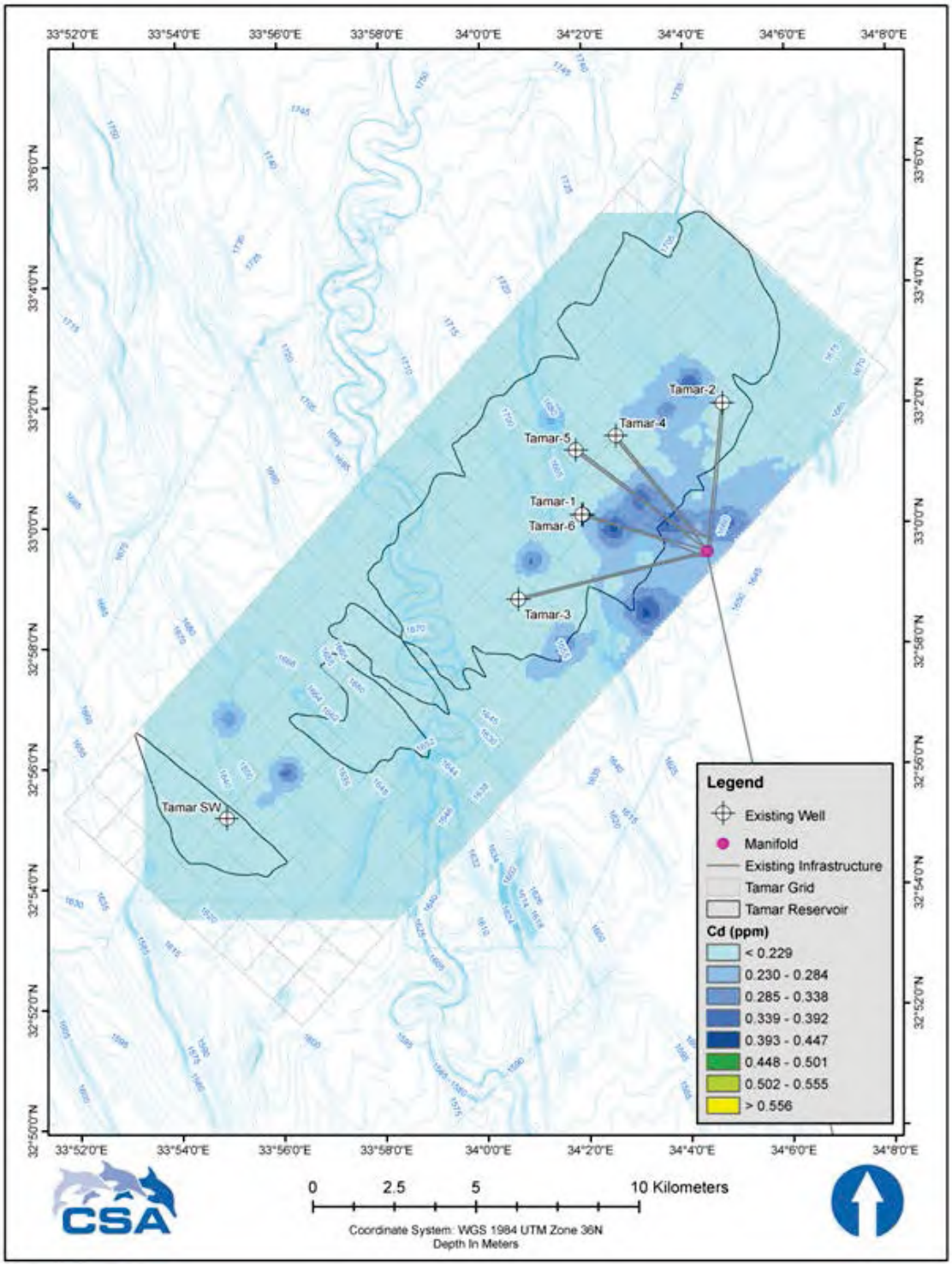

Figure 27. High-resolution sediment cadmium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

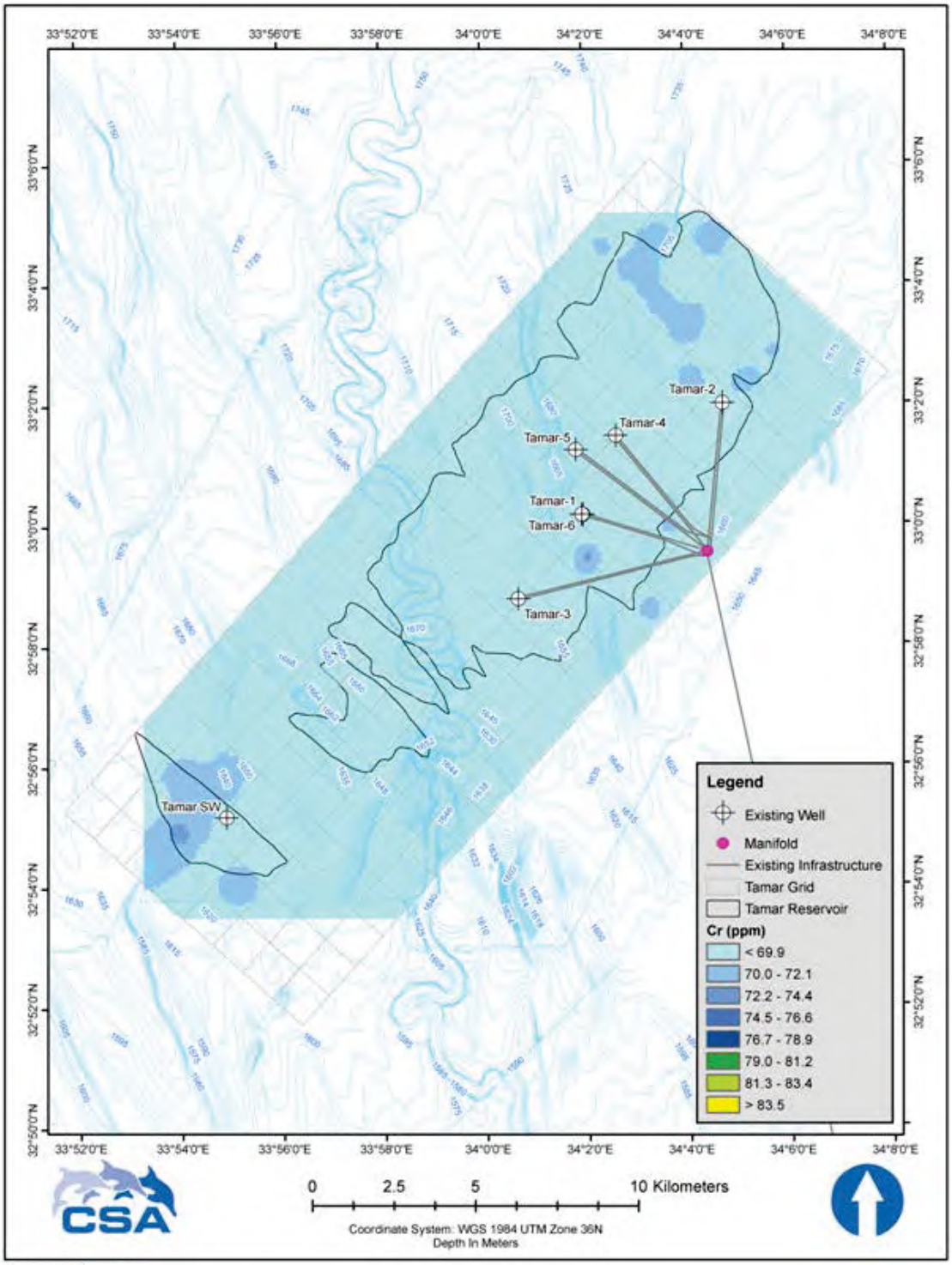

Figure 28. High-resolution sediment chromium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

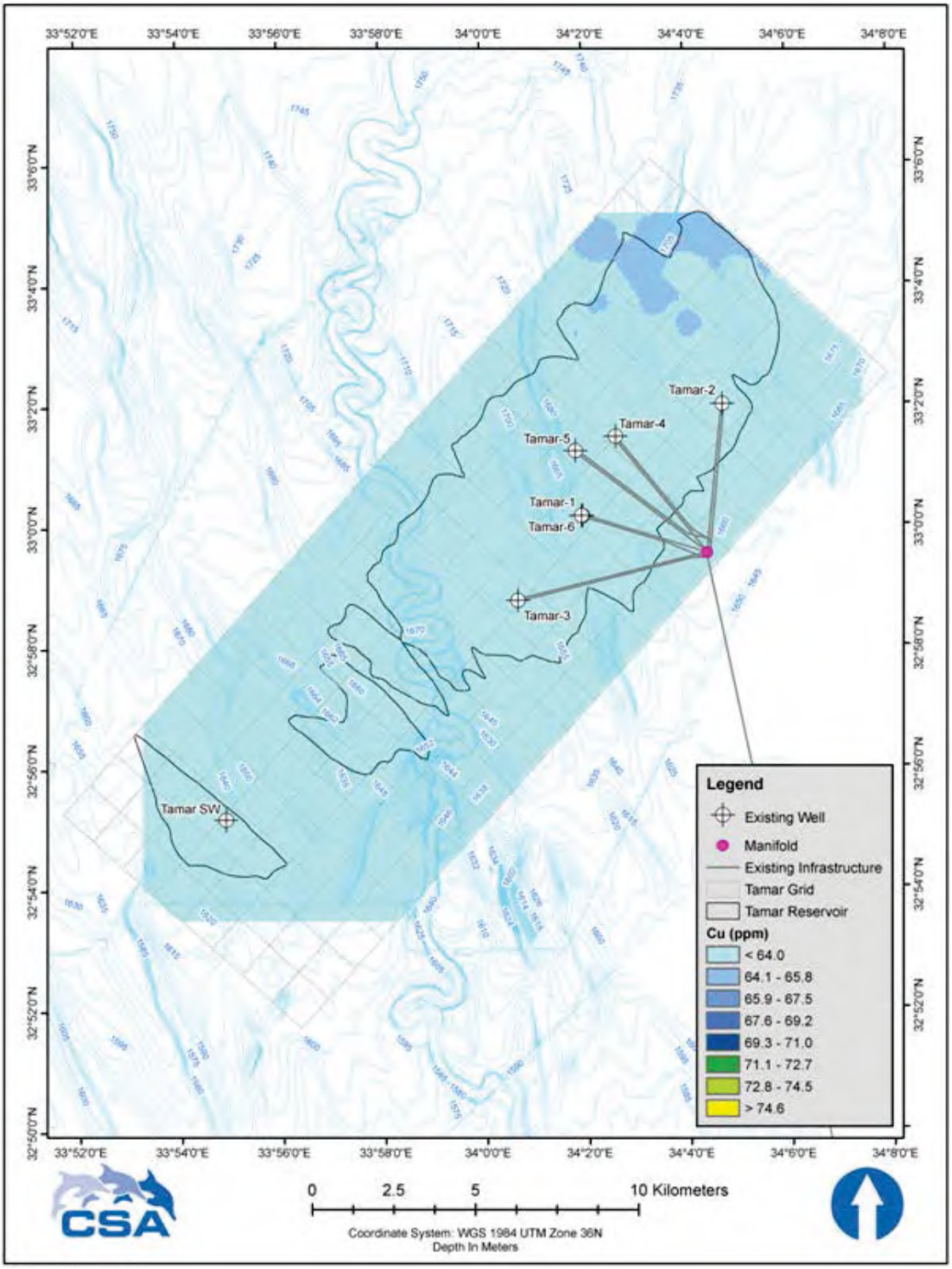

Figure 29. High-resolution sediment copper concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

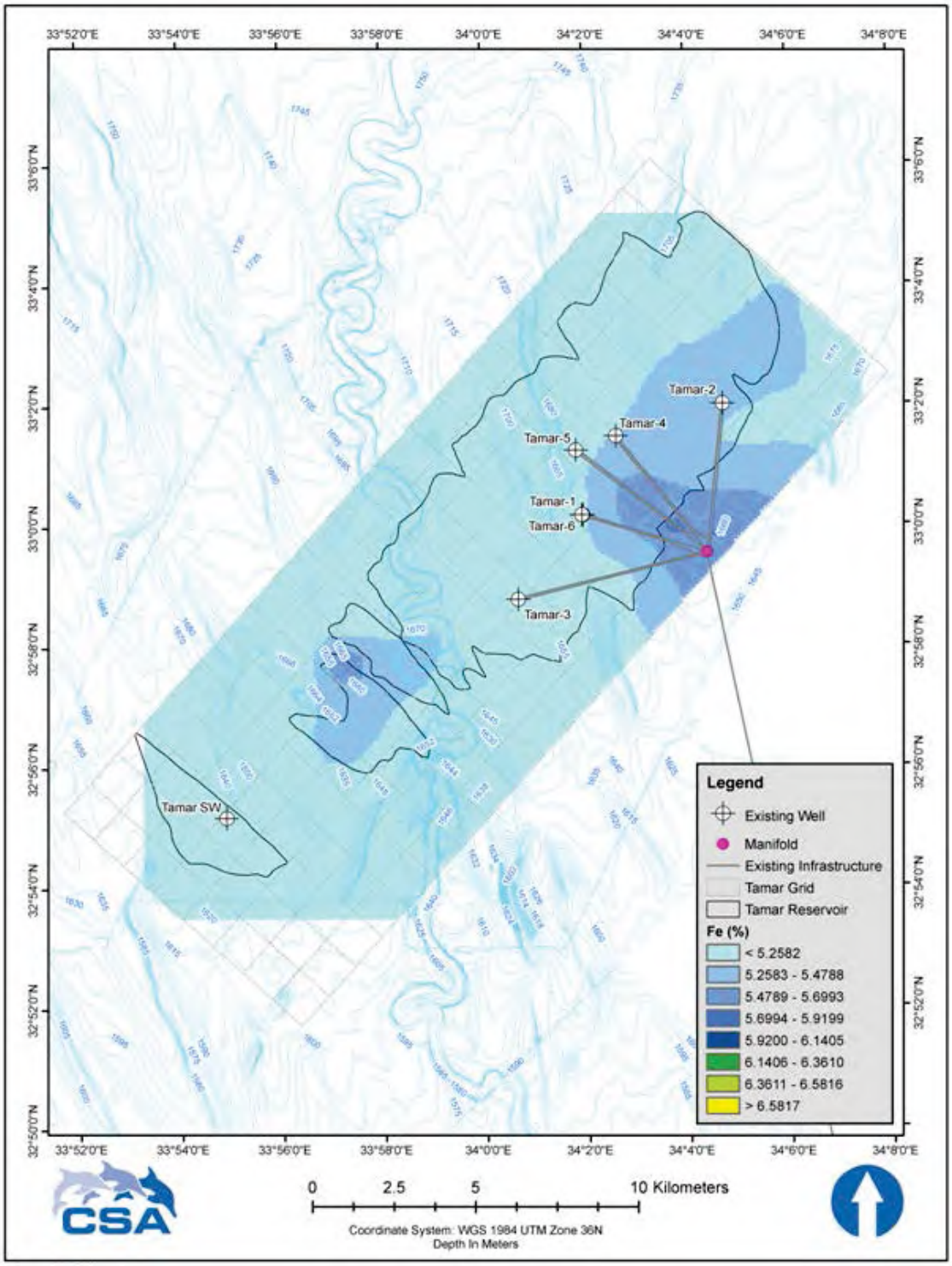

Figure 30. High-resolution sediment iron concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

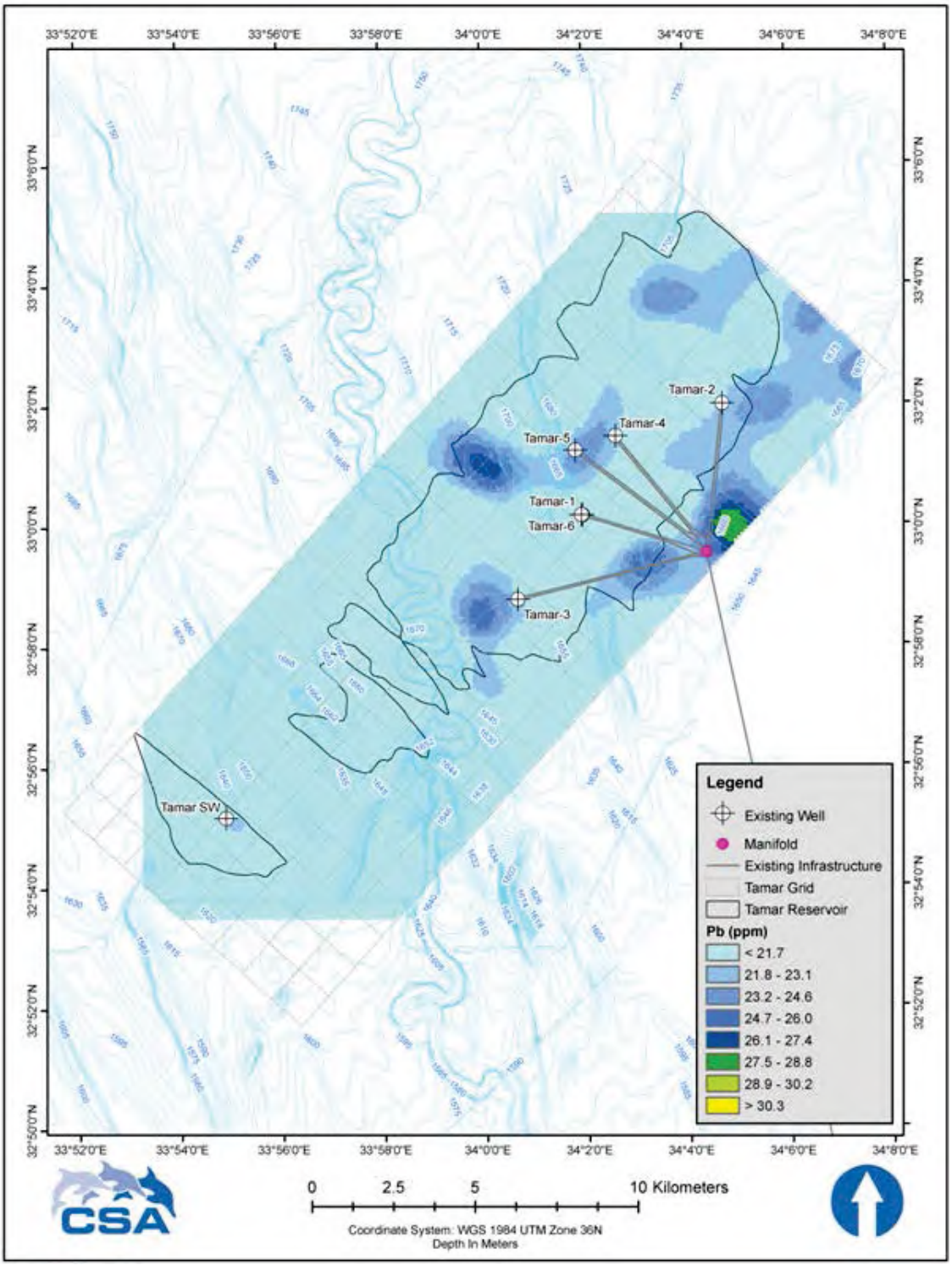

Figure 31. High-resolution sediment lead concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

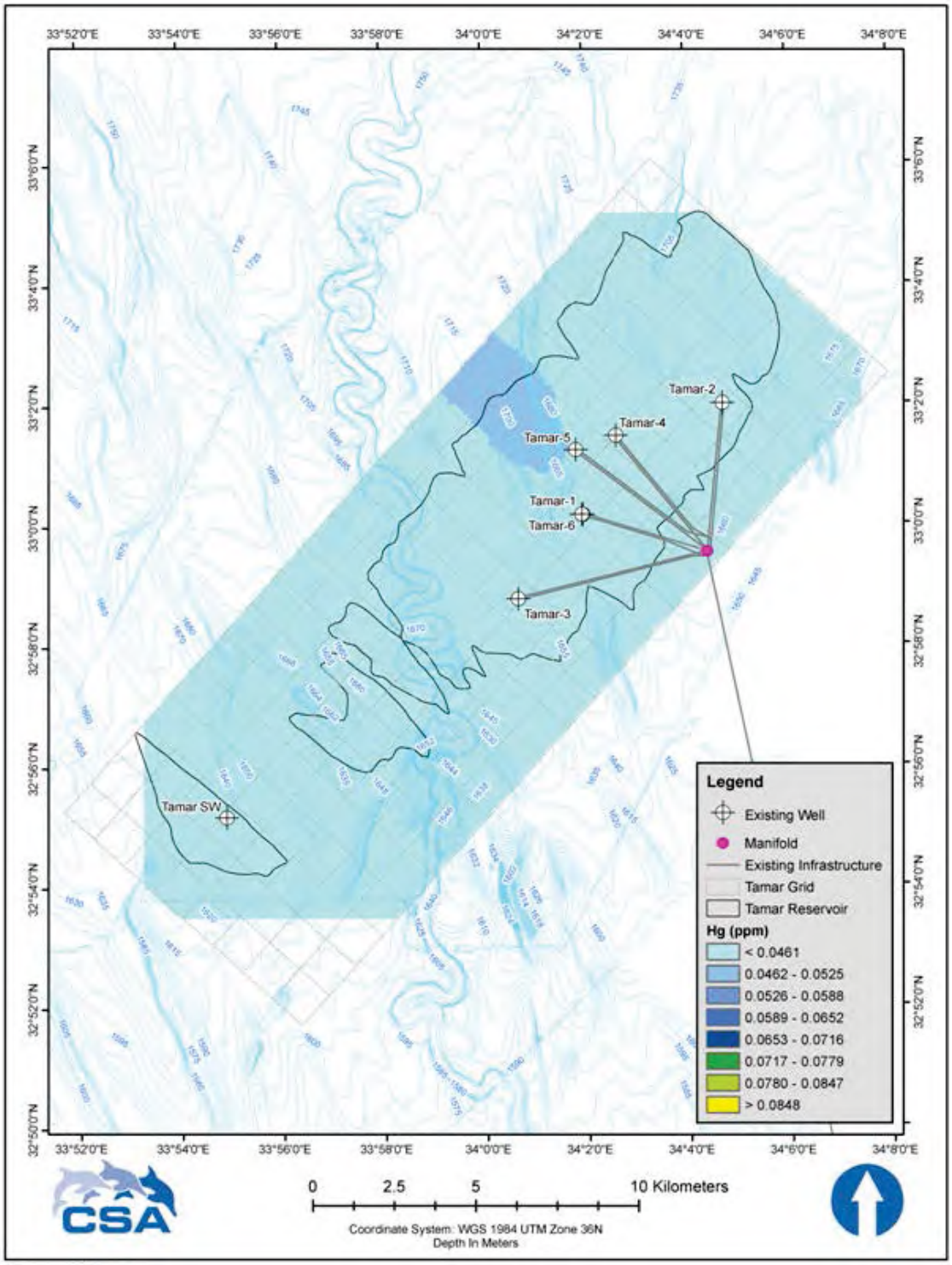

Figure 32. High-resolution sediment mercury concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

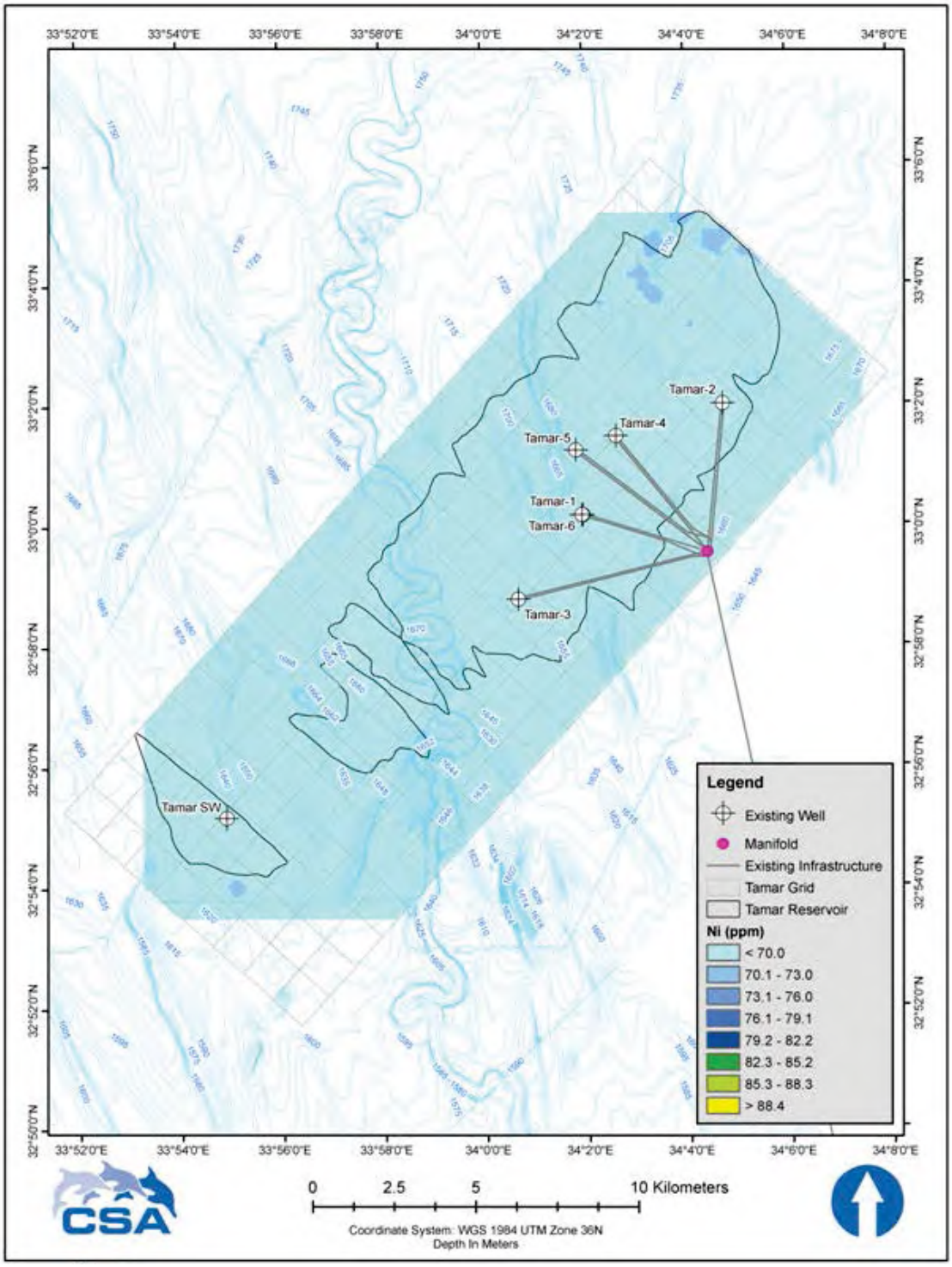

Figure 33. High-resolution sediment nickel concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

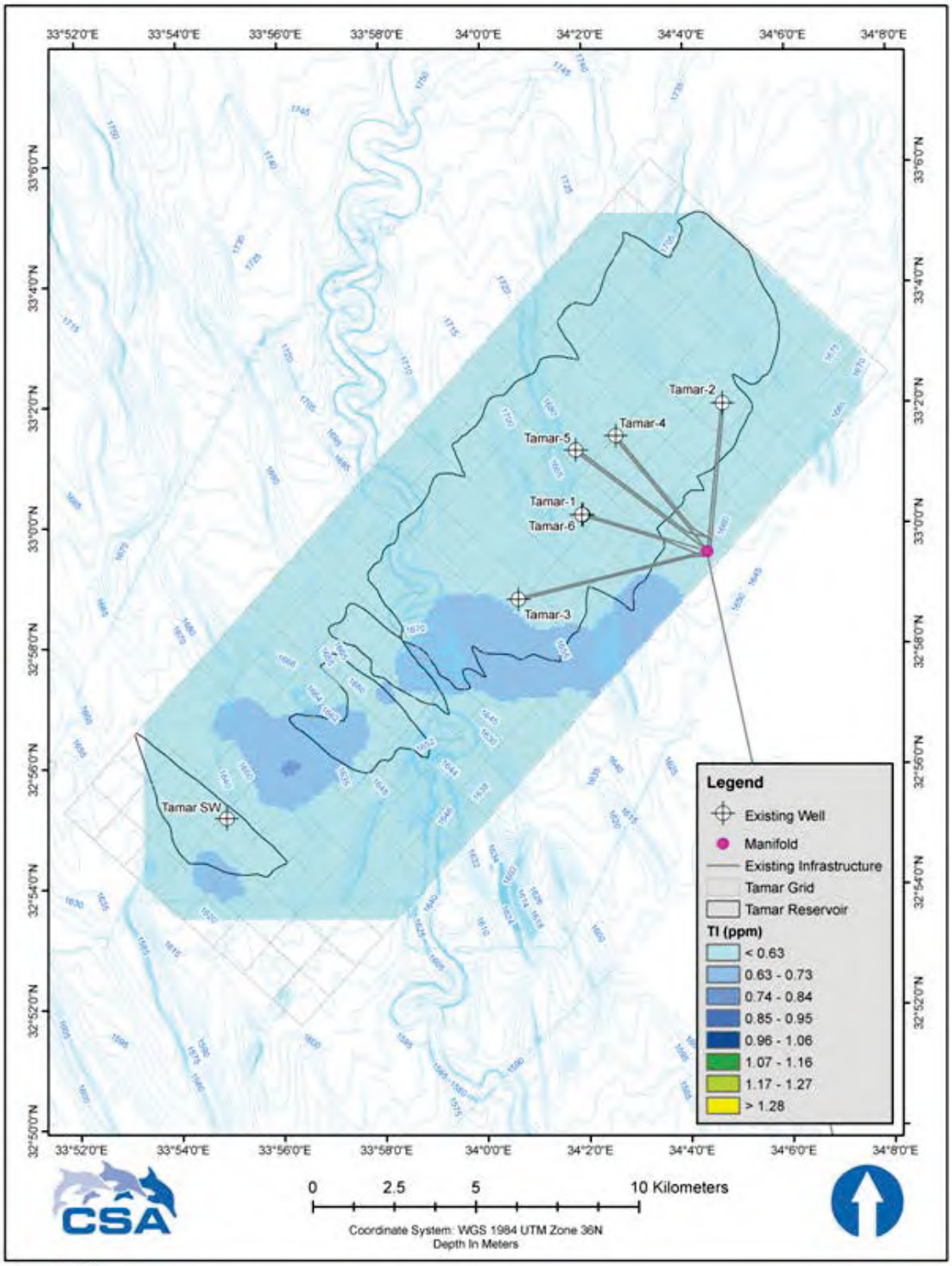

Figure 34. High-resolution sediment thallium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

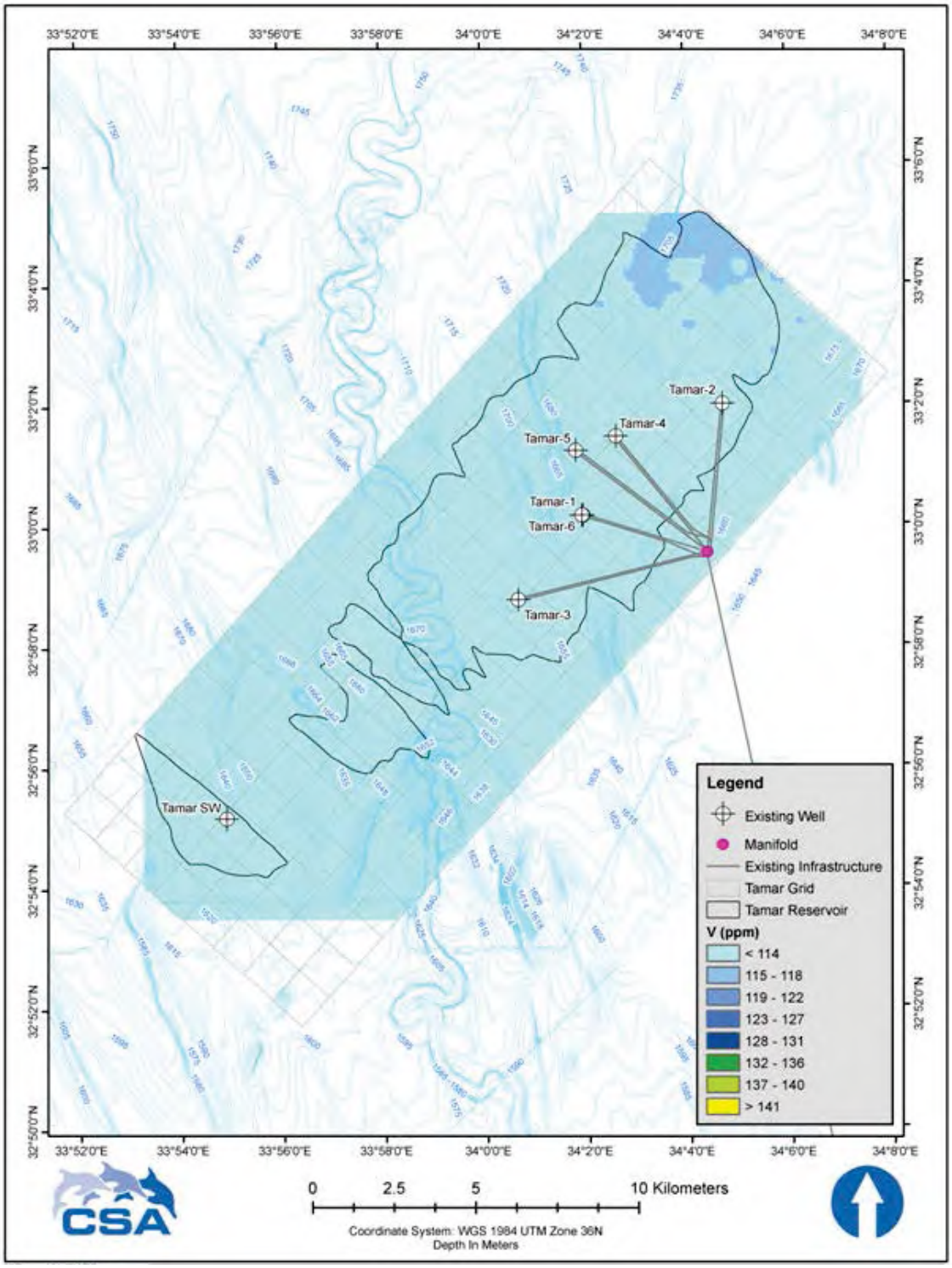

Figure 35. High-resolution sediment vanadium concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

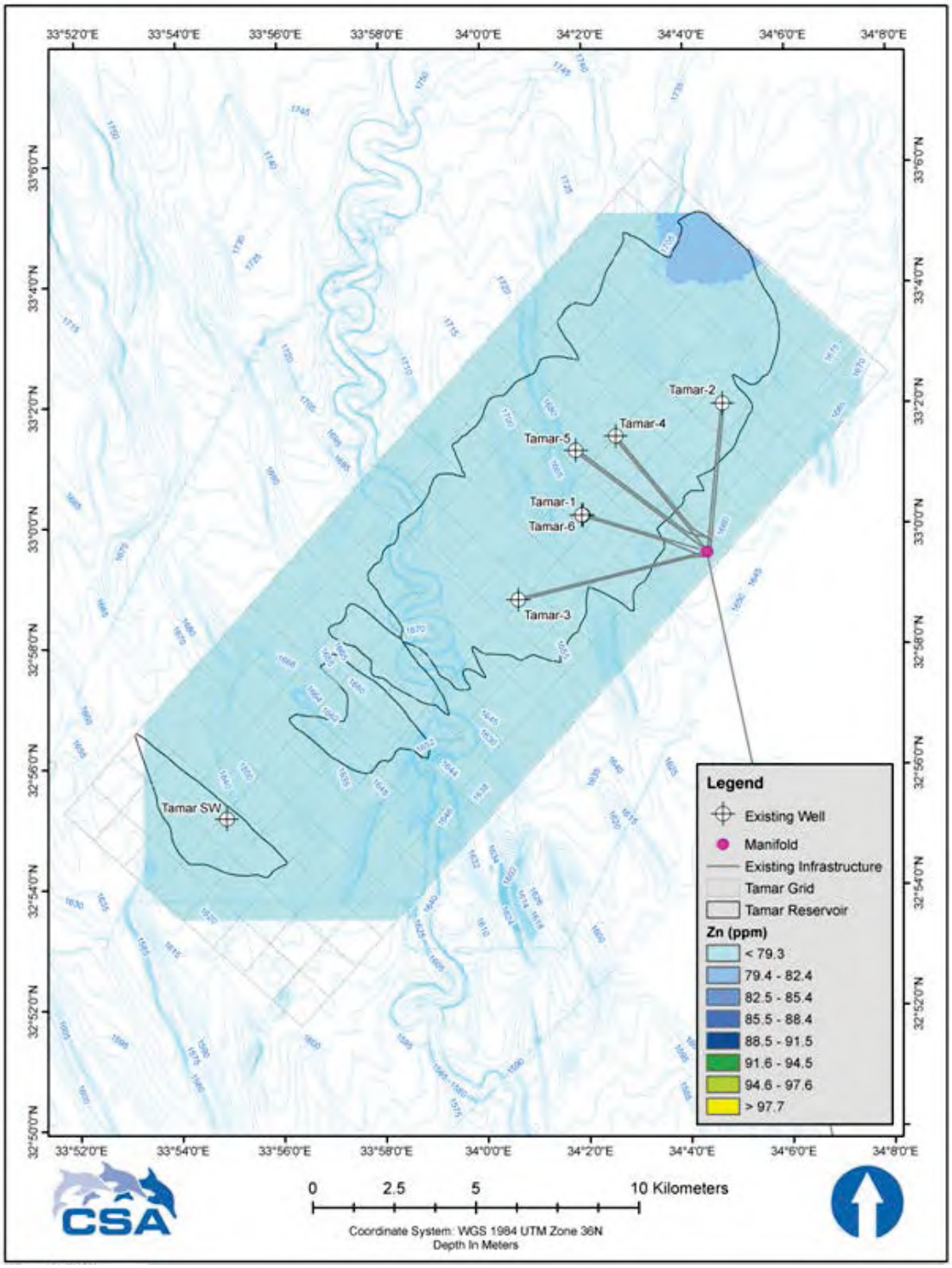

Figure 36. High-resolution sediment zinc concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

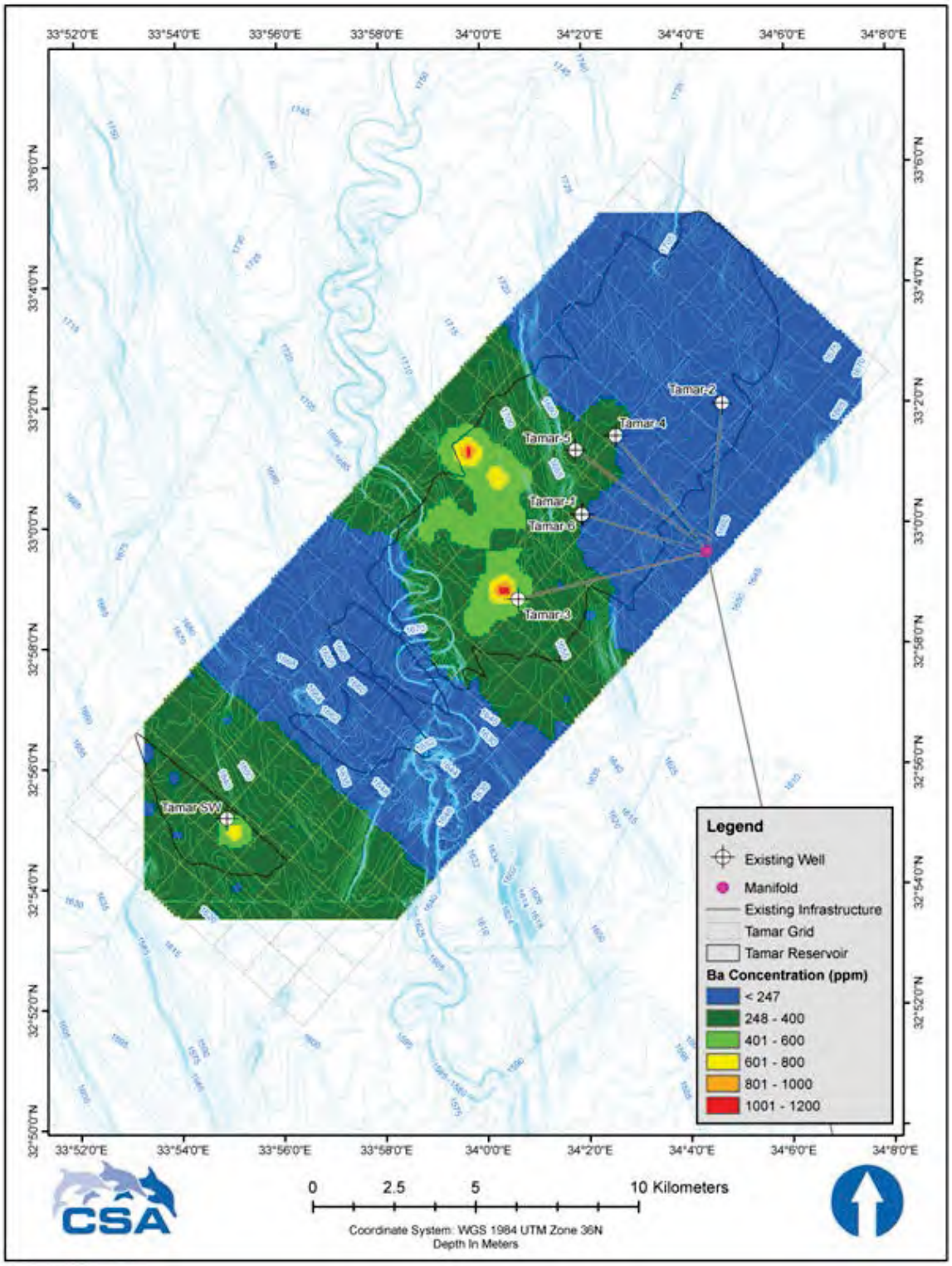

Figure 37. Sediment barium concentrations within the Tamar Field in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Other colors represent elevated levels of barium in 200 ppm increments. Levantine Basin averages are calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.

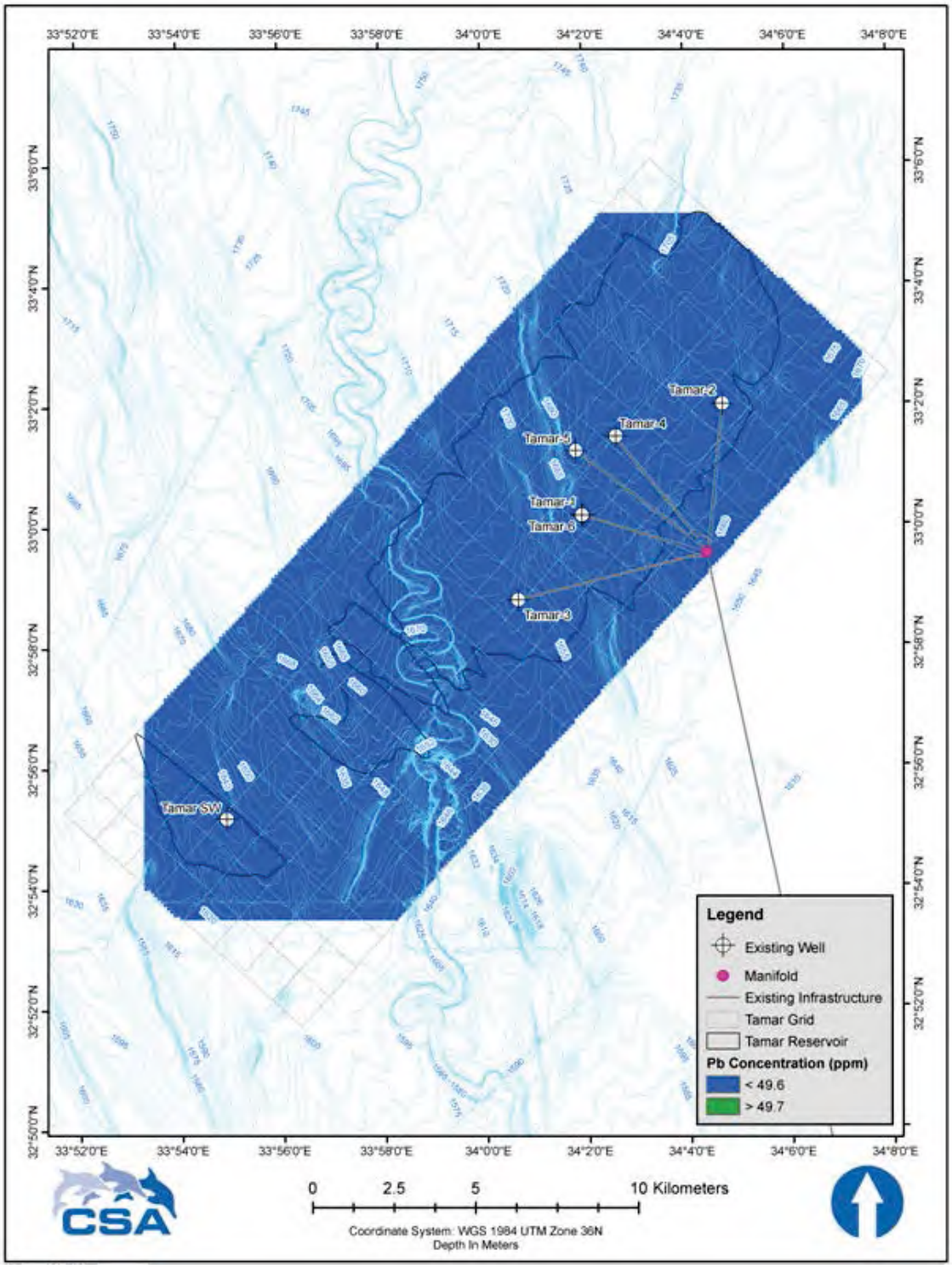

Figure 38. Sediment lead concentrations within the Tamar Field in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Dark green represents values that are greater than 2.5 SD from that average. Levantine Basin averages are calculated from Pre-Drill and Environmental Baseline Surveys conducted by CSA prior to September 2013. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

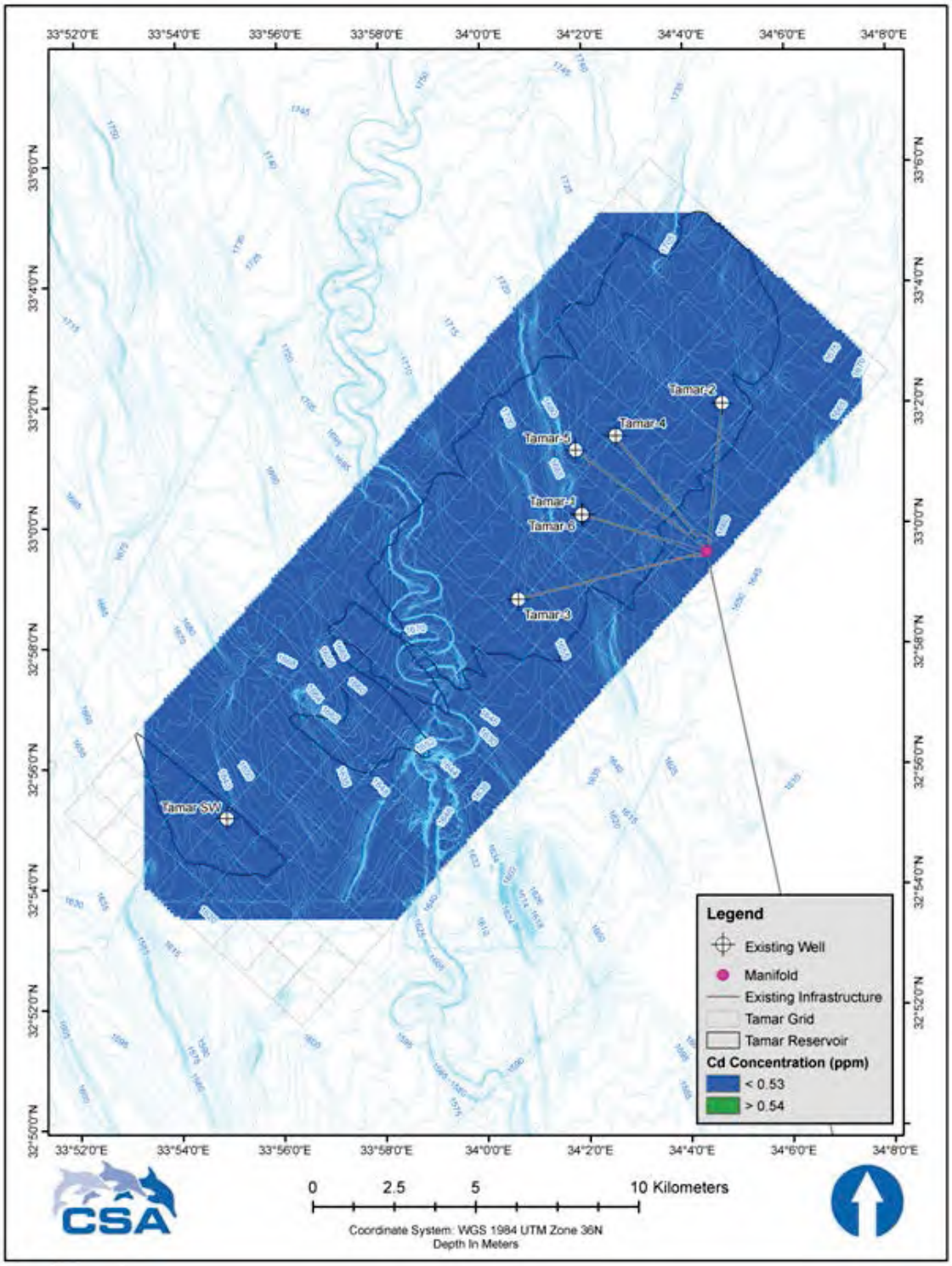

Figure 39. Sediment cadmium concentrations within the Tamar Field in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Dark green represents values that are greater than 2.5 SD from that average. Levantine Basin averages are calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

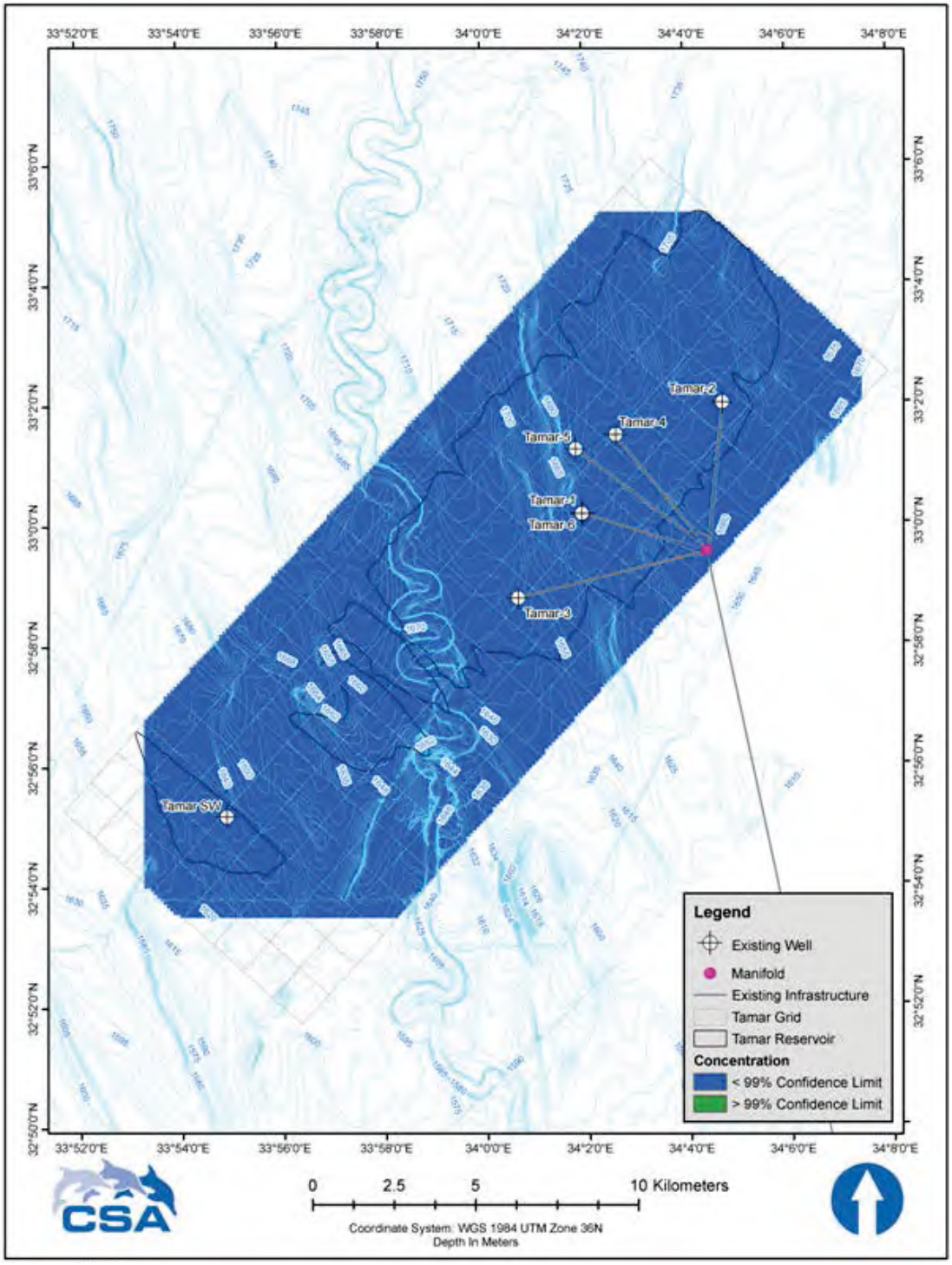

Figure 40. Representative map of sediment metals concentrations (ppm) for antimony, arsenic, beryllium, chromium, copper, iron, mercury, nickel, thallium, vanadium, and zinc within the Tamar Field in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Dark green represents values that are greater than 2.5 SD from that average. Actual Tamar Field and Reservoir averages (± SD) for these metals are provided in **Table 27**. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

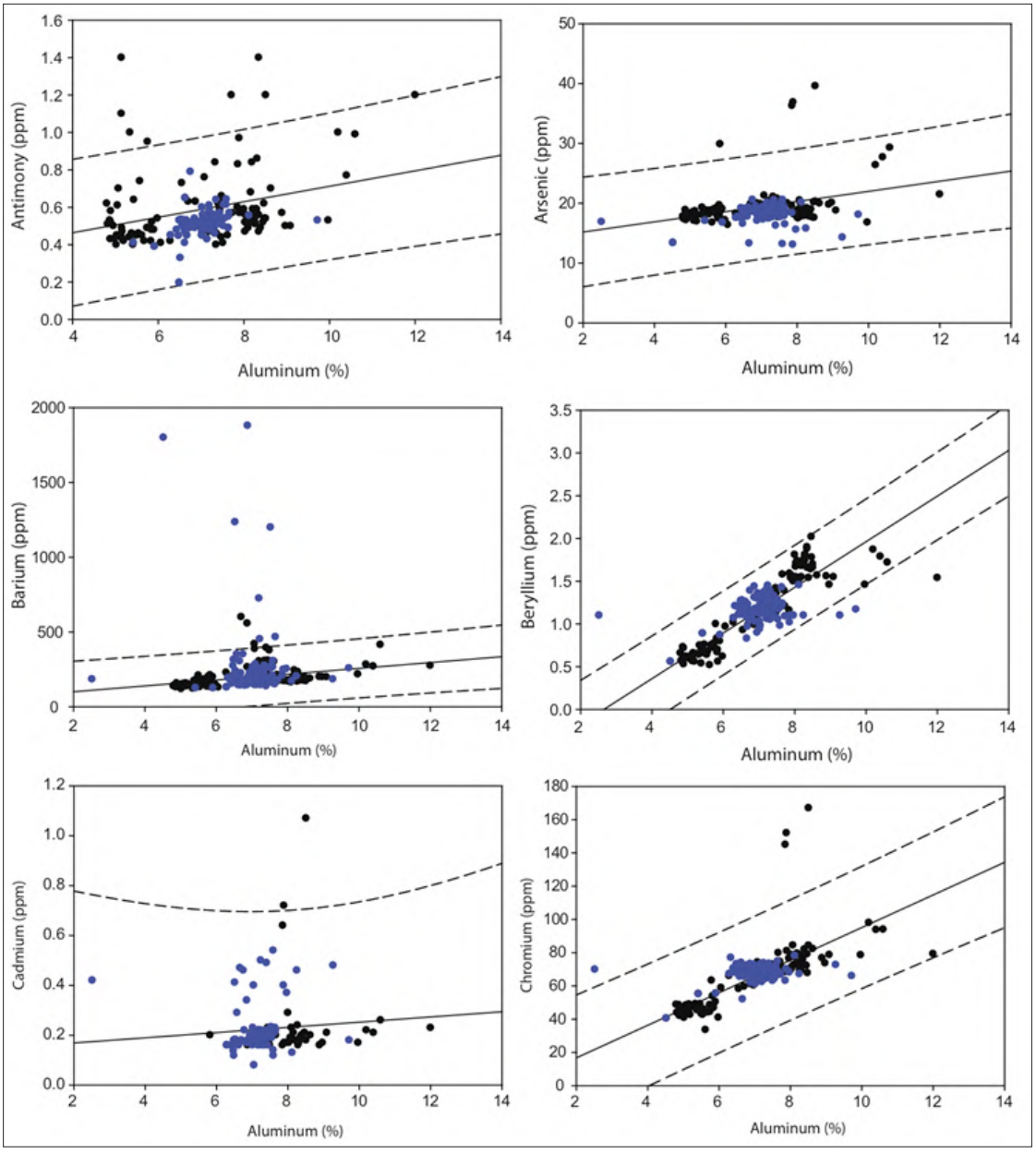

Figure 41. Plot of aluminum versus antimony, arsenic, barium, beryllium, cadmium, and chromium. Regression line (solid) and 99% prediction interval (dashed) based on Levantine Basin data collected during pre-drill and environmental baseline surveys conducted by CSA prior to September 2013 (black dots). Blue dots represent data from the Tamar Field.

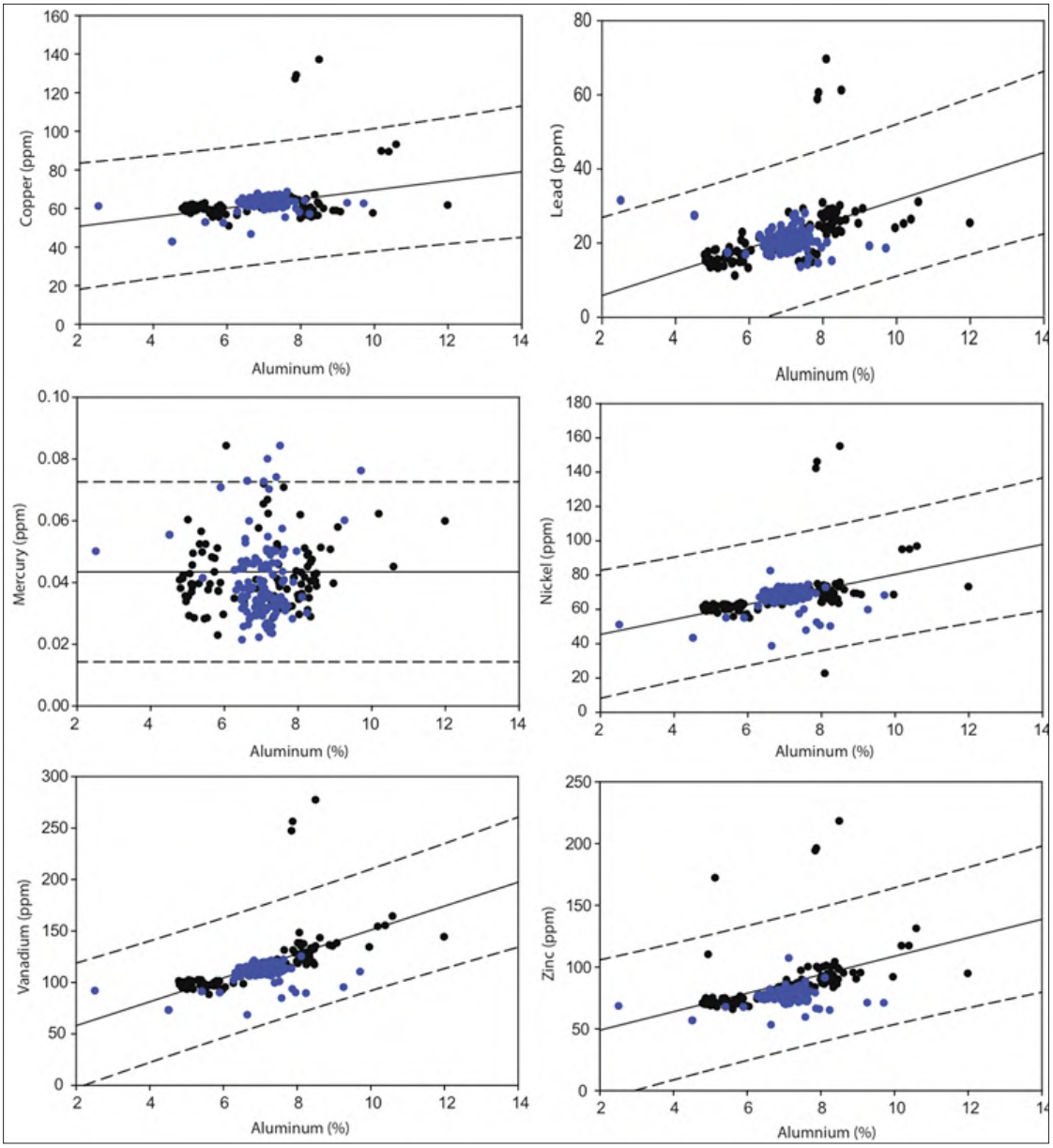

Figure 42. Plot of aluminum versus copper, lead, mercury, nickel, vanadium, and zinc. Regression line (solid) and 99% prediction interval (dashed) based on Levantine Basin data collected during pre-drill and environmental baseline surveys conducted by CSA prior to September 2013 (black dots). Blue dots represent data from the Tamar Field.

Table 27. Mean (± standard deviation) total metals concentrations (ppm) in sediments collected from within the Tamar Field and along the Tamar pipeline corridor. Metals concentrations in seafloor sediments of the Levantine Basin (pre-drill and environmental baseline surveys conducted prior to September 2013), effects range low (ERL) and effects range median (ERM) values (Buchman, 2008), and metals concentrations found in drilling muds and barite used at Tamar SW-1 are provided for comparison. Antimony, selenium, and silver concentrations were generally below primary analytical laboratory detection limits and are not presented in the table.

Location	As	Ba	Be	Cd	Cr	Cu	Hg	Ni	Pb	Tl	V	Zn
Tamar Field Average	18.3 ± 1.4	249.4 ± 263.2	1.2 ± 0.1	0.18 ± 0.11	67.7 ± 4.5	62.5 ± 3.4	0.04 ± 0.01	67.1 ± 6.2	20.5 ± 2.9	0.5 ± 0.2	110.4 ± 8.8	76.4 ± 6.2
Tamar Pipeline (1,400 - 1,700 m)	13.1 ± 0.8	95.3 ± 2.4	1.0 ± 0.1	0.48 ± 0.04	61.2 ± 2.3	49.7 ± 1.01	0.06 ± 0.04	47.7 ± 1.3	13.0 ± 1.7	N/A	93.3 ± 3.8	60.9 ± 4.1
Tamar Pipeline (900 - 1,400 m)	11.9 ± 0.9	105.4 ± 7.2	1.1 ± 0.1	0.54 ± 0.05	64.1 ± 0.9	46.8± 0.6	0.04 ± 0.01	48.3 ± 0.2	12.9 ± 2.6	N/A	99.0 ± 3.7	65.9 ± 1.4
Tamar Pipeline (300 – 900 m)	26.6 ± 6.7	203.5 ± 43.4	1.2 ± 0.1	0.73 ± 0.06	80.4 ± 13.0	48.8 ± 5.0	0.09 ± 0.05	51.3 ± 8.4	27.5 ± 10.2	N/A	97.0 ± 16.3	65.9 ± 9.7
Tamar Pipeline (200 – 300 m)	18.2 ± 4.6	177.0 ± 24.8	1.2 ± 0.1	0.79 ± 0.05	93.0 ± 8.4	45.2 ± 4.1	0.12 ± 0.05	53.9 ± 4.8	10.4 ± 1.4	N/A	130.9 ± 16.5	74.3 ± 5.7
Tamar Pipeline (20 – 200 m)	15.0 ± 72	199.9 ± 51.1	0.8 ± 0.3	0.53 ± 0.17	70.1 ± 33.8	30.4 ± 13.1	0.03 ± 0.03	39.8 ± 16.2	7.5 ± 8.1	N/A	99.9 ± 34.6	59.6 ± 22.9
Levantine Basin Average	19.2 ± 3.4	172.0 ± 29.9	1.2 ± 0.5	0.15 ± 0.15	64.8 ± 23.8	62.1 ± 13.5	0.04 ± 0.01	67.3 ± 16.7	22.3 ± 10.6	0.4 ± 0.2	118.9 ± 31.9	88.2 ± 26.6
99% Confidence Limit of Levantine Basin Average	29.2	249.2	2.5	N/A	126.1	97.0	0.06	110.4	49.6	0.9	201.2	156.8
ERL	8.2	N/A	N/A	1.2	81.0	34.0	0.2	20.9	46.7	N/A	N/A	150.0
ERM	70.0	N/A	N/A	9.6	370.0	270.0	0.7	51.6	218.0	N/A	N/A	410.0
Drilling Mud	4 ± 2.3	1,076.0 ± 396.3	1.0 ± 1.1	1.0 ± 1.1	4.0 ± 3.1	8.0 ± 2.1	0.001 ± 0.001	2.0 ± 1.9	162.0 ± 46.3	N/A	3.0 ± 2.5	15.0 ± 6.1
Barite	20.0	N/A	N/A	1.6 ± 0.6	8.0	121.0	N/A	7.0	165.0	N/A	N/A	109.0

As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Hg = mercury; N/A = data not available; Ni = nickel; Pb = lead; Tl = thallium; V = vanadium; Zn = zinc.

Tamar Pipeline Corridor

Metals concentrations along the Tamar pipeline corridor were within the 99% CL of the Levantine Basin average, with the exception of mercury (**Table 27**). Mercury concentrations along the pipeline in water depths between 200 and 300 m (0.09 ± 0.05 ppm) and between 300 and 900 m (0.12 ± 0.05 ppm) were slightly elevated; however, these values did not exceed the ERL (0.2 ppm) and ERM (0.7) values for mercury at these locations, and therefore were not present in concentrations of concern at these locations.

As done for the Tamar Field, normalization of metals concentrations with sediment grain size were achieved by performing a regression of each metal against aluminum. The data show that metals concentrations along the Tamar pipeline corridor generally were within the 99% prediction interval of the Levantine Basin (**Figures 43** and **44**). Figures for antimony, selenium, silver, and thallium are not shown because concentrations were frequently below the laboratory's detection limit. Concentrations of aluminum and other trace metals concentrations appear to vary naturally in ambient seafloor sediments, primarily due to differences in sediment grain sizes.

Similarities in Metals Concentrations

Sediment metals concentrations were generally uniform throughout the Tamar Field and Tamar pipeline corridor (**Table 27**). Sediment arsenic, copper, and nickel concentrations within the broad region of the survey area exceed the ERL (and ERM in the case of nickel) values for these metals. This finding indicates that seafloor sediments of the Levantine Basin are naturally high, and these metals and should be considered ambient. Nickel concentrations in global average marine sediments (52.0 ppm) also exceeds the established ERM (51.6 ppm) value (Salomons and Förstner, 1984).

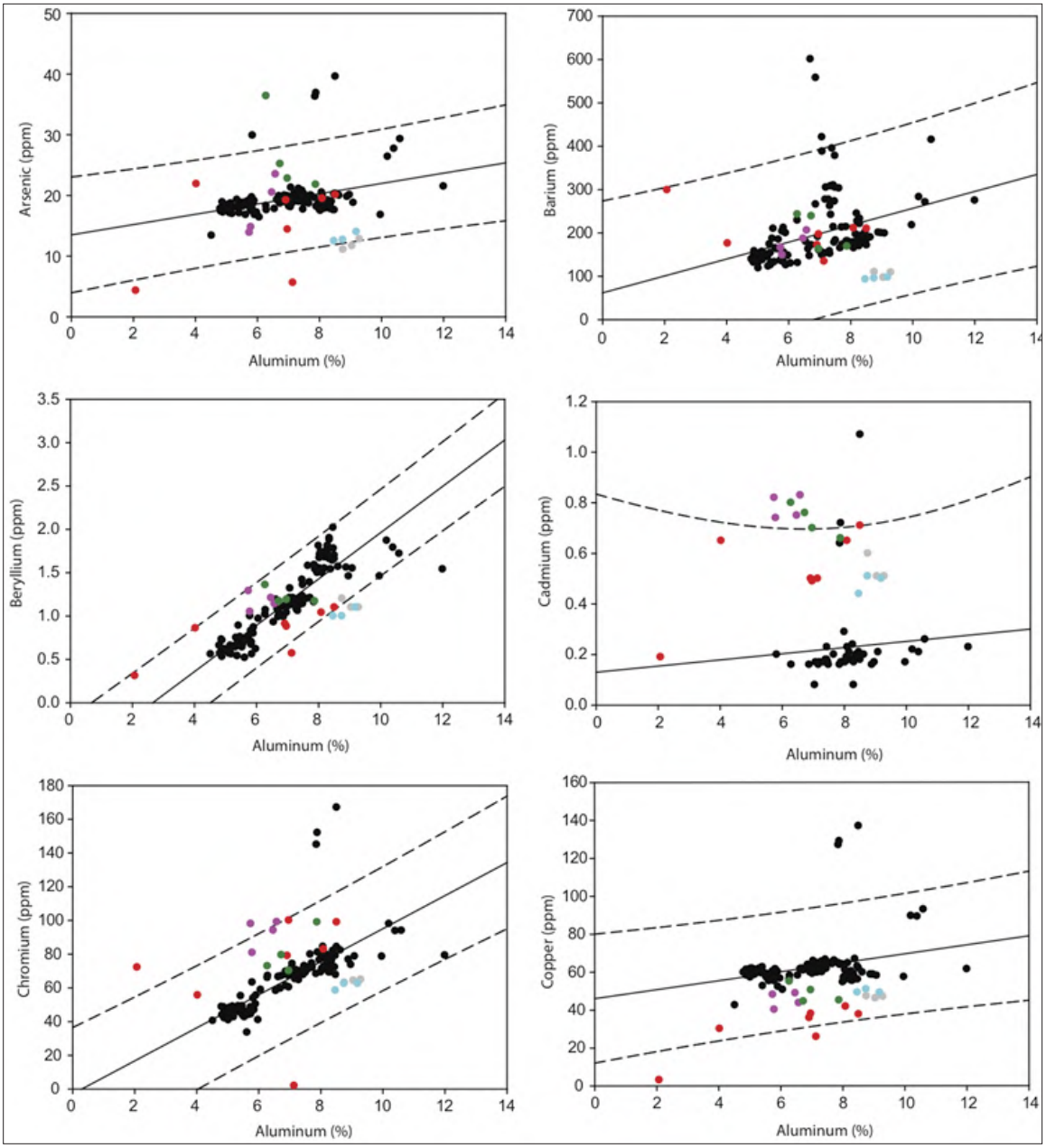

Figure 43. Plot of aluminum versus arsenic, barium, beryllium, cadmium, chromium, and copper concentrations along the Tamar pipeline corridor. Regression line (solid) and 99% prediction interval (dashed) based on Levantine Basin data collected on pre-drill and environmental baseline surveys conducted by CSA prior to September 2013 (black dots). Red = 20 to 200 m; pink = 200 to 300 m; green = 300 to 900 m; gray = 900 to 1,400 m; cyan = 1,400 to 1,700 m.

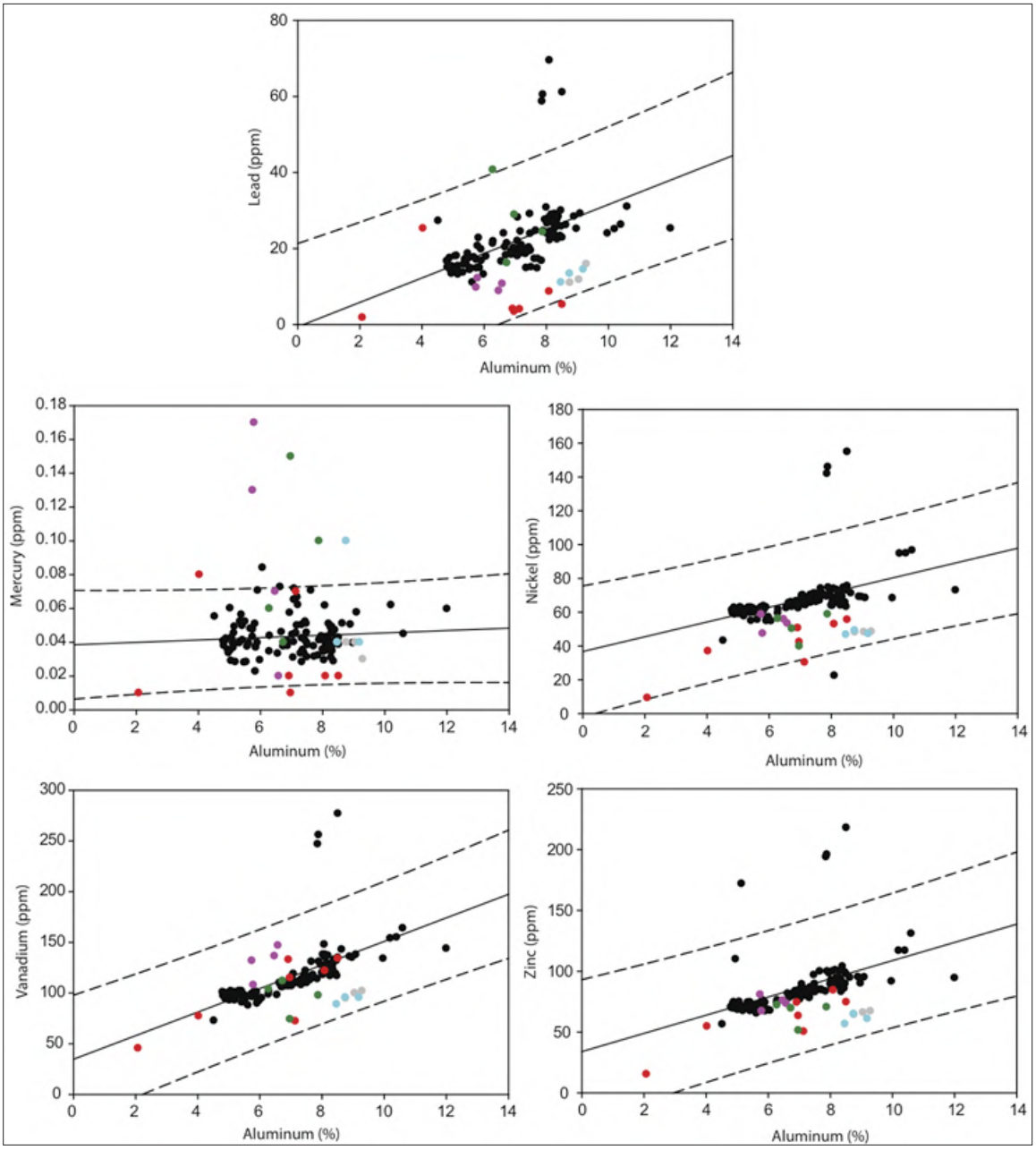

Figure 44. Plot of aluminum versus arsenic, barium, beryllium, cadmium, chromium, and copper concentrations along the Tamar pipeline corridor. Regression line (solid) and 99% prediction interval (dashed) based on Levantine Basin data collected on pre-drill and environmental baseline surveys conducted by CSA prior to September 2013 (black dots). Red = 20 to 200 m; pink = 200 to 300 m; green = 300 to 900 m; gray = 900 to 1,400 m; cyan = 1,400 to 1,700 m.

Hydrocarbons

Tamar Field

Tabulated values and analytical result for individual grid cell and pipeline station sediment hydrocarbon concentrations are provided in **Appendix Q**. TPH concentrations throughout the survey area were generally within the 99% CL of the Tamar Field average (**Figure 45**) and the Levantine Basin average (**Figure 46**), with the exception of grid cells surrounding the Tamar-1/Tamar-6 and Tamar SW-1 wellsites. The approximate distance from the center point of affected grid cells D09, F08, and G08 to the Tamar-6 wellsite is 1.55 km; while the approximate distance of affected grid cells D20 and E20 to the Tamar SW-1 wellsite is 1 km (**Appendix C**). Hydrocarbons were a minor component of the mud used to drill the Tamar wellsites, and slightly elevated levels of TPH at these locations may be indicative of minor impacts due to drilling and production activities. TPH concentrations throughout the field, even in the slightly elevated grid cells, are low and are at concentrations that do not pose a threat to the environment.

Hydrocarbons were analyzed further to determine concentrations of the 16 USEPA priority PAHs. All individual PAH concentrations were below the Levantine Basin average (**Figure 47**). Total PAH concentrations (less than 60 ppb) were within the 99% CL of the Tamar Field average (**Figure 48**) and were below the Levantine Basin average (77.5 ± 19 ppb) and well below ERL (4,022 ppb) and ERM (44,702 ppb) values for total PAHs in marine sediment.

The Fossil Fuel Pollution Index (FFPI) was calculated to determine the percentage of fossil fuel PAHs relative to total PAHs (Boehm and Farrington, 1984). The FFPI is based on the knowledge that combustion-derived (pyrogenic) PAH assemblages are enriched in three- to five-ringed PAH compounds while fossil fuels (petrogenic) are enriched in polynuclear organosulfur compounds (e.g., dibenzothiophene) and two- to three-ringed PAH assemblages (Steinhauer and Boehm, 1992). The FFPI is calculated by the following equation (Boehm and Farrington, 1984):

$$\frac{\left[\Sigma\, naphthalenes(C_o - C_4) + \Sigma\, dibenzothiophenes(C_o - C_3) + \frac{1}{2}\Sigma\, phenanthrenes(C_o - C_1) + \; + \Sigma\, phenanthrenes(C_2 - C_4)\right]}{\Sigma\, PAH}$$

An FFPI ratio of 0 to 0.25 indicates PAH assemblages dominated by pyrogenic sources, a ratio of approximately 0.25 to 0.49 is indicative of intermediate PAH assemblages containing a mix of pyrogenic and petrogenic sources, and a ratio of 0.5 to 1.0 is indicative of PAH assemblages dominated by petrogenic sources (Boehm and Farrington, 1984).

The FFPI ratio for sediments throughout the Tamar Field are classified as either having pyrogenic or pyrogenic/petrogenic sources (**Figure 49**). Most of the sediments classified as having a mixture of pyrogenic/petrogenic sources are far from the wellsites and none directly surround any wellsite.

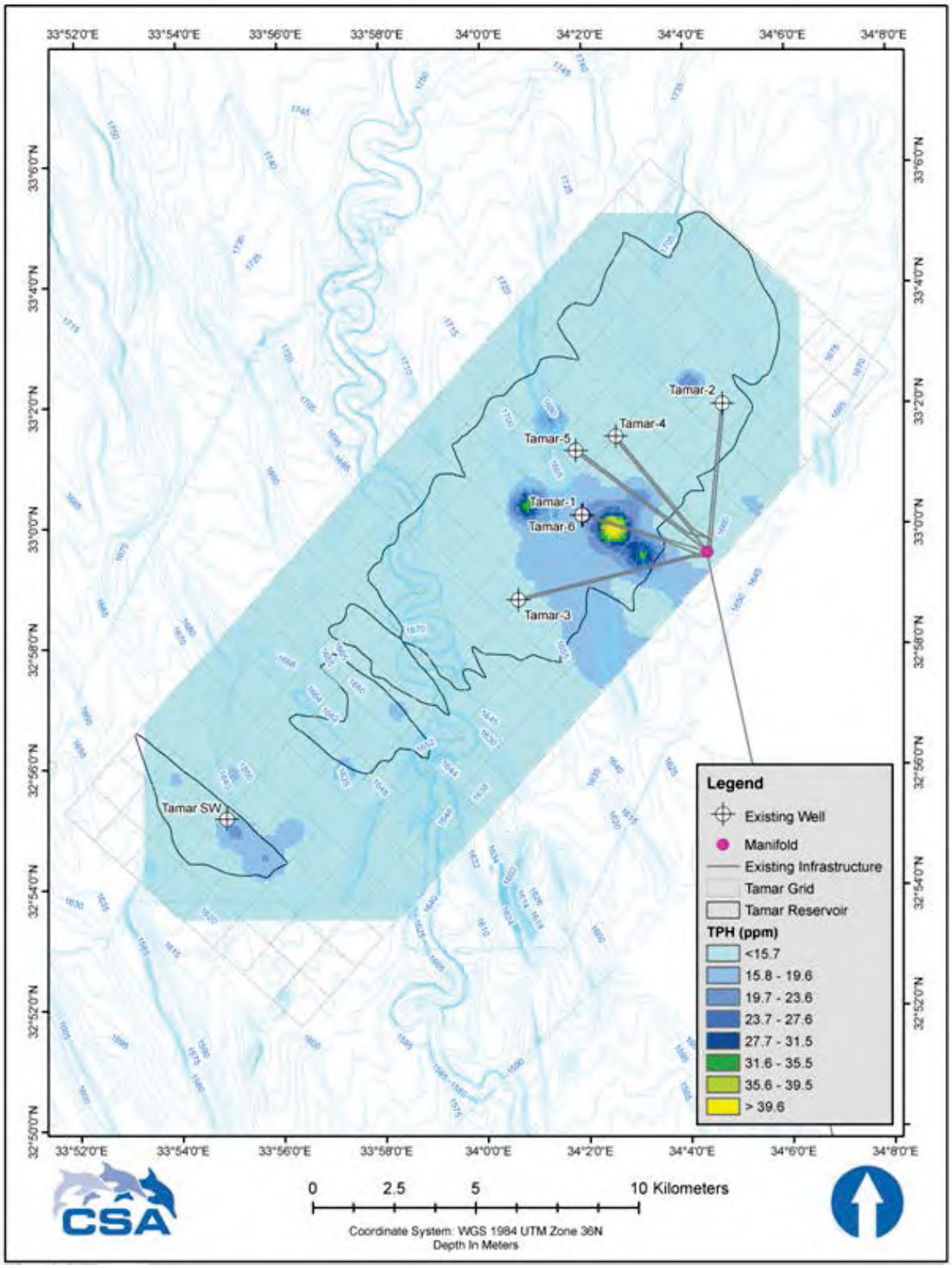

Figure 45. High-resolution sediment total petroleum hydrocarbons (TPH) concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean.

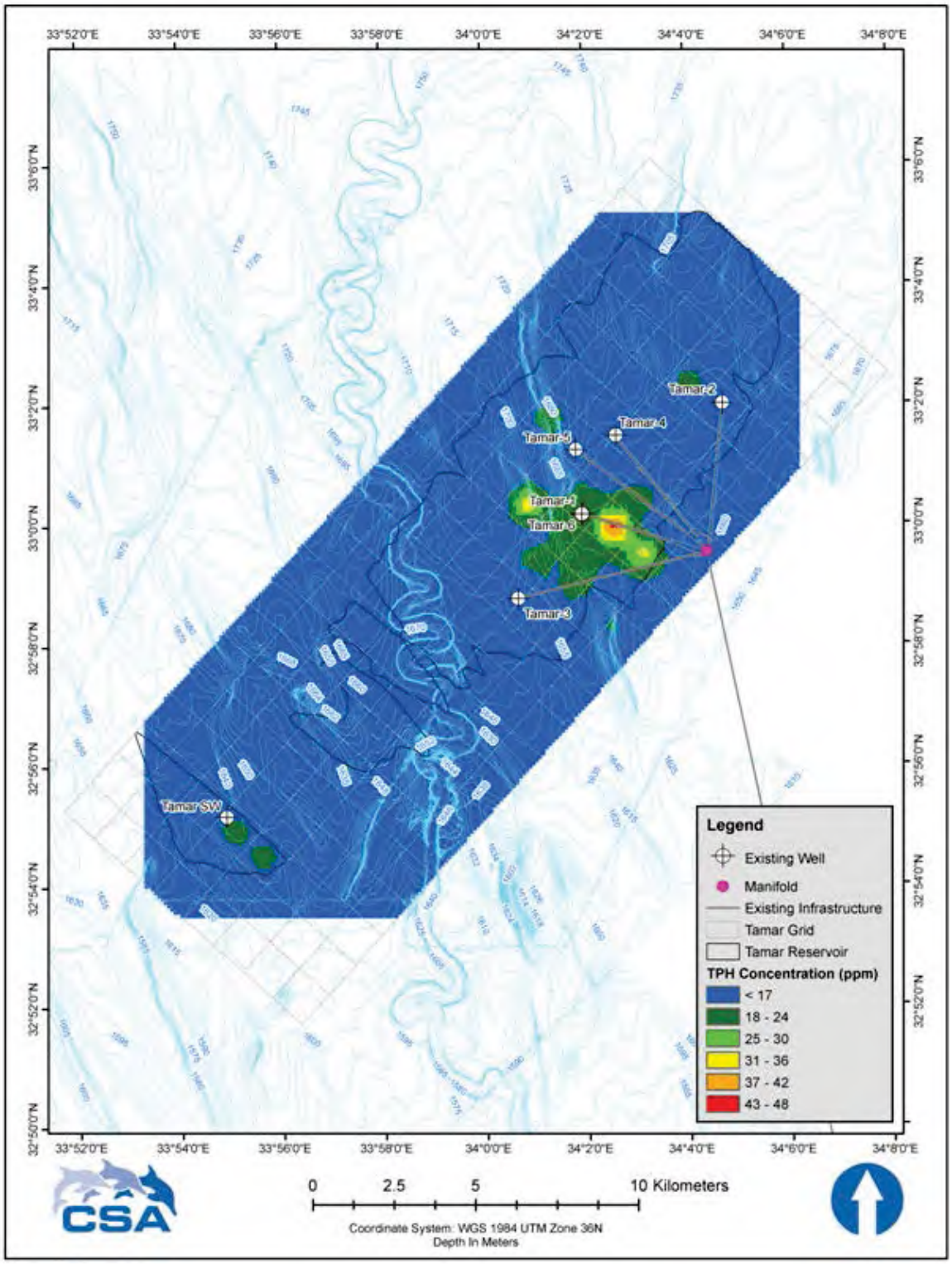

Figure 46. Sediment total petroleum hydrocarbons (TPH) concentrations within the Tamar Field in comparison to the Levantine Basin average. Blue represents values that are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Levantine Basin average. Other colors represent elevated levels of TPH in 6 ppm increments. Levantine Basin averages are calculated from pre-drill and environmental baseline surveys conducted by CSA prior to September 2013.

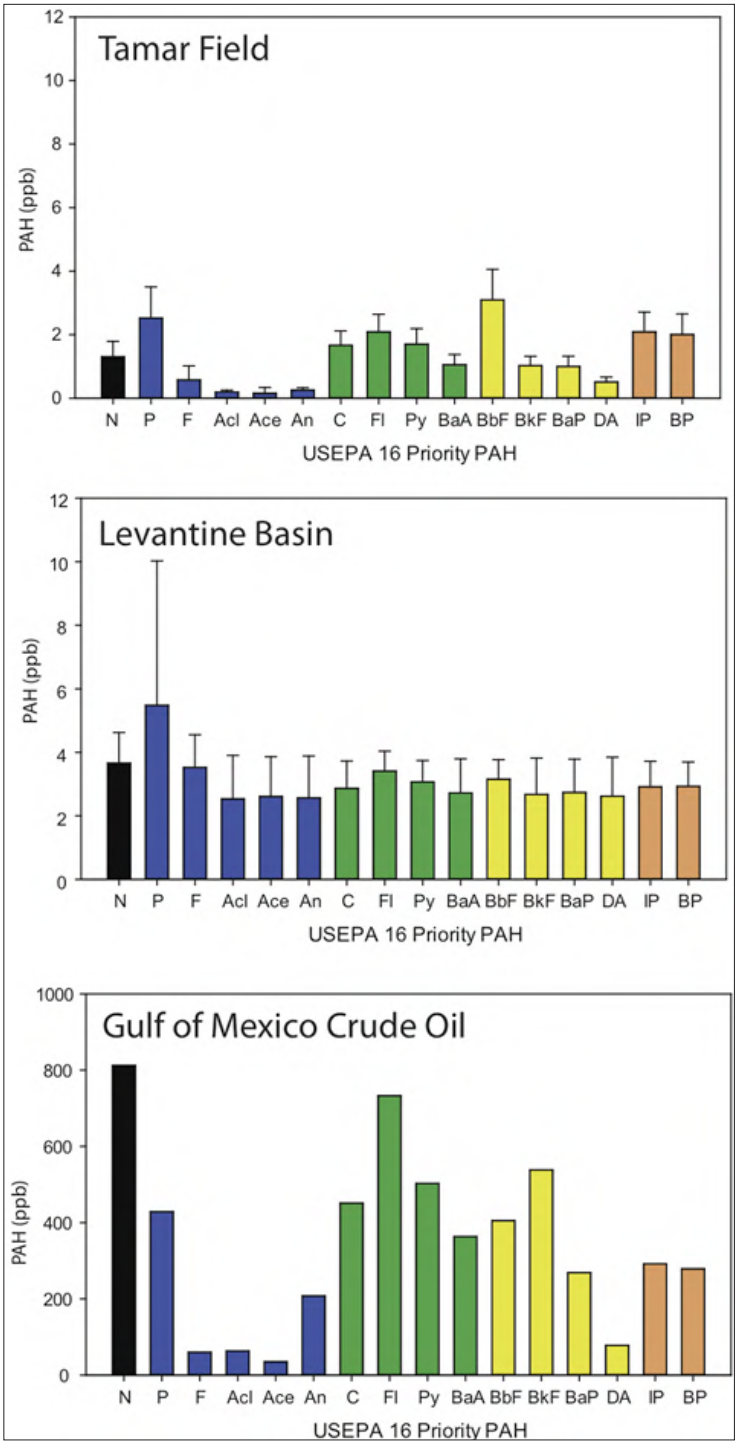

Figure 47. Average (+ standard deviation) concentrations for the 16 U.S. Environmental Protection Agency (USEPA) priority polycyclic aromatic hydrocarbons (PAHs) for sediment samples collected in the Tamar Field (top). For comparative purposes, PAH signatures for the Levantine Basin Average and Gulf of Mexico Crude Oil (SRM2779) are also shown (note scale change). Black = 2 rings (naphthalene); blue = 3 rings (phenanthrene, fluorene, acenaphthylene, acenaphthene, anthracene); green = 4 rings (chrysene, fluoranthracene, pyrene, benzo[a]anthracene); yellow = 5 rings (benzo[b]fluoranthene, benzo[k,j]fluoranthene, benzo[a]pyrene, and diben[a,h]anthracene); orange = 6 rings (ideno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).

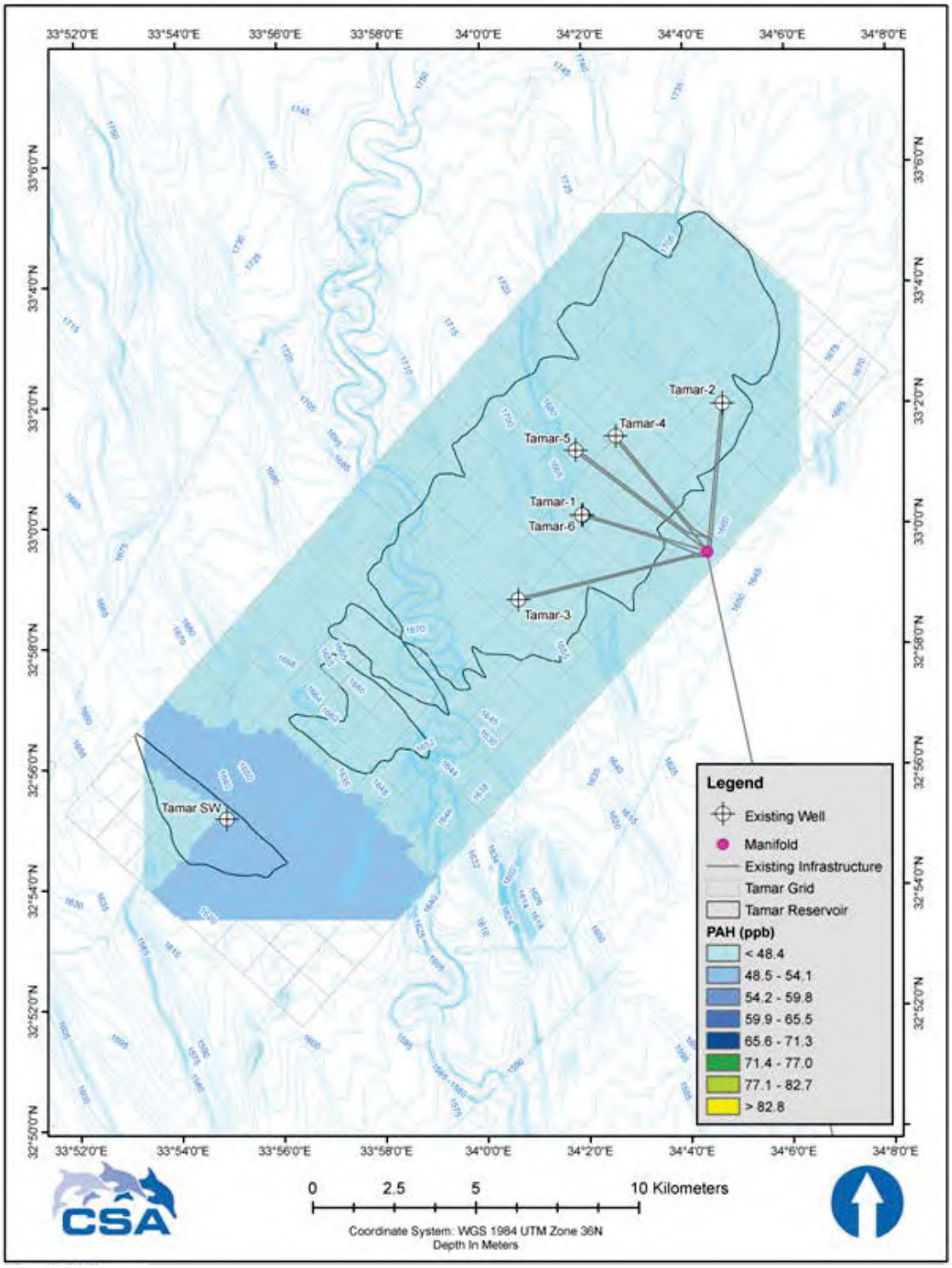

Figure 48. High-resolution sediment total polycyclic aromatic hydrocarbon (PAH) concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

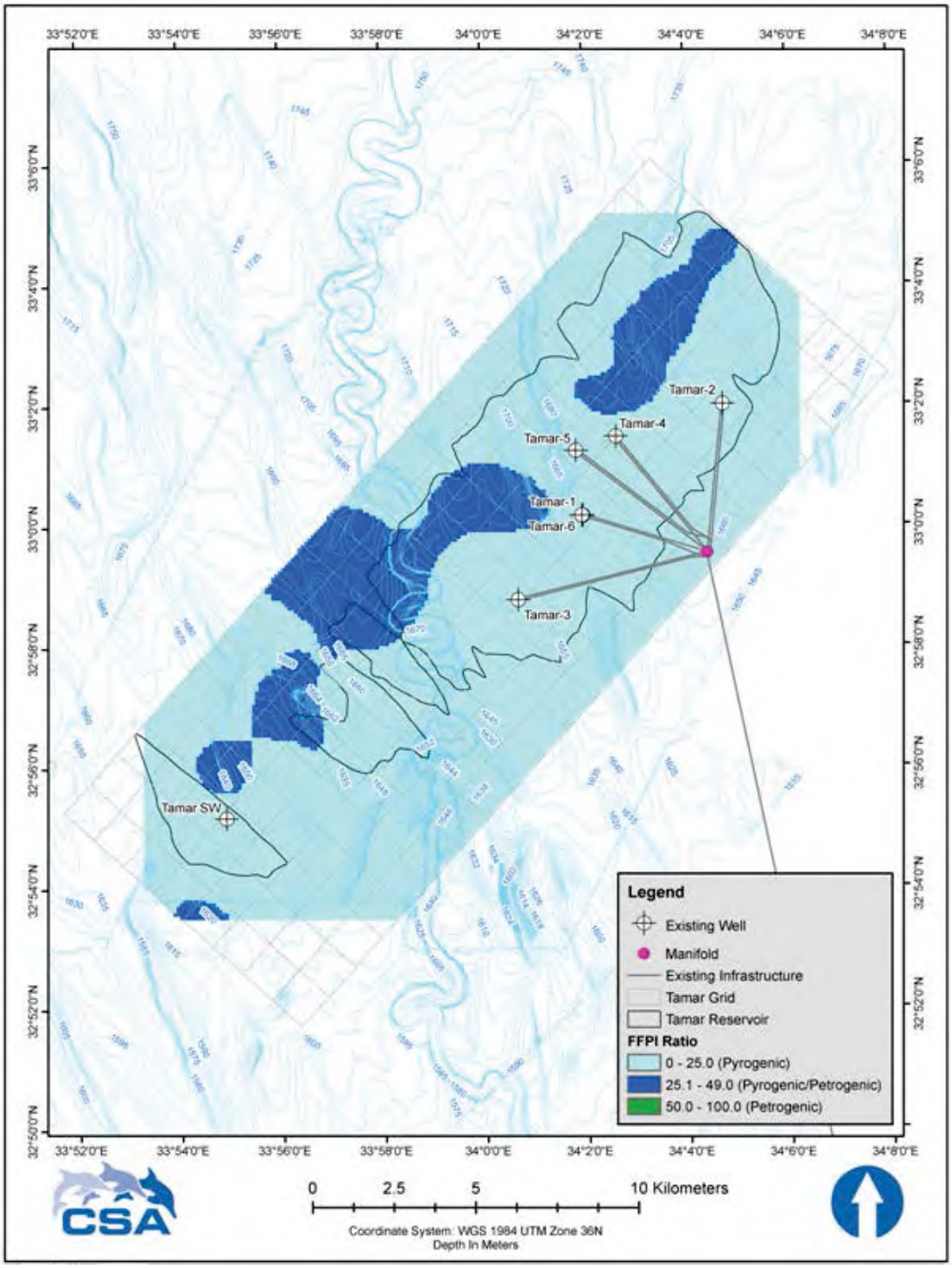

Figure 49. Calculated Fossil Fuel Pollution Index (FFPI) ratios within the Tamar Field. Light blue represents an FFPI ratio of 25%, which indicates a polycyclic aromatic hydrocarbon (PAH) assemblage dominated by pyrogenic sources. Dark blue represents an FFPI ratio between 25% and 40%, which is indicative of a mixture of pyrogenic and petrogenic sources. Green represents an FFPI ratio between 40% and 100% which indicates a PAH assemblage dominated by petrogenic sources. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

Tamar Pipeline Corridor

TPH concentrations in sediments increased with decreasing distance to the Israeli shoreline. Concentrations in sediments collected from water depths greater than 300 m generally were within the 99% CL of the Levantine Basin average, while concentrations from sediments collected from water depths less than 300 m were greater than the 99% CL (**Figure 50**). All concentrations, even when slightly elevated, are low and at concentrations that do not pose a threat to the environment.

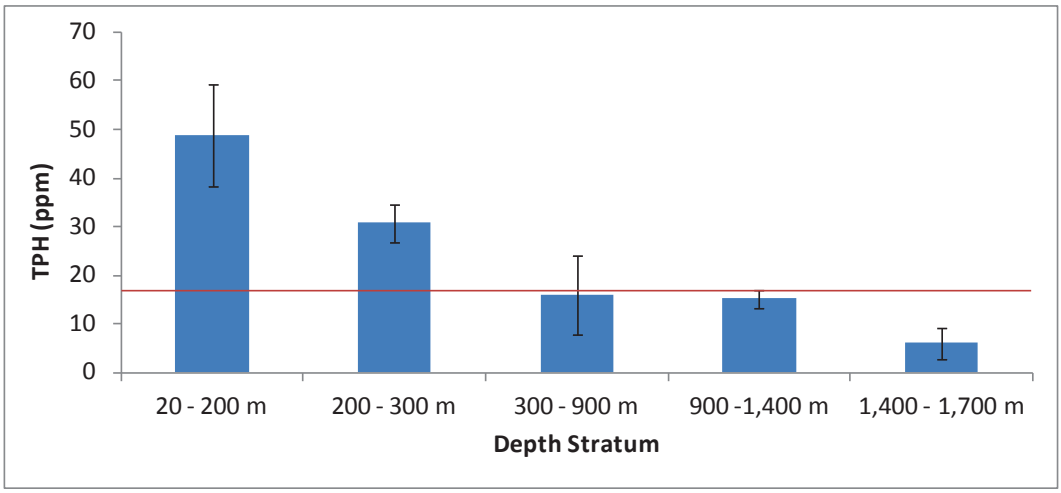

Figure 50. Average (± standard deviation) sediment total petroleum hydrocarbons (TPH) concentrations at stations located along the Tamar pipeline corridor. The red line represents the TPH concentration 99% confidence limit of the Levantine Basin average.

Concentrations of total PAHs in water depths less than 300 m generally were above the 99% CL of the Levantine Basin average (**Figure 51**); however, they were well below the corresponding ERL (4,022 ppb) and ERM (44,702 ppb) values. Hydrocarbons were analyzed further to determine concentrations of the 16 USEPA priority PAHs. Concentrations of individual PAHs were low throughout the survey area but were relatively higher in water depths between 20 and 200 m (**Figure 52**).

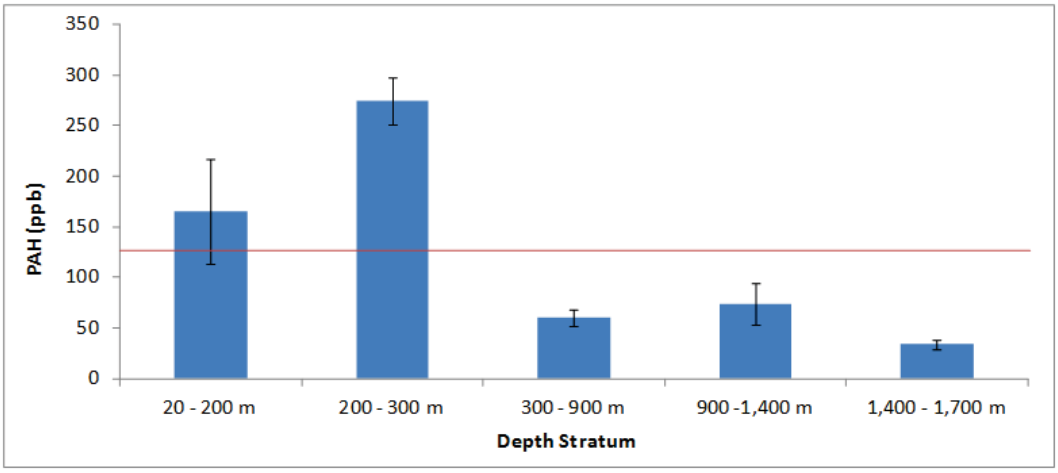

Figure 51. Average (± standard deviation) sediment total polycyclic aromatic hydrocarbon (PAH) concentrations at stations located along the Tamar pipeline corridor. The red line represents the total PAH concentration 99% confidence limit of the Levantine Basin average.

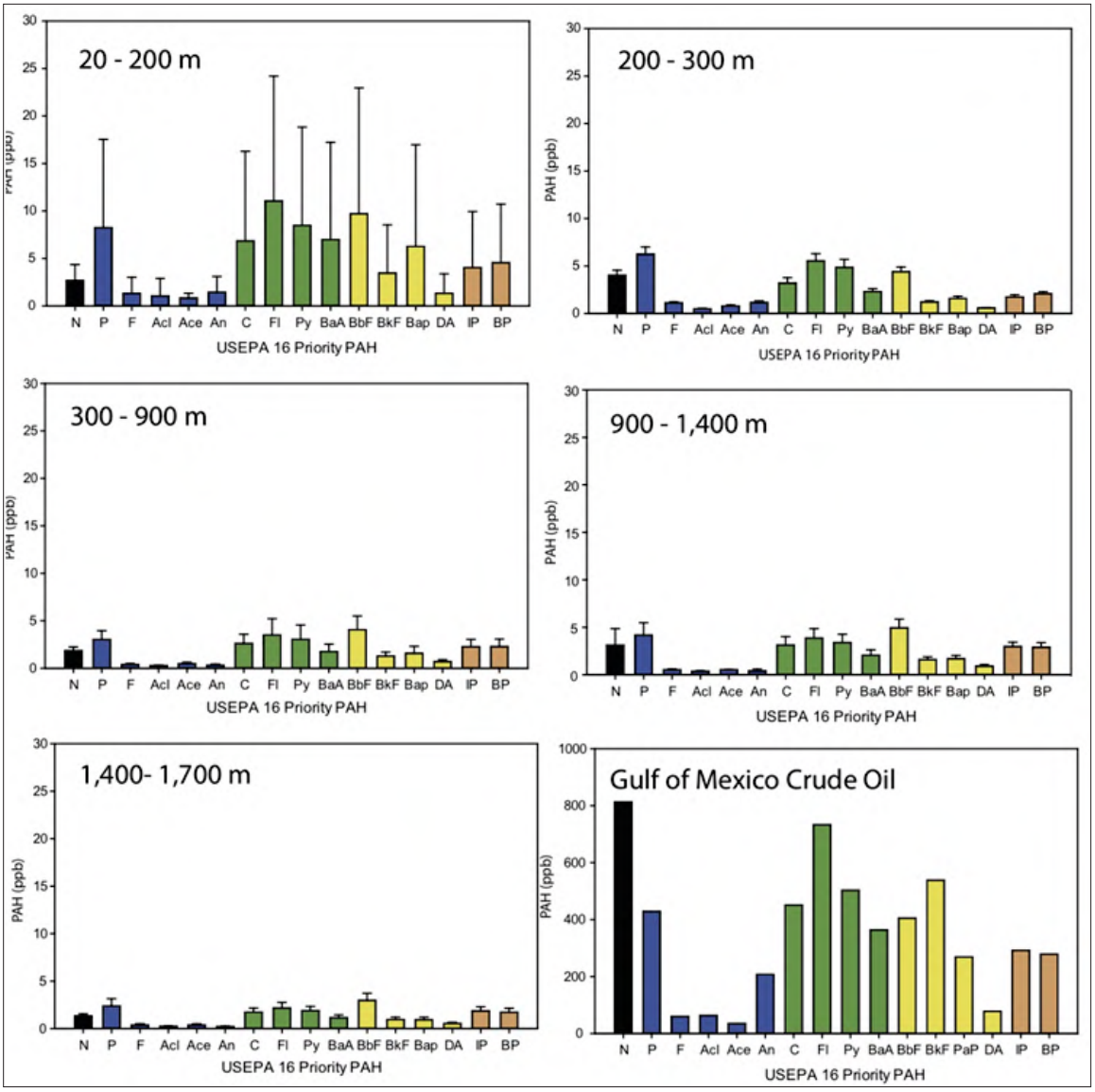

Figure 52. Average (+ standard deviation) concentrations for the 16 U.S. Environmental Protection Agency (USEPA) priority polycyclic aromatic hydrocarbons (PAHs) for sediment samples collected along the Tamar pipeline corridor. For comparative purposes, PAH signatures for Gulf of Mexico Crude Oil (SRM2779) are also shown (note scale change). Black = 2 rings (naphthalene); blue = 3 rings (phenanthrene, fluorene, acenaphthylene, acenaphthene, anthracene); green = 4 rings (chrysene, fluoranthracene, pyrene, benzo[a]anthracene); yellow = 5 rings (benzo[b]fluoranthene, benzo[k,j]fluoranthene, benzo[a]pyrene, and diben[a,h]anthracene); orange = 6 rings (ideno[1,2,3-cd]pyrene, benzo[g,h,i]perylene).

The FFPI ratio for sediments along the Tamar pipeline corridor are classified as either having pyrogenic or pyrogenic/petrogenic sources (**Figure 53**), with the highest value being 43% in a water depth between 200 and 300 m. The major features along this region of the pipeline are the Mari-B and Tamar Platforms. Because of the aggregation of activities around the platforms, there is a greater chance for minor petrogenic contamination of sediments occurring from non-point sources (i.e., vessel traffic). While the FFPI ratio at this location is high compared to the rest of the pipeline corridor, the PAH concentration signature of sediments at this location is orders of magnitude lower than that of actual oil (**Figure 52**), indicating that any actual contamination of sediments at this location is extremely minimal.

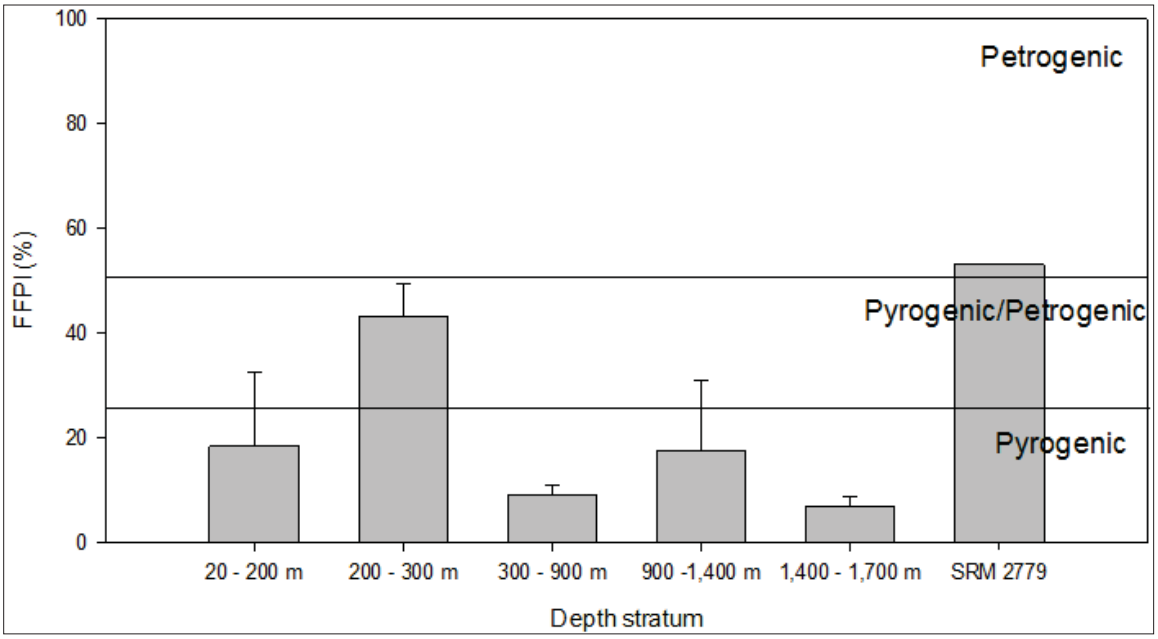

Figure 53. Calculated Fossil Fuel Pollution Index (FFPI) ratios from along the Tamar pipeline corridor. Gulf of Mexico crude oil (SRM 2779) is shown for comparative purposes.

Similarities in Hydrocarbon Concentrations

Studies done in the Arabian Gulf have shown ambient background TPH concentrations of 10 to 15 ppm (Massoud et al., 1996; Tehrani et al., 2012), which are similar to those of the eastern Levantine Basin. These studies have characterized TPH concentrations between 15 and 50 ppm as "slightly polluted" and concentrations greater than 200 ppm as "heavily polluted." Using this classification as a guide, TPH concentrations within the Tamar Field and along the pipeline corridor were primarily considered ambient with a few locations near existing infrastructure being classified as slightly polluted. There are no official established toxicity thresholds for TPH concentrations.

PAH concentrations within the field and reservoir and along the pipeline corridor were also extremely low and well below ERL and ERM concentrations of concern, even in close proximity to the Mari-B and Tamar Platforms (200 to 300 m water depths). Signatures of the 16 USEPA priority PAH were also similar among locations as well as several orders of magnitude below that of the standard reference material for crude oil. These finding show that hydrocarbon concentrations within the Tamar Field and along the pipeline corridor are low and do not indicate any source of environmental concern.

Radionuclides

Ambient radium concentrations in most natural soils and rocks are approximately 0.5 to 5.0 pCi/g of total radium (U.S. Geological Survey, 1999). Ambient concentrations of Th 228 in sediments range from 0.36 to 1.93 pCi/g (Agency for Toxic Substances and Disease Registry, 1990). The USEPA (1998) established a protective health-based level for radium and thorium of 5 pCi/g at the sediment surface as a threshold for the cleanup of the top 15 cm of soil from contaminated U.S. Superfund sites.

All radionuclide concentrations within the Tamar Field are considered natural ambient concentrations (Agency for Toxic Substances and Disease Registry, 1990; U.S. Geological Survey, 1999) and are below levels of concern as outlined by the USEPA (1998) protective health-based level recommendations. High-resolution variations of sediment Ra 226 and Ra 228 as well as Th 228 concentrations are shown in **Figures 54** to **56**. All values are within the 99% CL for radionuclide concentrations within the Levantine Basin. Radionuclide samples were not collected along the pipeline corridor. Tabulated values and analytical results for individual grid cell and pipeline station sediment radionuclide concentrations are provided in **Appendix R.**

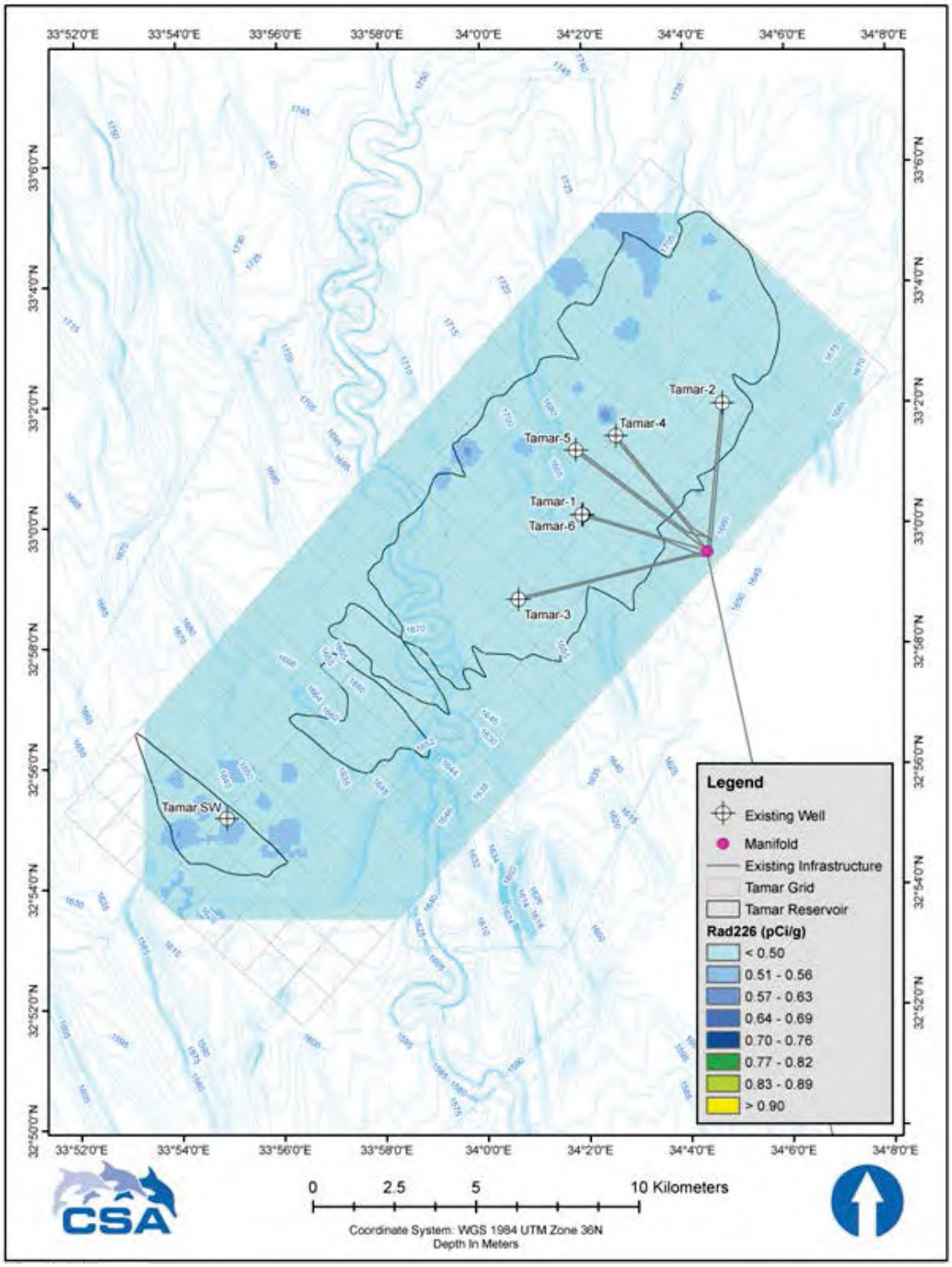

Figure 54. High-resolution sediment radium 226 concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

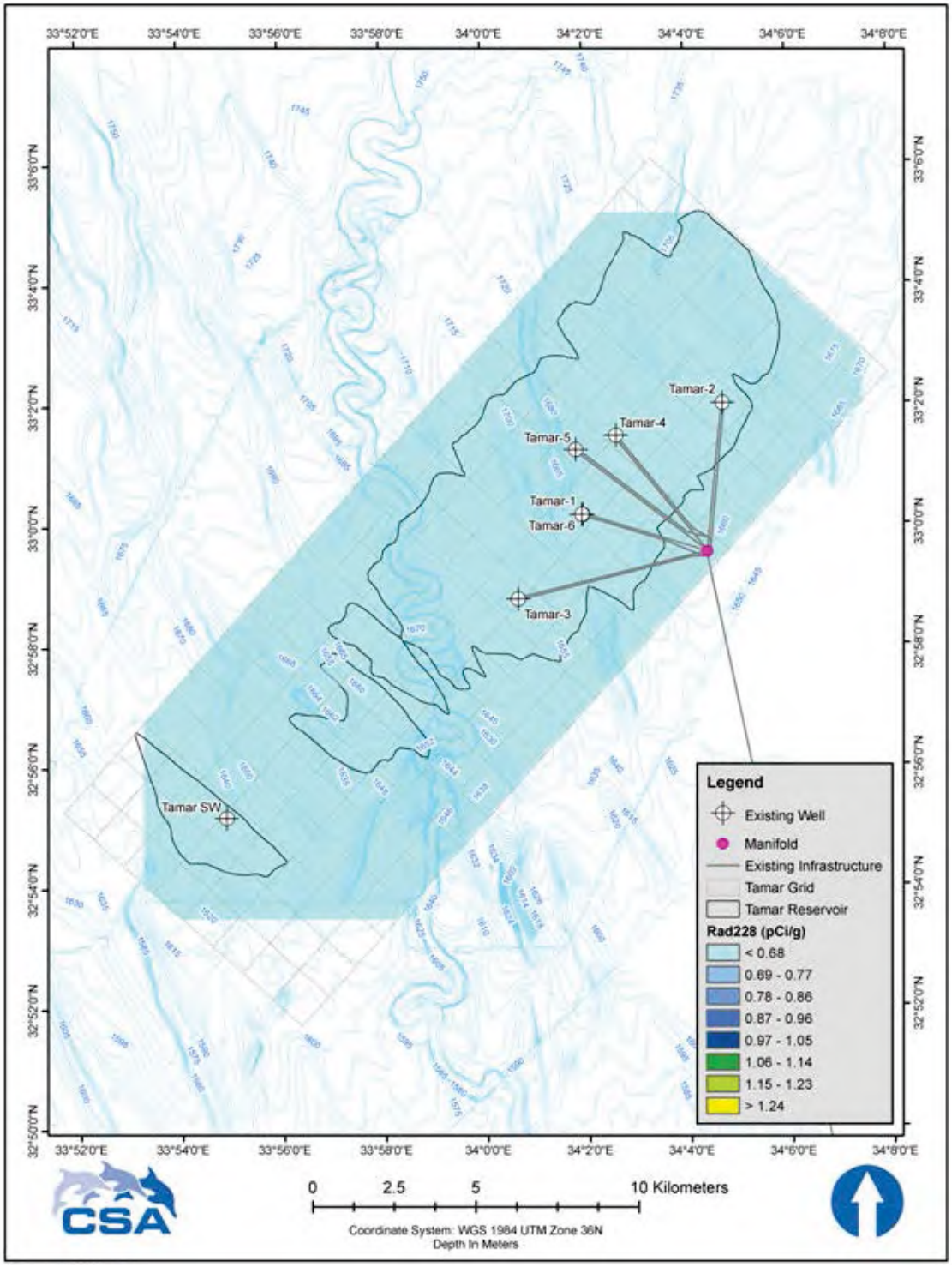

Figure 55. High-resolution sediment radium 228 concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

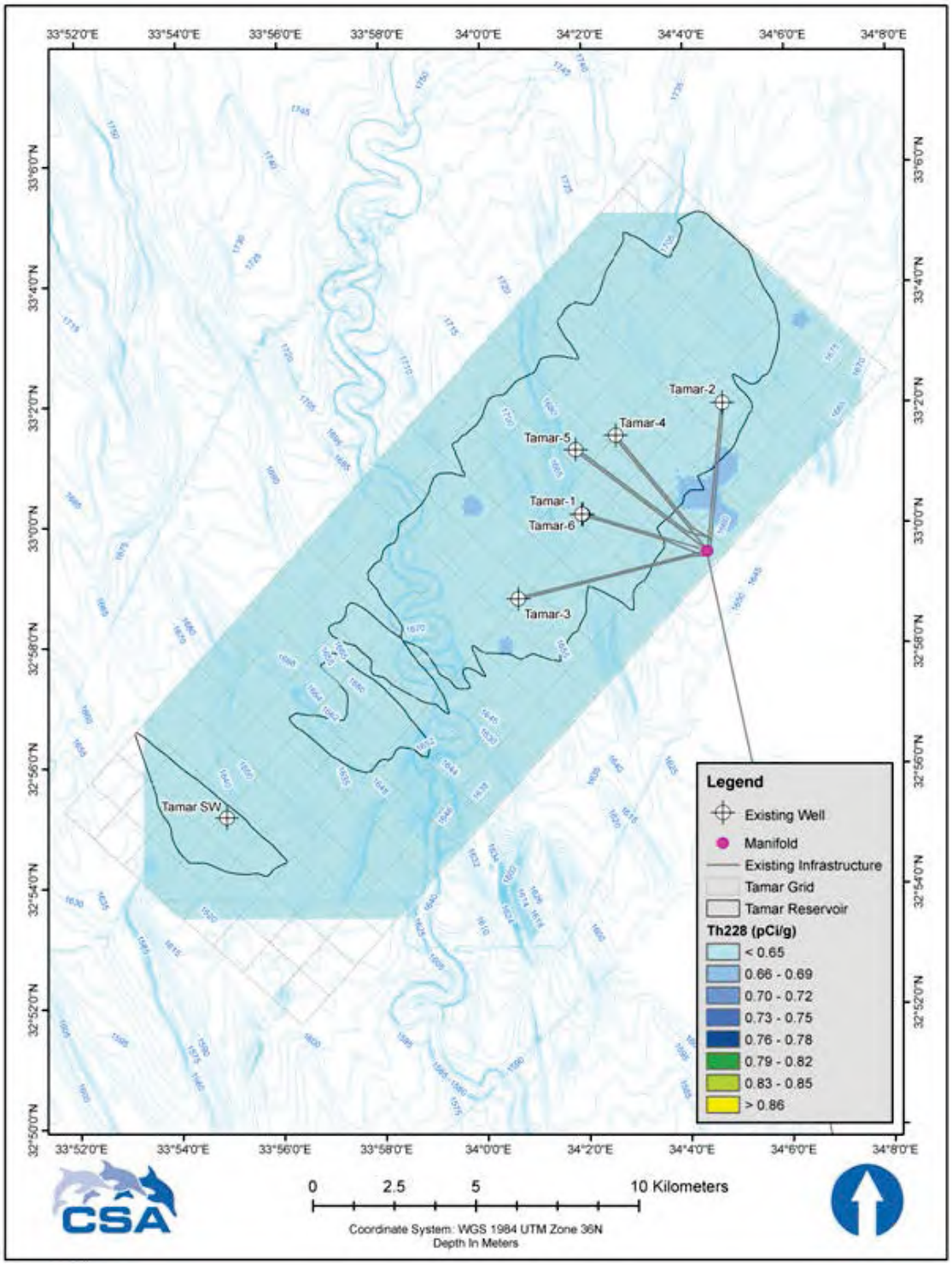

Figure 56. High-resolution sediment thorium 228 concentrations within the Tamar Field. Concentrations represented by shades of blue are within the 99% confidence limit (less than 2.5 standard deviations [SD]) of the Tamar Field mean. Dark green represents values that are 2.5 to 3.0 SD from the mean. Light green represents values that are 3.0 to 3.5 SD from the mean. Yellow represents values that are greater than 3.5 SD from the mean. Map color scales are standardized to show the possible range of concentrations over the established SD scale; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

5.5 INFAUNA

5.5.1 Tamar Field

Analytical laboratory data sheets for infauna are provided in **Appendix S**. Within the Tamar Field, 667 individuals were collected. The taxonomic listing of infauna within the Tamar Field is provided in **Table 28**. Infaunal abundance within the Tamar Field was patchy and ranged from 25 to 125 individuals per m^2 (**Figure 57**). The dominant taxa within the field were annelid worms (**Figure 58**) and were primarily composed of *Notomastus* sp. (**Image 13**), which accounted for 31% of the total organisms collected (**Table 28**). Crustaceans were abundant (25 to 50 individuals per m^2) within the northeastern portion of the field (**Figure 59**). Mollusks and other various phyla were not abundant within the field (**Figures 60** and **61**; **Table 28**).

Species richness throughout the field was low ranging from 1 to 10 species for most samples (**Figure 62**). Given the low species richness, it is not surprising that Pielou's evenness was high (**Figure 63**) and species diversity was moderate (**Figure 64**) throughout the region. There is no apparent pattern to organism abundance, composition, or diversity with existing infrastructure within the field.

Image 13. Specimen of the polychaetous annelids *Notomastus* sp.

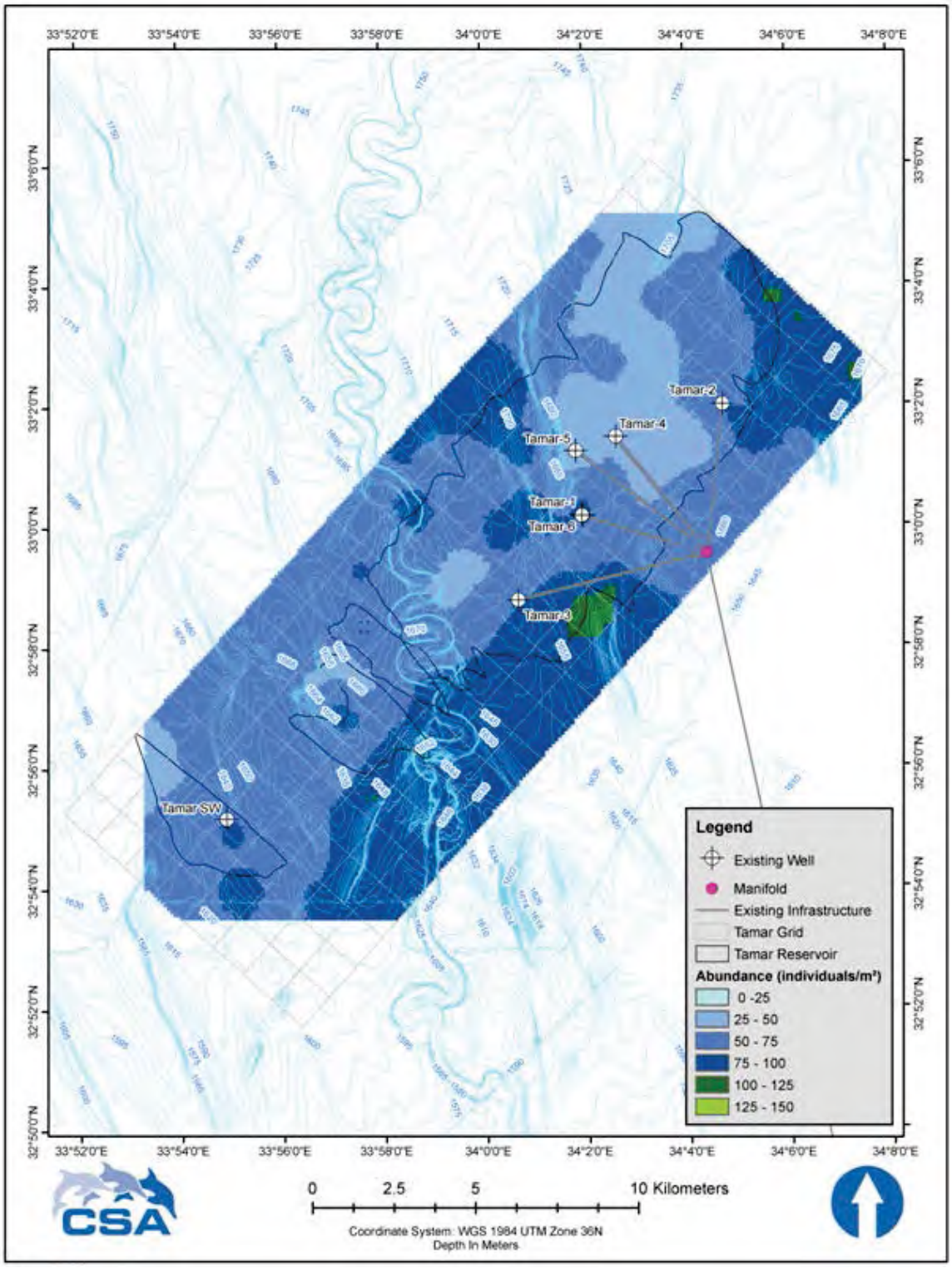

Figure 57. Abundance (individuals/m^2) of infauna organisms within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

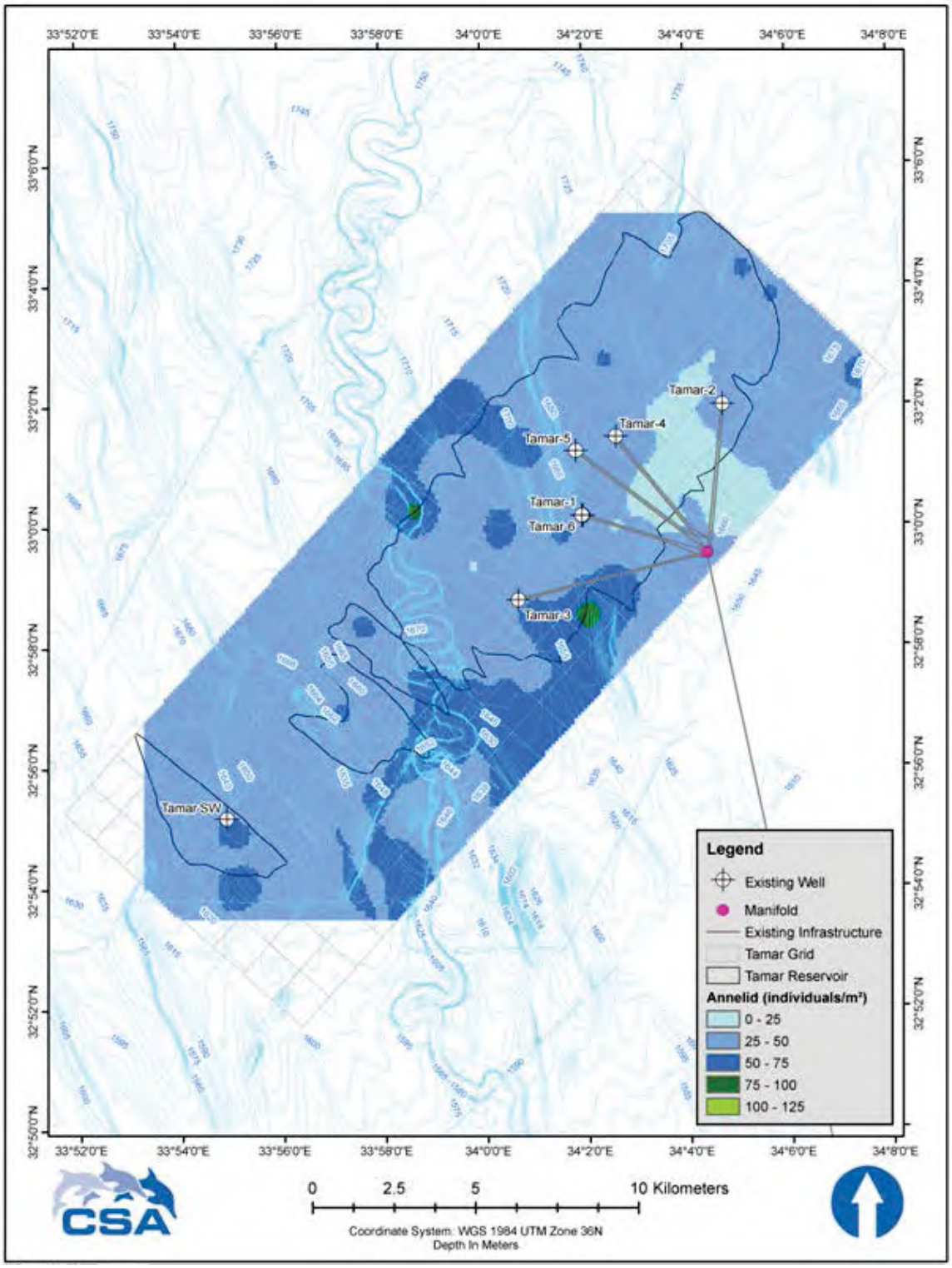

Figure 58. Abundance (individuals/m^2) of annelids within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

Table 28. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from the Tamar Field (1,700 m water depth).

Phylum	Class	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (# of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Annelida	Clitellata	Oligochaeta	7	0.86	1.05
	Polychaeta	Capitellidae	2	0.25	0.30
		Capitella capitata	2	0.25	0.30
		Notomastus sp.	204	24.99	30.58
		Pseudocapitella incerta	2	0.25	0.30
		Opheliidae	7	0.86	1.05
		Aphroditiformia	8	0.98	1.20
		Pettiboneia sp.	3	0.37	0.45
		Glycera lapidium	26	3.19	3.90
		Microphthalmus sp.	1	0.12	0.15
		Lumbrineridae	1	0.12	0.15
		Abyssoninoe sp. 1 EcoA	1	0.12	0.15
		Nephtys sp.	1	0.12	0.15
		Ancistrosyllis groenlandica	1	0.12	0.15
		Exogone sp.	5	0.61	0.75
		Acrocirridae	4	0.49	0.60
		Spiochaetopterus sp.	4	0.49	0.60
		Cirratulidae	4	0.49	0.60
		Aphelochaeta sp.	1	0.12	0.15
		Oweniidae	1	0.12	0.15
		Galathowenia sp.	4	0.49	0.60
		Poecilochaetus sp.	1	0.12	0.15
		Lygdamis sp.	12	1.47	1.80
		Pseudochitinopoma sp.	7	0.86	1.05
		Spionidae	58	7.11	8.70
		Spiophanes sp.	8	0.98	1.20
		Polycirrinae	23	2.82	3.45
		Terebellinae	12	1.47	1.80
		Terebellides stroemii	18	2.21	2.70
		Aricidea (Allia) antennata	13	1.59	1.95
Arthropoda	Malacostraca	Amphipoda	1	0.12	0.15
		Lysianassidae	2	0.25	0.30
		Harpinia sp.	2	0.25	0.30
		Pseudotiron bouvieri	5	0.61	0.75
		Cumacea	4	0.49	0.60
		Makrokylindrus sp.	3	0.37	0.45
		Lampropidae	1	0.12	0.15
		Nannastacidae	4	0.49	0.60
		Asellota	3	0.37	0.45
		Desmosomatidae	10	1.23	1.50
		Tanaidomorpha sp.	2	0.25	0.30
		Tanaidomorpha sp. 1 EcoA	25	3.06	3.75
		Tanaidomorpha sp. 2 EcoA	17	2.08	2.55
		Tanaidomorpha sp. 3 EcoA	46	5.64	6.90
		Tanaidomorpha sp. 4 EcoA	3	0.37	0.45
		Tanaidomorpha sp. 5 EcoA	1	0.12	0.15
		Tanaella unguicillata	1	0.12	0.15

Table 28. (Continued).

Phylum	Class	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (# of specimens)	Abundance (individuals/m²)	Total Fauna (%)
Mollusca	Bivalvia	Cuspidariidae	2	0.25	0.30
		Cardiomya costellata	6	0.74	0.90
		Arcidae	19	2.33	2.85
		Microgloma sp.	39	4.78	5.85
		Galeommatoidea	1	0.12	0.15
		Kelliella sp.	4	0.49	0.60
	Gastropoda	Gastropoda	4	0.49	0.60
		Mangeliidae	1	0.12	0.15
	Solenogastres	Solenogastres	4	0.49	0.60
Nemertea	Anopla	Lineidae	2	0.25	0.30
		Palaeonemertea	3	0.37	0.45
	Palaeonemertea	Tubulanidae	1	0.12	0.15
Sipuncula	Phascolosomatidea	Sipuncula	8	0.98	1.20
		Apionsoma murinae bilobatae	1	0.12	0.15
Phoronida	N/A	*Phoronis* sp.	1	0.12	0.15
Total			**667**	**81.7075**	**100.00**

N/A = not available.

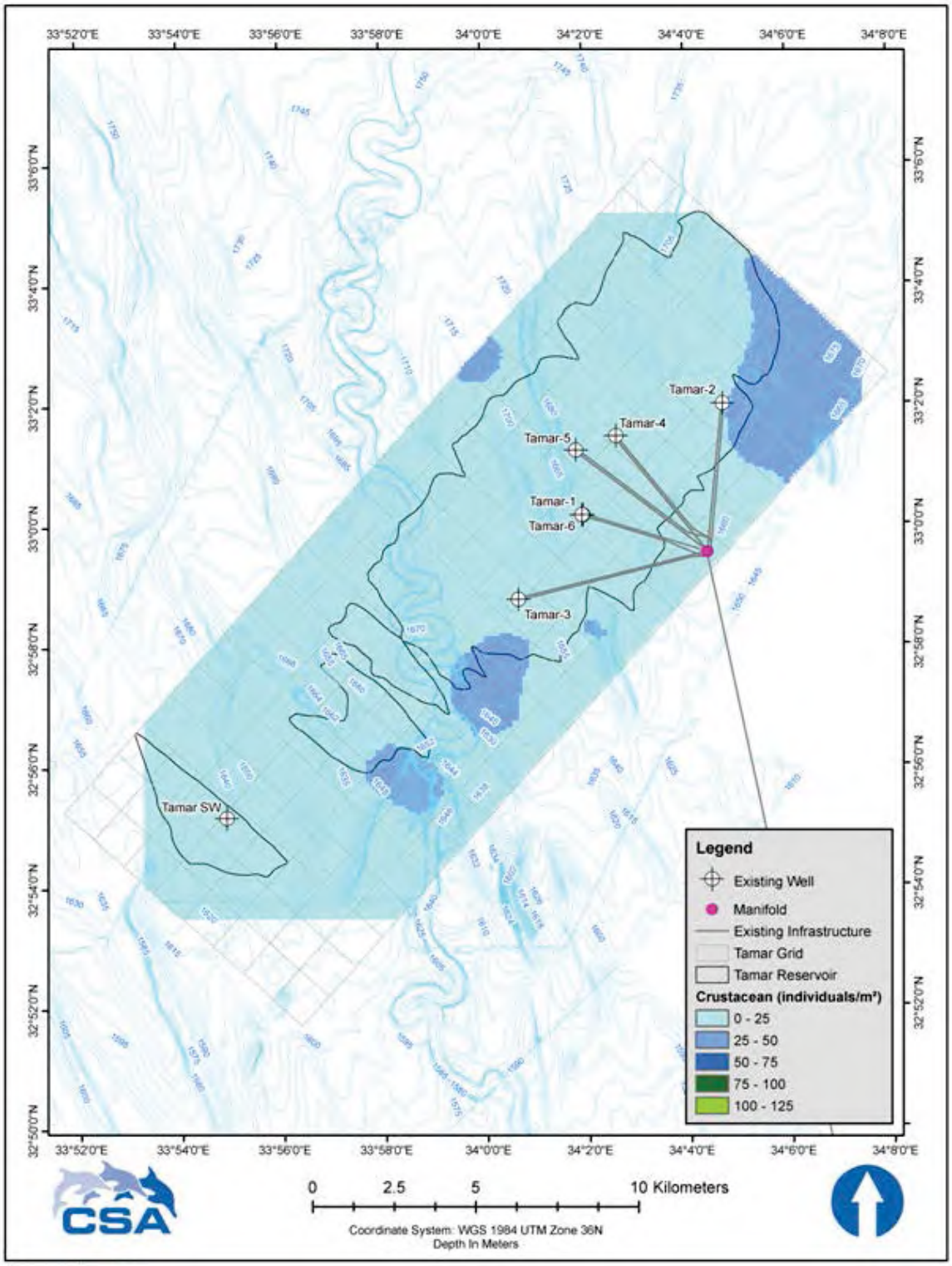

Figure 59. Abundance (individuals/m^2) of crustaceans (Arthropoda) within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

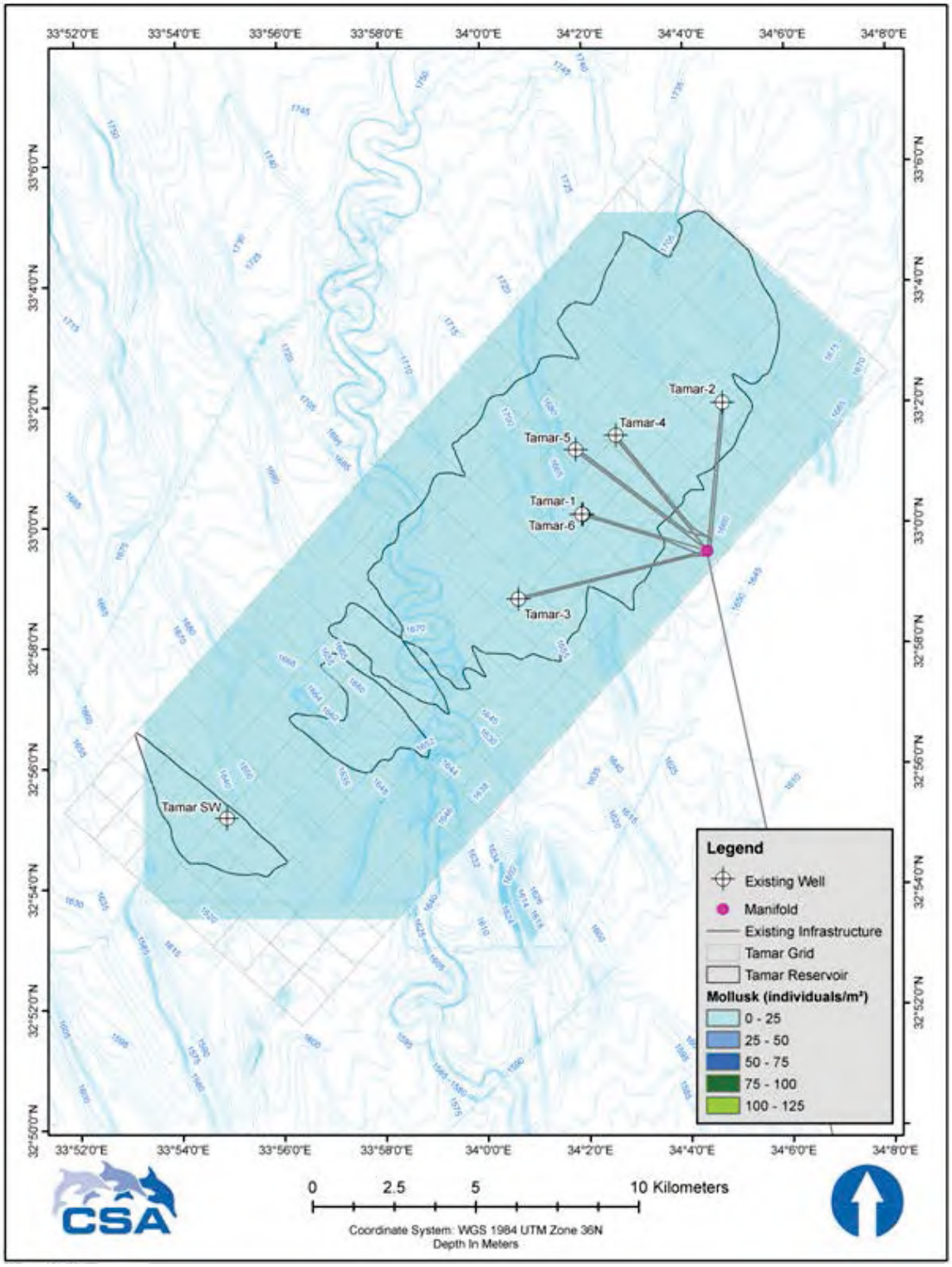

Figure 60. Abundance (individuals/m^2) of mollusks within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

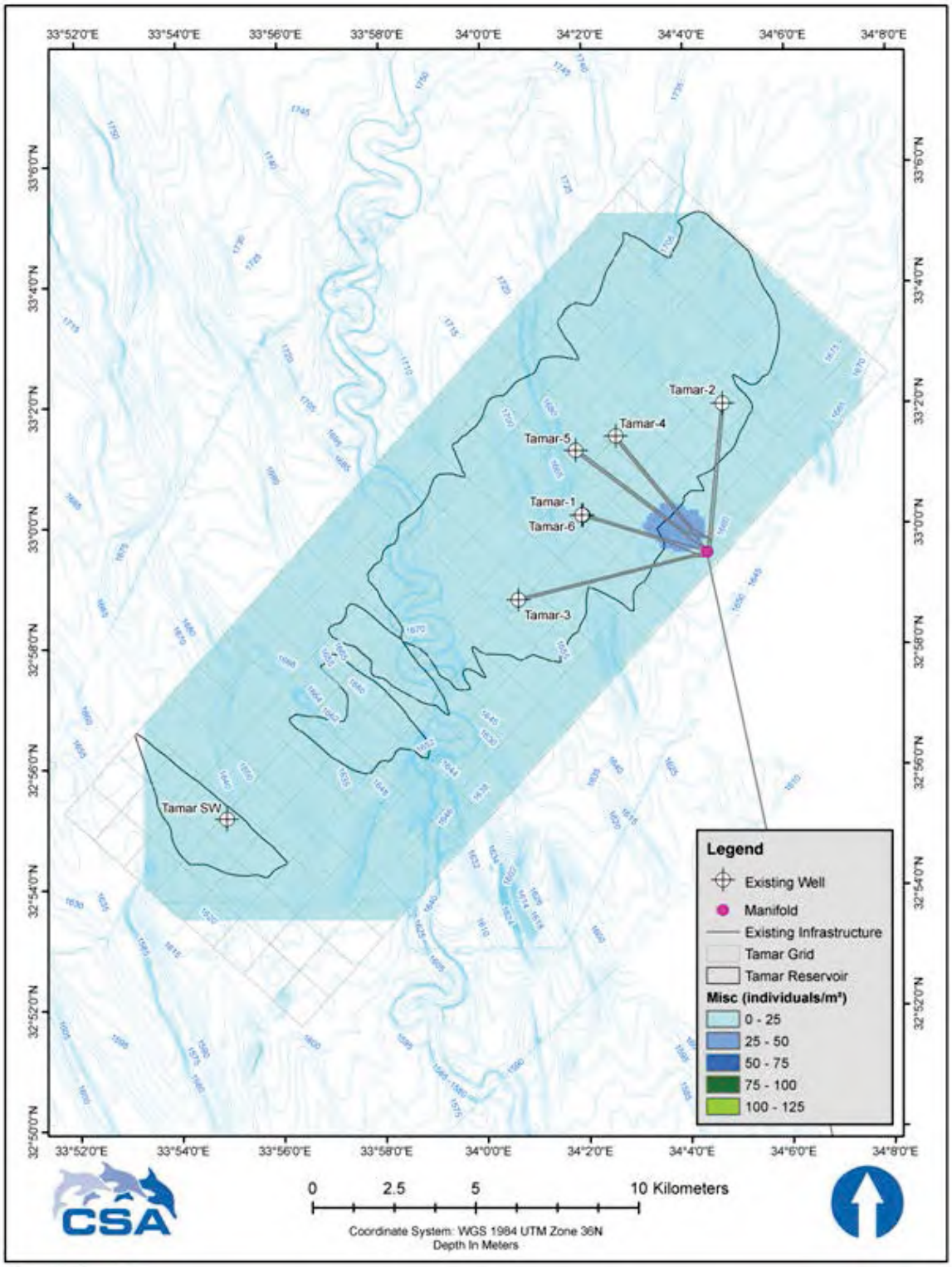

Figure 61. Abundance (individuals/m^2) of Nemertea, Sipuncula, and Phoronida within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

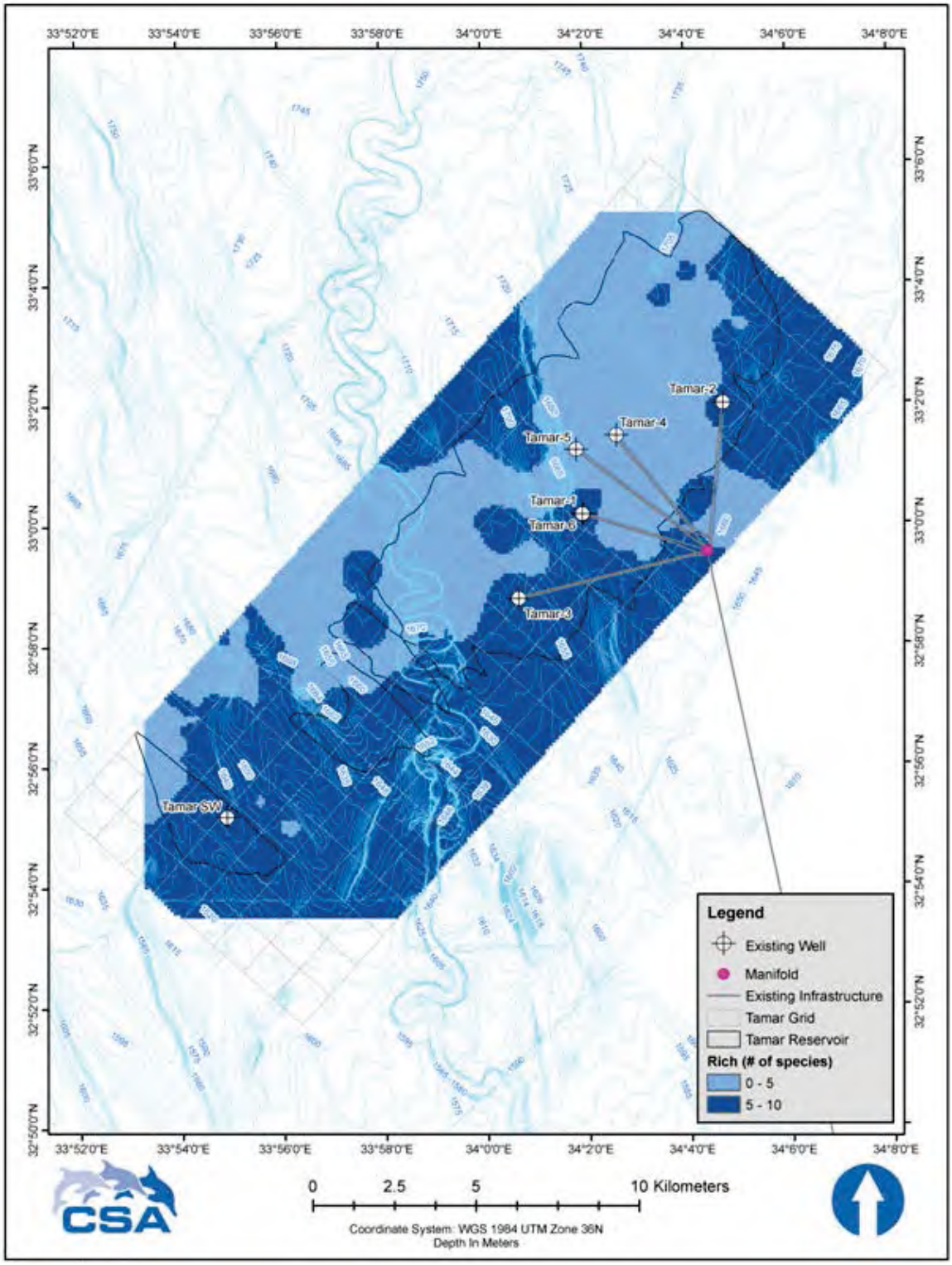

Figure 62. Species richness within the Tamar Field. Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

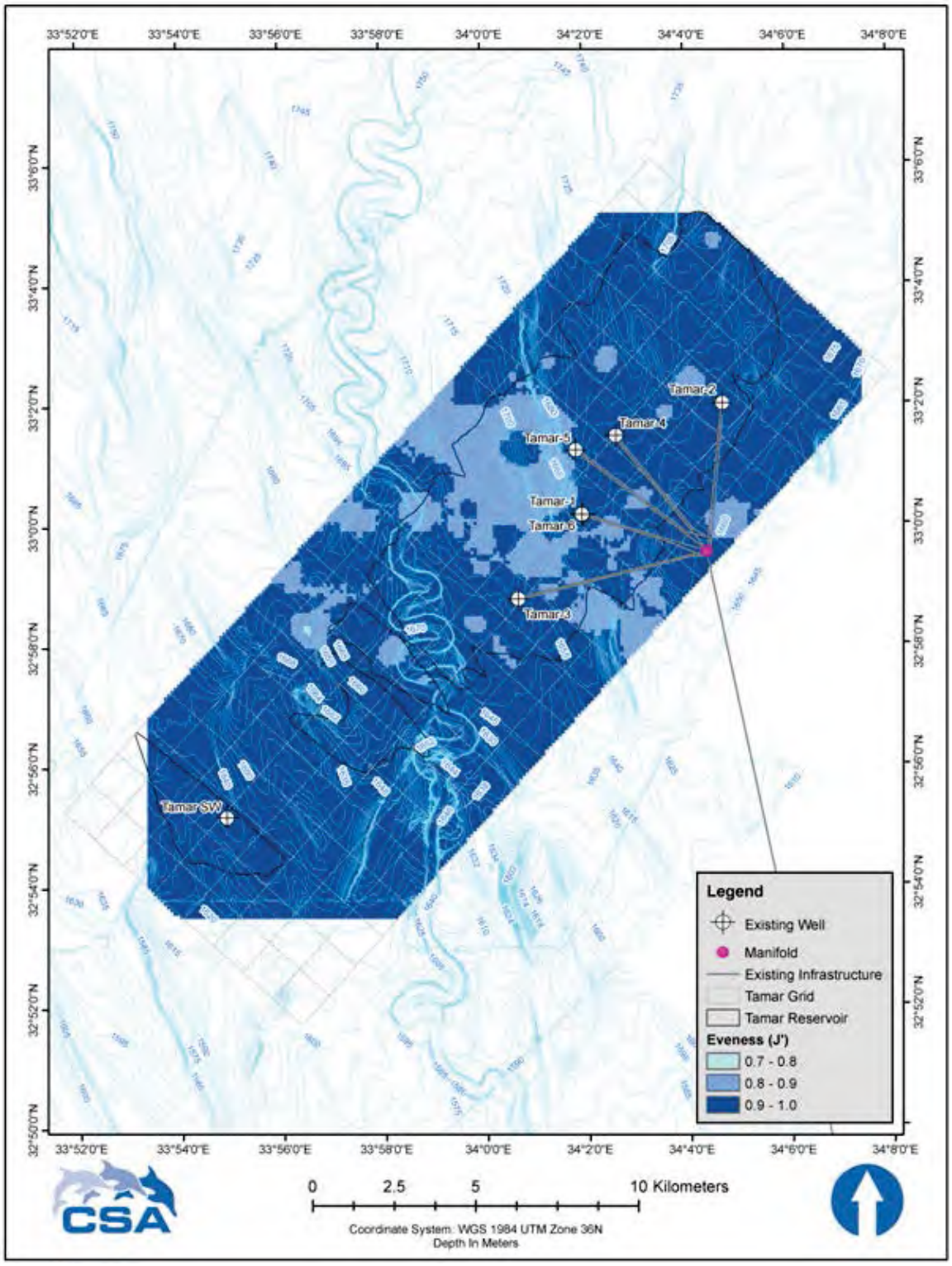

Figure 63. Pielou's evenness (J′) metrics from within the Tamar Field. Pielou's evenness is a value that ranges from 0 (low evenness) to 1 (high evenness). Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

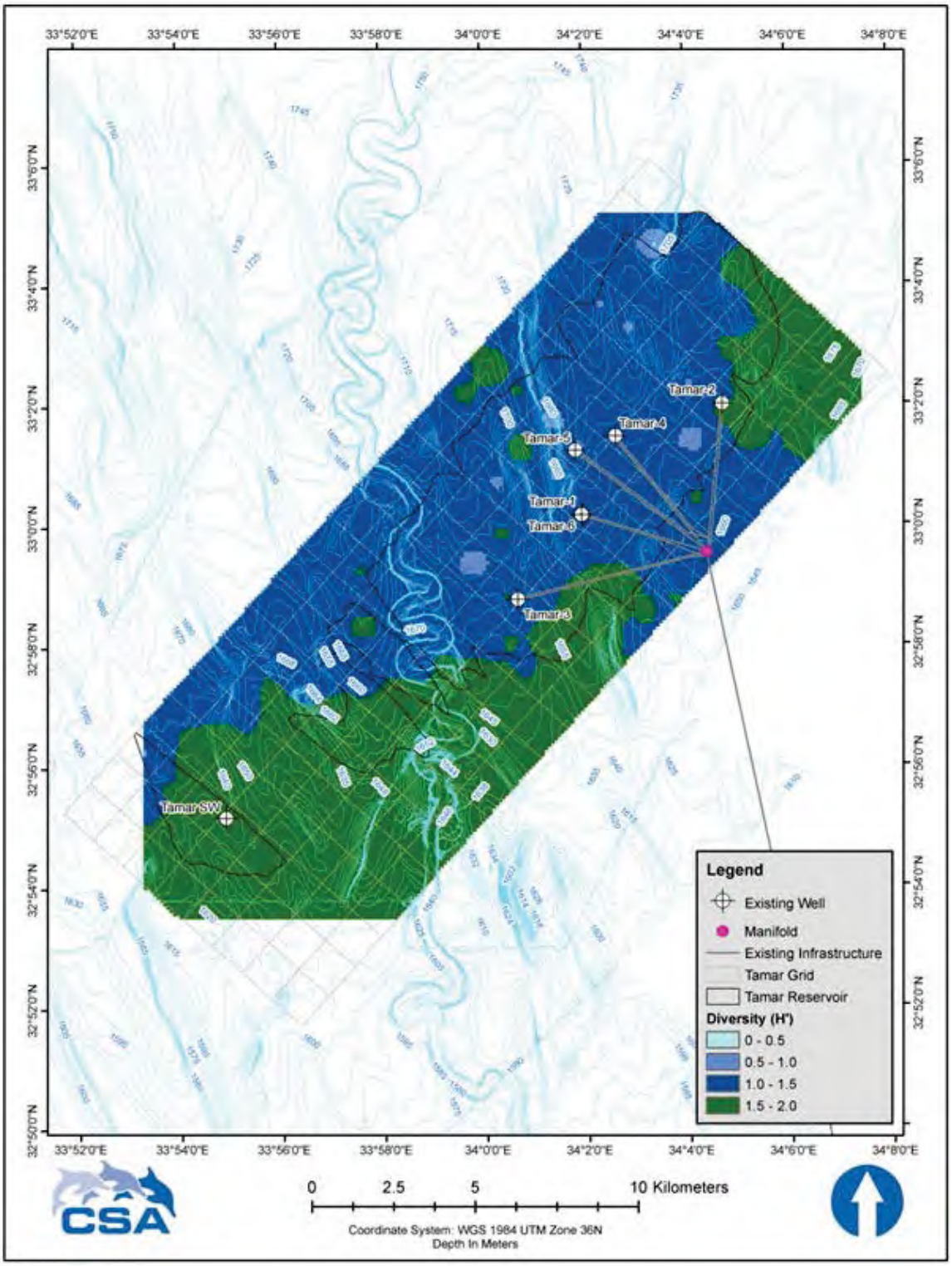

Figure 64. Shannon-Wiener Diversity Index (H′) values from within the Tamar Field. The Shannon-Weiner Diversity Index operates on a scale of 0 (lowest diversity) to 4 (highest diversity). Map color scales are standardized to show the possible range of values; therefore, all colors in the scale may not be present on the map because concentrations at those levels may not be present.

5.5.2 Tamar Pipeline Corridor

1,400 to 1,700 m Depth Stratum

In the portion of the pipeline located in water depths between 1,400 and 1,700 m, polychaete worms were the most dominant taxa and accounted for 56% of the total infaunal abundance. Taxa consisting of Crustacea and Mollusca-Bivalvia accounted for 22% and 28% of all organisms, respectively. Only one or two individuals of each species were collected at this water depth, so no species was particularly dominant over any other (**Table 29**).

Table 29. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 1,400 to 1,700 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Mollusca-Bivalvia	Bivalvia sp.	1	2.67	6
	Cardiomya costellata	2	5.33	11
	Yoldiella sp.	1	2.67	6
Crustacea	*Pseudotiron bouvieri*	1	2.67	6
	Tanaidacea sp.	2	5.33	11
	Tanaellidae sp.	2	5.33	11
Polychaeta	*Notomastus* sp.	2	5.33	11
	Glycera lapidium	1	2.67	6
	Polynoidae sp.	1	2.67	6
	Syllis sp.	1	2.67	6
	Cirratulidae sp.	1	2.67	6
	Spionidae sp.	1	2.67	6
	Terebellides stroemii	2	5.33	11
Total		**18**	**48**	**100**

900 to 1,400 m Depth Stratum

In the portion of the pipeline located in water depths between 900 and 1,400 m, polychaete worms were the most dominant taxa and accounted for 50% of the total infaunal abundance. The polychaete worm *Notomastus* sp. (**Image 13**) was the most abundant organism at this depth (**Table 30**). Taxa comprising Crustacea and Mollusca-Bivalvia each accounted for 20% of infaunal organisms. Mollusca-Bivalvia was composed exclusively of *Yoldiella* sp. (**Table 30**; **Image 14**).

Table 30. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 900 to 1,400 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Mollusca-Bivalvia	*Yoldiella* sp.	5	13.33	20
Crustacea	Hyperiidea sp.	1	2.67	4
	Phoxocephalidae sp.	1	2.67	4
	Asellota sp.	1	2.67	4
	Anthuridae sp.	1	2.67	4
	Tanaellidae sp.	1	2.67	4
Polychaeta	*Leiocapitella* sp.	1	2.67	4
	Notomastus sp.	6	16.00	24
	Syllis sp.	2	5.33	8
	Autolytinae sp.	1	2.67	4
	Cirratulidae sp.	1	2.67	4
	Spionidae sp.	2	5.33	8
	Aricidea (*Allia*) *monicae*	1	2.67	4
Echiuridae	*Echiurus abyssalis*	1	2.67	4
Total		**25**	**66.67**	**100**

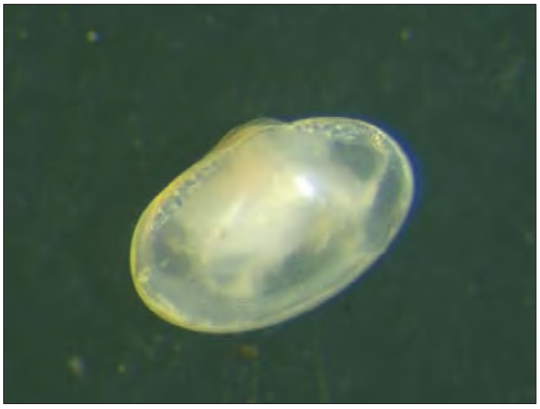

Image 14. Specimen of the bivalve mollusk *Yoldiella* sp.

300 to 900 m Depth Stratum

In the portion of the pipeline located in water depths between 300 and 900 m, polychaete worms were the most dominant taxa and accounted for 50% of the total infaunal abundance, with *Notomastus* sp. being the most dominant polychaete (**Image 13**). The most dominant organism was a crustacean, *Apseudopsis acutifrons* (**Image 15**), that accounted for 25% of the total organisms collected in this depth range (**Table 31**).

Table 31. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 300 to 900 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Nemertea	Palaeonemertea sp.	3	6	3
Mollusca-Bivalvia	Bivalvia sp.	2	4	2
	Tropidomya abbreviata	1	2	1
	Ennucula aegeensis	1	2	1
	Yoldiella sp.	5	10	5
Mollusca-Gastropoda	Pyramidellidae sp.	1	2	1
Crustacea	*Eriopisa elongata*	1	2	1
	Podocerus variegatus	1	2	1
	Bruzelia typica	1	2	1
	Nannastacidae sp.	1	2	1
	Asellota sp.	1	2	1
	Amakusanthura pori	1	2	1
	Agathotanaidae sp.	1	2	1
	Apseudopsis acutifrons	26	52	25
	Tanaellidae sp.	2	4	2
	Typhlotanais angstromensis	1	2	1
Polychaeta	*Neoheteromastus* sp.	4	8	4
	Notomastus sp.	13	26	13
	Ophelia sp.	2	4	2
	Glycera lapidium	1	2	1
	Gallardoneris sp. 1 EcoA	1	2	1
	Sphaerodoropsis sp. 1 EcoA	7	14	7
	Syllis sp.	4	8	4
	Ampharetidae sp.	1	2	1
	Spiochaetopterus sp.	4	8	4
	Diplocirrus sp.	1	2	1
	Spionidae sp.	3	6	3
	Cirrophorus sp.	1	2	1
	Levinsenia sp.	9	18	9
Sipunculida	Sipuncula sp.	1	2	1
Echinodermata	Spatangoida sp.	1	2	1
Total		**102**	**204**	**100**

Image 15. Specimen of the crustacean *Apseudopsis acutifrons*.

200 to 300 m Depth Stratum

In the portion of the pipeline located in water depths between 200 and 300 m, polychaete worms were the most dominant taxa and accounted for 57% of the total infaunal abundance. The most dominant organism in this water depth range was a bivalve mollusk, Bivalvia sp. (**Image 16**), that accounted for 20% of the total organisms collected at this depth (**Table 32**).

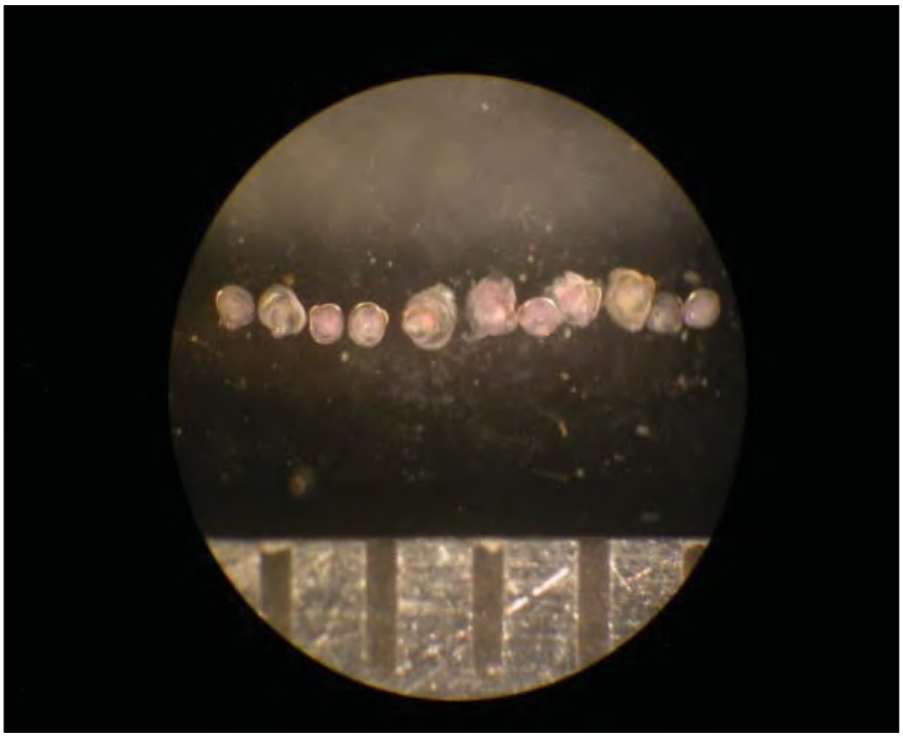

Image 16. Specimen of the bivalve mollusk Bivalvia sp.

Table 32. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 200 to 300 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Nemertea	Lineidae sp.	1	2	0.1
	Palaeonemertea sp.	21	42	2.1
Mollusca-Aplacophora	Neomeniomorpha sp.	1	2	0.1
	Falcidens sp.	39	78	3.9
	Limifossor sp.	2	4	0.2
	Chevroderma sp.	8	16	0.8
	Spathoderma sp.	18	36	1.8
Mollusca-Bivalvia	Bivalvia sp.	212	424	20.9
	Nuculanidae sp.	1	2	0.1
	Nuculidae sp.	16	32	1.6
	Ennucula aegeensis	8	16	0.8
	Ennucula sp.	6	12	0.6
	Axinulus croulinensis	17	34	1.7
	Thyasira sp.	89	178	8.8
	Thyasira biplicata	1	2	0.1
Mollusca-Gastropoda	*Nassarius elatus*	4	8	0.4
	Alvania sp.	5	10	0.5
Crustacea	*Carangoliopsis spinulosa*	24	48	2.4
	Eriopisa elongata	2	4	0.2
	Phoxocephalidae sp.	14	28	1.4
	Eudorella sp.	1	2	0.1
	Asellota sp.	2	4	0.2
	Apseudopsis acutifrons	2	4	0.2
	Colletteidae sp.	11	22	1.1
	Pseudotanais stiletto	8	16	0.8
	Tanaellidae sp.	6	12	0.6
Polychaeta	*Neoheteromastus* sp.	9	18	0.9
	Cossura sp.	32	64	3.2
	Praxillella gracilis	2	4	0.2
	Ophelia sp.	1	2	0.1
	Glycera lapidium	5	10	0.5
	Podarkeopsis sp.	5	10	0.5
	Abyssoninoe sp. 1 EcoA	4	8	0.4
	Gallardoneris sp. 1 EcoA	22	44	2.2
	Ninoe sp.	4	8	0.4
	Nephtys sp.	28	56	2.8
	Drilonereis filum	1	2	0.1
	Pholoe sp.	8	16	0.8
	Ancistrosyllis groenlandica	5	10	0.5
	Litocorsa sp.	1	2	0.1
	Sigalion sp.	1	2	0.1
	Sphaerodoropsis sp. 1 EcoA	5	10	0.5
	Exogone sp.	1	2	0.1
	Syllis sp.	1	2	0.1
	Autolytinae sp.	4	8	0.4
	Cirratulidae sp.	10	20	1.0
	Monticellina sp.	10	20	1.0
	Jasmineira sp.	1	2	0.1
	Spionidae sp.	14	28	1.4
	Prionospio sp.	40	80	4.0
	Spiophanes sp.	7	14	0.7
	Sternaspis sp.	19	38	1.9
	Sternaspis scutata	13	26	1.3
	Aricidea (*Acmira*) *catherinae*	9	18	0.9

Table 32. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Polychaeta (continued)	*Aricidea* (*Allia*) *antennata*	4	8	0.4
	Aricidea (*Allia*) *monicae*	17	34	1.7
	Aricidea (*Aricidea*) *wassi*	61	122	6.0
	Aricidea sp. 1 EcoA	89	178	8.8
	Levinsenia sp.	50	100	4.9
Echinodermata	Ophiuroidea sp.	9	18	0.9
Enteropneusta	*Enteropneusta* sp.	1	2	0.1
Total		**1,012**	**2,024**	**100**

20 to 200 m Depth Stratum

In the portion of the pipeline located in water depths between 20 and 200 m, polychaete worms were the most dominant taxa and accounted for more than 47% of the total infaunal abundance. The polychaete worms *Jasmineira* sp. (**Image 17**) and *Prionospio* sp. (**Image 18**) were the most abundant organisms at this depth, accounting for 13% and 7% of the total organisms collected, respectively (**Table 33**).

Image 17. Specimen of the polychaetous annelid *Jasmineria* sp.

Image 18. Specimen of the polychaetous annelid *Prionospio* sp.

Table 33. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations located in the 20 to 200 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Platyhelmentes-Turellaria	*Turbellaria* sp.	3	3.43	0.1
Nemertea	Lineidae sp.	6	6.86	0.2
	Palaeonemertea sp.	11	12.57	0.3
Mollusca-Aplacophora	Neomeniomorpha sp.	2	2.29	0.1
	Chaetoderma sp.	13	14.86	0.4
	Falcidens sp.	27	30.86	0.7
	Chevroderma sp.	7	8.00	0.2
	Spathoderma sp.	15	17.14	0.4
Mollusca-Bivalvia	Bivalvia sp.	175	200.00	4.8
	Cardiomya costellata	1	1.14	0.0
	Cuspidaria sp.	2	2.29	0.1
	Lyonsia sp.	3	3.43	0.1
	Thraciidae sp.	1	1.14	0.0
	Anadara sp.	4	4.57	0.1
	Glycymeris glycymeris	1	1.14	0.0
	Glycymeris nummaria	1	1.14	0.0
	Corbula gibba	102	116.57	2.8
	Nuculanidae sp.	2	2.29	0.1
	Nuculidae sp.	11	12.57	0.3
	Ennucula aegeensis	8	9.14	0.2
	Parvicardium minimum	37	42.29	1.0
	Parvicardium sp.	5	5.71	0.1
	Loripes lucinalis	1	1.14	0.0
	Lucinella divaricata	1	1.14	0.0
	Abra longicallus	23	26.29	0.6
	Abra sp.	16	18.29	0.4
	Axinulus croulinensis	1	1.14	0.0
	Thyasira sp.	49	56.00	1.3
	Thyasira biplicata	5	5.71	0.1
	Veneridae sp.	50	57.14	1.4
Mollusca-Gastropoda	Gastropoda sp.	2	2.29	0.1
	Ringicula conformis	1	1.14	0.0
	Philinidae sp.	6	6.86	0.2
	Retusa mammillata	1	1.14	0.0
	Volvulella acuminata	4	4.57	0.1
	Eulimella sp.	5	5.71	0.1
	Odostomia sp.	1	1.14	0.0
	Turbonilla sp.	1	1.14	0.0
	Neogastropoda sp.	22	25.14	0.6
	Nassarius elatus	1	1.14	0.0
	Turridae sp.	2	2.29	0.1
	Naticidae sp.	1	1.14	0.0
	Rissoidae sp.	1	1.14	0.0
	Alvania sp.	3	3.43	0.1
	Conomurex persicus	2	2.29	0.1
Mollusca-Scaphopoda	*Antalis* sp.	1	1.14	0.0
Crustacea	*Ampelisca* sp.	93	106.29	2.6
	Leptocheirus sp.	4	4.57	0.1
	Carangoliopsis spinulosa	9	10.29	0.2
	Medicorophium runcicorne	6	6.86	0.2
	Gammaridae sp.	2	2.29	0.1
	Isaeidae sp.	6	6.86	0.2
	Cheiriphotis mediterranea	167	190.86	4.6
	Photis sp.	6	6.86	0.2
	Ischyroceridae sp.	7	8.00	0.2
	Leucothoe sp.	1	1.14	0.0
	Lysianassidae sp.	2	2.29	0.1
	Eriopisa elongata	5	5.71	0.1

Table 33. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Crustacea (continued)	*Oedicerotidae* sp.	8	9.14	0.2
	Phoxocephalidae sp.	38	43.43	1.0
	Eudorella sp.	4	4.57	0.1
	Brachyura sp.	1	1.14	0.0
	Paguroidea sp.	1	1.14	0.0
	Alpheidae sp.	4	4.57	0.1
	Crangonidae sp.	1	1.14	0.0
	Diogenes pugilator	1	1.14	0.0
	Jaxea nocturna	1	1.14	0.0
	Leptochela pugnax	1	1.14	0.0
	Portunidae sp.	1	1.14	0.0
	Asellota sp.	1	1.14	0.0
	Gnathiidea sp.	3	3.43	0.1
	Isopoda sp.	1	1.14	0.0
	Kupellonura mediterranea	5	5.71	0.1
	Tanaidacea sp.	1	1.14	0.0
	Agathotanaidae sp.	15	17.14	0.4
	Apseudes sp.	77	88.00	2.1
	Colletteidae sp.	10	11.43	0.3
	Cristapseudes omercooperi	127	145.14	3.5
	Leptochelia tanykeraia	7	8.00	0.2
	Pseudotanais stiletto	12	13.71	0.3
	Tanaellidae sp.	3	3.43	0.1
	Typhlotanais angstromensis	25	28.57	0.7
Pycnogonida	Phoxichilidiidae sp.	53	60.57	1.5
Polychaeta	*Capitella* sp.	1	1.14	0.0
	Leiocapitella sp.	1	1.14	0.0
	Mediomastus sp.	11	12.57	0.3
	Neoheteromastus sp.	6	6.86	0.2
	Notomastus sp.	136	155.43	3.7
	Cossura sp.	42	48.00	1.2
	Clymenella sp.	2	2.29	0.1
	Maldane sp.	2	2.29	0.1
	Micromaldane sp.	1	1.14	0.0
	Praxillella gracilis	5	5.71	0.1
	Rhodine loveni	13	14.86	0.4
	Nereis sp.	4	4.57	0.1
	Alciopidae sp.	1	1.14	0.0
	Ophryotrocha sp.	3	3.43	0.1
	Glycera lapidium	33	37.71	0.9
	Podarkeopsis sp.	6	6.86	0.2
	Abyssoninoe sp. 1 EcoA	10	11.43	0.3
	Gallardoneris sp. 1 EcoA	39	44.57	1.1
	Nephtys sp.	102	116.57	2.8
	Eunereis sp.	1	1.14	0.0
	Drilonereis filum	1	1.14	0.0
	Onuphis sp.	15	17.14	0.4
	Paradiopatra sp.	1	1.14	0.0
	Paralacydonia sp.	2	2.29	0.1
	Pholoe sp.	15	17.14	0.4
	Phyllodoce sp.	2	2.29	0.1
	Ancistrosyllis groenlandica	38	43.43	1.0
	Litocorsa sp.	3	3.43	0.1
	Sigambra tentaculata	127	145.14	3.5
	Polynoidae sp.	3	3.43	0.1
	Lepidonotinae sp.	1	1.14	0.0
	Sigalion sp.	18	20.57	0.5
	Sphaerodoropsis sp. 1 EcoA	15	17.14	0.4
	Exogone sp.	20	22.86	0.5
	Sphaerosyllis sp.	1	1.14	0.0

Table 33. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals/m^2)	Total Fauna (%)
Polychaeta (continued)	*Autolytinae* sp.	4	4.57	0.1
	Acrocirridae sp.	2	2.29	0.1
	Eclysippe sp.	11	12.57	0.3
	Melinna sp.	22	25.14	0.6
	Spiochaetopterus sp.	8	9.14	0.2
	Cirratulidae sp.	71	81.14	2.0
	Chaetozone sp.	1	1.14	0.0
	Monticellina sp.	70	80.00	1.9
	Diplocirrus sp.	2	2.29	0.1
	Magelona sp.	133	152.00	3.7
	Owenia fusiformis	2	2.29	0.1
	Owenia sp.	2	2.29	0.1
	Pectinaria sp.	6	6.86	0.2
	Poecilochaetus sp.	17	19.43	0.5
	Chone sp.	23	26.29	0.6
	Euchone sp.	3	3.43	0.1
	Jasmineira sp.	457	522.29	12.6
	Spionidae sp.	18	20.57	0.5
	Polydora sp.	44	50.29	1.2
	Prionospio sp.	266	304.00	7.3
	Pseudopolydora sp.	3	3.43	0.1
	Scolelepis sp.	1	1.14	0.0
	Spiophanes sp.	16	18.29	0.4
	Sternaspis sp.	3	3.43	0.1
	Sternaspis scutata	3	3.43	0.1
	Polycirrinae sp.	1	1.14	0.0
	Terebellides stroemii	5	5.71	0.1
	Aricidea (*Allia*) *monicae*	10	11.43	0.3
	Aricidea (*Aricidea*) *wassi*	8	9.14	0.2
	Aricidea sp. 1 EcoA	79	90.29	2.2
	Cirrophorus branchiatus	2	2.29	0.1
	Levinsenia sp.	97	110.86	2.7
Sipunculida	Sipuncula sp.	4	4.57	0.1
	Apionsoma murinae bilobatae	2	2.29	0.1
	Thysanocardia procera	4	4.57	0.1
Echinodermata	Ophiuroidea sp.	191	218.29	5.3
	Amphiodia obtecta	7	8.00	0.2
	Amphiura filiformis	1	1.14	0.0
Enteropneusta	*Enteropneusta* sp.	2	2.29	0.1
Phoronida	*Phoronida* sp.	9	10.29	0.2
Total		**3,637**	**4,156.57**	**100**

Individual station diversity metrics for the Tamar pipeline corridor are shown in **Table 34.** The greatest numbers of organisms found in the 20 to 200 m water depth stratum. Pielou's evenness was moderate to high when averaged for each stratum and generally consistent among strata. Stations in the 20 to 200 m water depth stratum had the lowest evenness values (0.63 to 0.87), and stations in the 1,400 to 1,700 m water depth stratum had the highest evenness values (0.97 to 1.00) (**Table 34**).

Species diversity, as calculated by the Shannon-Weiner Diversity Index, was moderate to high (2.51 to 3.46) in water depths less than 300 m and low (0.00 to 1.67) in water depths greater than 1,400 m (**Table 34**). The Shannon-Weiner Diversity Index operates on a scale of 0 (lowest diversity) to 4 (highest diversity).

Table 34. Benthic community parameters at infaunal sampling stations during the March 2013 Tamar Field and Pipeline Survey.

Depth Stratum	Station	Number of Taxonomic Subgroups per Station	Number of Individuals per Station	Pielou's Evenness (J′)	Log Series Fisher's *alpha*	Shannon-Weiner Diversity (H′)
1,400–1,700 m	1	3	3	1.00	--	1.10
	2	10	14	0.97	15.65	2.24
	3	1	1	--	--	0.00
900–1,400 m	1	5	8	0.93	5.71	1.49
	2	5	5	1.00	--	1.61
	3	9	12	0.95	16.36	2.09
300–900 m	1	6	11	0.79	5.40	1.42
	2	11	33	0.73	5.78	1.74
	3	6	16	0.83	3.49	1.49
	4	20	42	0.91	14.96	2.74
200–300 m	1	22	106	0.89	8.44	2.76
	2	46	407	0.80	13.33	3.08
	3	38	224	0.83	13.13	3.00
	4	36	275	0.79	11.07	2.82
20–200 m	1	42	316	0.87	13.00	3.25
	2	41	288	0.81	13.07	3.00
	3	53	558	0.71	14.39	2.83
	4	59	341	0.85	20.59	3.46
	5	59	621	0.79	16.02	3.23
	6	55	1,230	0.63	11.82	2.51
	7	41	283	0.69	13.17	2.57

-- = no data.

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Taxonomic Listing of Infauna

Tamar Environmental Monitoring Program

Tamar Field and Pipeline Survey

November 2013

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EXECUTIVE SUMMARY

Noble Energy Mediterranean Ltd (Noble Energy) has constructed a subsea gas production and transportation system connecting the deepwater Tamar Gas Field (Tamar Field) to the Tamar Offshore Receiving and Processing Platform (Tamar Platform). The Ministry of Environmental Protection (MoEP) and Ministry of Energy and Water Resources (MEWR) required Noble Energy to develop and implement an environmental monitoring program, which consisted of a minimal number of sampling stations and generally characterized the physical, chemical, and biological environment of the pipeline route.

The primary objective of the Tamar Field and Pipeline Survey, which was conducted by CSA Ocean Sciences Inc. from 25 to 31 March 2013, was to characterize the existing environmental conditions along the pipeline. The sampling effort consisted of 1) hydrographic profiling of the water column within the Tamar Field; 2) collection of water samples at specific depths in the water column within the Tamar Field; and 3) collection of sediment and infaunal samples within the Tamar Field and along the pipeline route. For the Tamar Field, sampling was conducted in three geographic strata, and three sampling stations were randomly located within each of these strata. At these stations, sampling consisted of collection of seawater and sediment/infaunal samples and video data. For the pipeline route, sampling was divided among strata that were defined by water depth. Stations were randomly located within each stratum, and only sediment and infaunal samples were collected.

Seawater samples collected near the seafloor in the Tamar Field survey area were analyzed to determine concentrations of total suspended solids (TSS), nutrients (total nitrogen [TN] and total phosphorus [TP]), total metals, hydrocarbons, and radionuclides. TSS values averaged 6.1 mg L^{-1}, and TN and TP concentrations in seawater samples were generally low and nearly uniform throughout the water column within the survey area. All seawater total metals concentrations in the Tamar Field samples were below the Criterion Continuous Concentration reference values, which are values used to evaluate possible effects on organisms. Alkanes and total petroleum hydrocarbons (TPH) were not detected in seawater from the survey area. Total polycyclic aromatic hydrocarbon (PAH) concentrations in seawater averaged 70.2 ± 52.4 ng L^{-1}, and concentrations of radionuclides in seawater (radium [Ra] 226 and Ra 228) averaged 0.12 ± 0.08 pCi L^{-1} and 0.11 ± 0.12 pCi L^{-1}, respectively. Overall, values for seawater samples were generally at or below detection limits, similar to results from previous baseline surveys in the Levantine Basin, and below the proposed Mediterranean Sea water quality standards in Israel (when applicable).

Sediment samples were analyzed to determine grain size distribution and concentrations of total organic carbon (TOC), total metals, hydrocarbons, and radionuclides. Analyses of sediment grain size indicated silty-clay sediments were predominant in waters depths greater than 450 m, clayey-silt sediments were predominant at depths between 450 and 70 m, and the sand component increased steadily between depths of 70 and 20 m. Concentrations of metals in sediments in the vicinity of the Tamar Field wellsites generally were within the range of normal deep-sea sediments (i.e., mean marine sediments, continental crust), with the exception of arsenic and copper. These arsenic and copper concentrations are considered to be ambient for the seafloor of this region. Repeated measurements of arsenic and copper concentrations within the Levantine Basin have consistently yielded values higher than those reported for mean marine sediments and continental crust in locations with minimal anthropogenic activity or influences. Concentrations of radionuclides (Ra 226 and Ra 228, thorium [Th] 228) in sediments ranged averaged 0.35 ± 0.10 pCi g^{-1} for Ra 226, 0.58 ± 0.22 pCi g^{-1} for Ra 228, and 0.65 ± 0.05 pCi g^{-1} for Th 228. Concentrations of TPH in sediments ranged from 6.0 ± 3.2 to 48.9 ± 10.5 μg g^{-1}, and concentrations of PAHs in sediments ranged from 34.4 ± 4.8 to 274.1 ± 22.7 ng g^{-1}. Overall, values for sediment samples were generally at or below detection limits and similar to results from previous baseline surveys in the Levantine Basin.

The infaunal assemblage differed significantly among depth strata. At shallow water (≤300 m) stations, species diversity was moderate to high and there was high organism abundance. Stations in deeper water (>300 m) had moderate to low species diversity and low organism abundance. Polychaete worms were the most abundant taxa collected from all survey strata, accounting for approximately 50% of all organisms collected. Crustaceans (shrimp-like animals) and bivalves were the two most prevalent infaunal taxa after polychaetes.

An undisturbed smooth and relatively flat soft bottom seafloor was seen within the survey area. No hard bottom substrate or chemosynthetic communities were observed. There was biological activity at most of the sampling stations in the Tamar Field, and observations included fauna and bioturbation (i.e., biologically maintained burrows and mounds). As may be expected for a soft bottom deepwater environment where food availability is low, fauna observed on the seafloor were sparse. The organisms most commonly observed from the video data were fishes and shrimps. Small groupings of patterned burrows and small conical mounds likely created by polychaetes were observed in the soft sediments.

All observations indicated a relatively pristine deepwater environment that would be expected at a oligotrophic eastern Mediterranean location far from riverine discharges and terrigenous sediment sources.

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LIST OF ACRONYMS AND ABBREVIATIONS

Ac 228	actinium 228
ANOVA	analysis of variance
$BaSO_4$	barium sulfate
Bi 214	bismuth 214
CCC	Criterion Continuous Concentration
CO_2	carbon dioxide
CoC	chain-of-custody
CSA	CSA Ocean Sciences Inc.
CTD	conductivity, temperature, and depth
DGPS	differential global positioning system
DO	dissolved oxygen
EDTA	ethylenediaminetetraacetic acid
ERL	Effects Range Low
ERM	Effects Range Median
GC-MS	gas chromatography-mass spectrometry
HF	hydrofluoric acid
HNO_3	nitric acid
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
MANOVA	multivariate analysis of variance
MDL	method detection limit
MEWR	Ministry of Energy and Water Resources
Noble Energy	Noble Energy Mediterranean Ltd
NRWQC	National Recommended Water Quality Criteria
NTU	nephelometric turbidity unit
MCL	maximum contaminant level
MoEP	Ministry of Environmental Protection
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QC	quality control
Ra 226	radium 226
Ra 228	radium 228
Rn 222	radon 222
ROV	remotely operated vehicle
SAP	Sampling and Analysis Plan
SBE	Sea-Bird Electronics
SOW	Scope of Work
TAMI	IMI TAMI Institute for Research & Development Ltd.
Th 228	thorium 228
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION AND PROJECT DESCRIPTION

Noble Energy Mediterranean Ltd (Noble Energy) has constructed a subsea gas production and transportation system connecting the deepwater Tamar Gas Field (Tamar Field) to the Tamar Offshore Receiving and Processing Platform (Tamar Platform). The components of the Tamar Development are shown in **Figure 1**. The Tamar Field is located in License 309, Tamar Block, approximately 90 km west of Haifa, within the Levantine Basin. The Tamar Gas Field was developed as a subsea tieback to the Tamar Platform, which is located within 2 km of the existing Mari-B Platform. The Tamar and Mari-B Platforms are located approximately 25 km off the coast of Israel in a water depth of approximately 230 m. The processed gas will be delivered from the Tamar Platform to the Ashdod Onshore Terminal via hot tap into an existing 30-in. pipeline for gas sales into the Israel Natural Gas Line (INGL) system.

The Ministry of Energy and Water Resources (MEWR) has required Noble Energy to develop and conduct a survey to characterize the environment of the Tamar Field and pipeline route. Noble Energy contracted CSA Ocean Sciences Inc. (CSA) to provide support for the project that included developing a Scope of Work (SOW)/Sampling and Analysis Plan (SAP) for the Tamar Field and Pipeline Survey (**Appendix A**). The SOW/SAP described the parameters to be sampled, sampling methods, data processing, laboratory methods, data analysis, and reporting. The SOW/SAP was accepted by the Israeli Ministry of Environmental Protection (MoEP) prior to survey activities. The data collected during the survey will also be useful for assessing impacts should an accidental event occur in the field or along the pipeline route.

1.1 BACKGROUND

The Tamar Field and Pipeline Survey included the following survey components:

- Collection of video data, including forward-looking sonar, in the Tamar Field to identify characteristics of the seafloor substrates and associated fauna (epibenthos and fishes);
- Seawater characterization, including collection of hydrographic profiles of water column conductivity (salinity), temperature, fluorescence, turbidity, and dissolved oxygen (DO) as well as collection of near-bottom water samples to document metals and hydrocarbon (alkanes and polycyclic aromatic hydrocarbons [PAHs]) concentrations in the Tamar Field; and
- Collection of sediment and infaunal samples to document geological (grain size), chemical (total organic carbon [TOC], metals, and hydrocarbons [alkanes and PAHs]), and biological attributes at all stations in the Tamar Field and along the pipeline route**.**

1.2 PURPOSE AND OBJECTIVES

The purpose of this environmental survey was to characterize environmental conditions in the Tamar Field and along the pipeline route leading from the field to the production platform and from the Tamar Platform to the Ashdod Onshore Terminal. The characterization of environmental conditions consisted of determining the spatial variation of selected environmental components (i.e., chemical, geological, and biological) in sediments within the study area. Near-bottom water samples also were collected at all Tamar Field stations and analyzed for a set of chemical analytes.

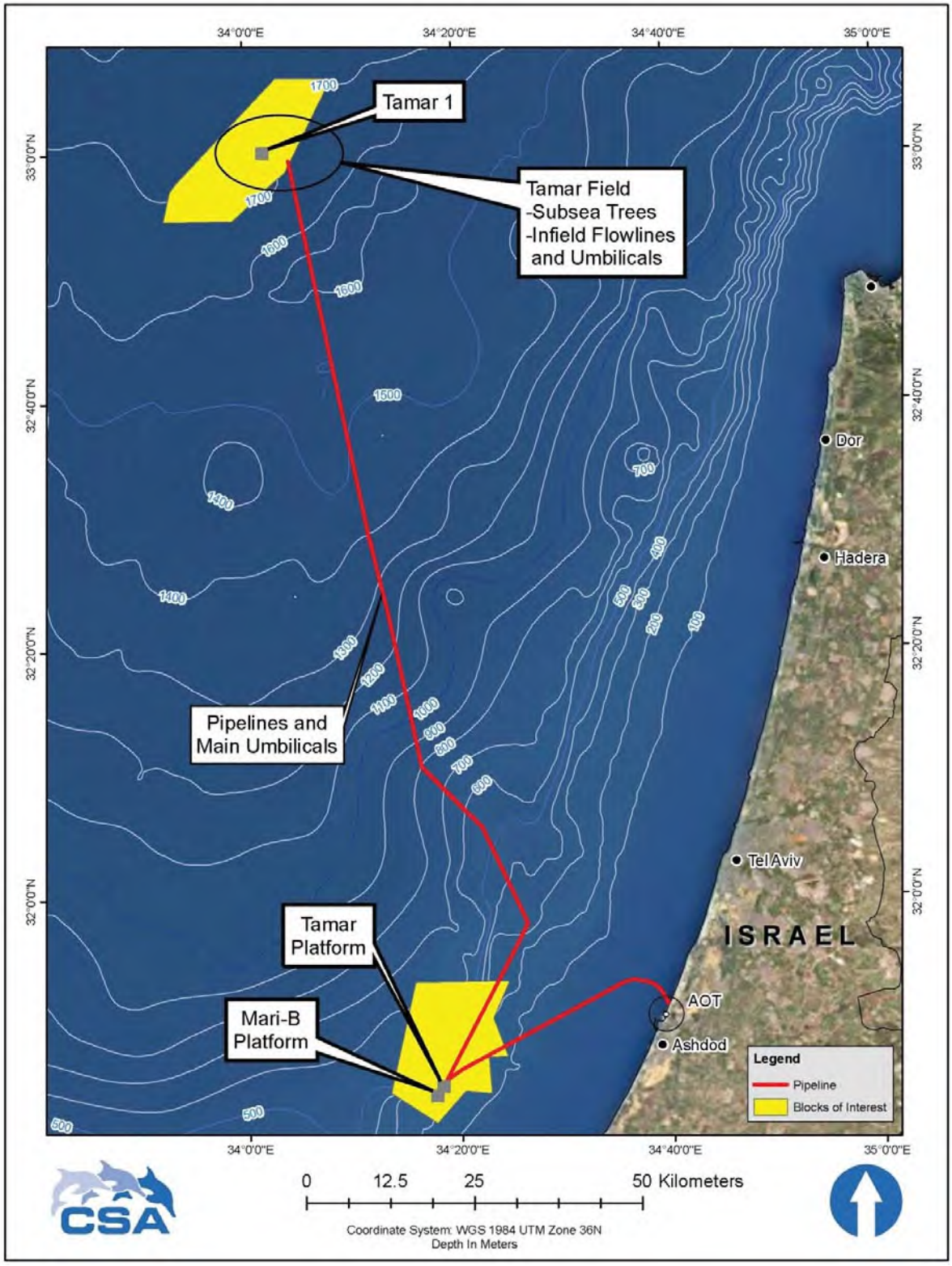

Figure 1. Location of the Tamar Field and pipeline relative to the Israeli coastline.

The objectives of the Tamar Field and Pipeline Survey were to

- document baseline conditions of the environment against which effects from future operations can be compared; and
- identify parameters within the ecosystem that may be sensitive to change and provide a reference point to evaluate future claims of impacts.

The survey was conducted from 26 to 31 March 2013 and included collection of hydrographic profiling data and water column samples from the Tamar Field and collection of sediment/infaunal samples at all stations within the Tamar Field and at stations located along the pipeline.

2.0 SURVEY DESIGN

Sampling stations were located within two stratified random sampling designs, one corresponding to environmental characterization of the Tamar Field and the other corresponding to environmental characterization of the pipeline route. The sampling designs were selected to avoid potential pseudo-replication (sensu Hurlbert, 1984) and provide representative samples for characterization of the environment in the survey area.

For the Tamar Field, sampling was conducted in three geographic strata, with three sampling stations randomly located within each of these strata (**Figure 2**). At Tamar Field stations, sampling consisted of collection of seawater, sediment, infauna, and video. For the pipeline route, sampling was divided among five strata defined by water depth (**Table 1**); station locations were randomly located within each stratum, and only sediment and infaunal samples were collected. The sampling effort is summarized in **Table 1** and shown in **Figure 2**. A total of 30 stations was sampled.

Table 1. Summary of sampling conducted for the Tamar Field and Pipeline Survey.

Depth Stratum	Description	Sample Type	Number of Sampling Stations
20 – 200 m	Between the Tamar Platform and Ashdod Onshore Terminal	Sediment/infauna	7
200 – 300 m	Between the Tamar Platform and 300-m isobath	Sediment/infauna	4
300 – 900 m	Between the 300- and 900-m isobaths	Sediment/infauna	4
900 – 1,400 m	Between the 900- and 1,400-m isobaths	Sediment/infauna	3
1,400 – 1,700 m	Between the 1,400-m isobath and the manifold in the Tamar Field	Sediment/infauna	3
Tamar Field (1,700 m)	3 strata x 3 stations	Seawater/sediment/ infauna	9

Seawater samples were collected and hydrographic profiles were conducted in the Tamar Field. The water column was profiled for conductivity (salinity), temperature, DO, fluorescence, and turbidity. Seawater samples were collected near-bottom at each Tamar Field station and analyzed for total suspended solids (TSS), total organic carbon (TOC), nutrients (total nitrogen [TN] and total phosphorus [TP]), total metals, hydrocarbons (alkanes, total petroleum hydrocarbons [TPH], and PAHs), and radionuclides (radium [Ra] 226 and Ra 228).

Seafloor sediment samples were collected at all 30 sampling stations. These samples were analyzed for grain size distribution, TOC, total metals, hydrocarbons (alkanes, TPH, and PAHs), radionuclides (Ra 226, Ra 228, and thorium [Th] 228), and infauna.

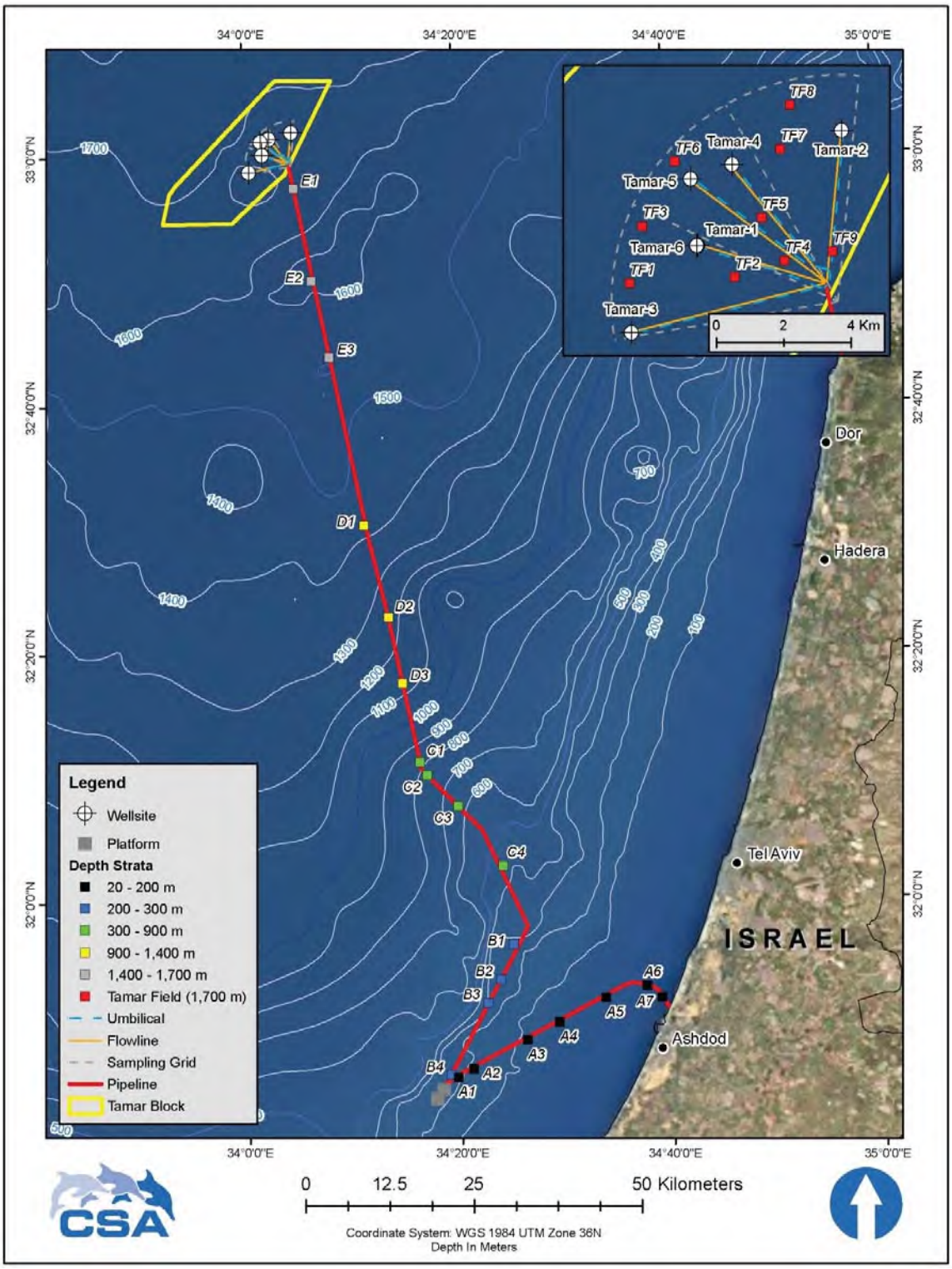

Figure 2. Configuration of sampling strata and locations of sampling stations for the Tamar Field and Pipeline Survey.

3.0 FIELD METHODS

3.1 VESSEL OPERATION, NAVIGATION, AND REQUIRED PERSONNEL

The survey vessel and navigational equipment were provided by Noble Energy. The M/V *EDT ARES*, owned and operated by EDT Shipping Company Ltd., was under contract to Noble Energy and used for the field survey operations. Vessel specifications are provided in **Appendix B**. The survey vessel was mobilized with personnel and equipment at the Haifa shorebase in Israel.

Dynamic positioning was used to maintain the vessel on station. WinFrog, a computer software and hardware system, was used to interface various data sources with a differential global positioning system (DGPS) receiver. Prior to the survey, all survey sampling locations (i.e., video transects and seawater/sediment collection stations) were pre-plotted and submitted to the navigator for entry into the navigation software. The DGPS and vessel fathometer were connected to an on-board computer equipped with navigation and data acquisition software. An ultra-short baseline transponder was attached to a remotely operated vehicle (ROV) to record its position, using DGPS, relative to the vessel position. The positions of the ROV track and sample collection locations were recorded and stored by the navigation software.

Field sampling operations were conducted on a 24-hour-per-day basis. CSA provided six survey personnel (three scientists and three operational technicians) to conduct in-country mobilization of survey equipment and supplies, outfit the ROV for conducting seawater and sediment sampling, program hydrographic instrumentation, and process collected samples. The CSA Chief Scientist was responsible for preparing sampling equipment and storage containers, directing data collection, overseeing all aspects of sample processing, and coordinating shipment or delivery of samples to respective laboratories.

3.2 REMOTELY OPERATED VEHICLE

A Triton XLS, a heavy duty, 150-hp work class ROV system manufactured by Perry Slingsby Systems and rated to 3,000 m, was used for data and sample collection during the Tamar Field and Pipeline Survey (**Image 1**).

Image 1. Triton XLS work class remotely operated vehicle.

The ROV system was installed on the M/V *EDT ARES* and included an A-frame and winch with a 3,300-m steel armored umbilical and ROV control center. The computer control system provided auto heading, attitude, depth, pitch, and roll control. Video collection capability was provided by one Kongsberg OE1366 standard definition color zoom camera and one Kongsberg OE15-100A Enhanced CCD low light camera mounted on hydraulic pan-and-tilt units with multiple 250-watt lamps. The hydraulic propulsion system consisted of four 15-in. horizontal thrusters and four 12-in. vertical thrusters. Solid syntactic flotation blocks provided neutral trim and a maximum payload capacity of 300 kg. One seven-function manipulator and one five-function manipulator were mounted on the front of the ROV.

A Sea-Bird Electronics (SBE) SBE-19 conductivity-temperature-depth (CTD)/water quality profiler was mounted on the upper front of the ROV above the manipulators and integrated with the ROV instrumentation junction box to provide real-time surface monitoring. GO-FLO water sample bottles (10 L) were mounted across the back of the ROV and hydraulically triggered using the ROV's auxiliary tooling manifold. The box cores were carried in an aluminum frame bracket attached to the port side, forward tray of the ROV and operated using the ROV's auxiliary tooling manifold.

3.3 WATER COLUMN SAMPLING

Water column sampling was conducted to evaluate chemical and physical parameters. Hydrographic data, including conductivity (salinity), temperature, DO, fluorescence, and turbidity, were collected throughout the water column with an SBE-19*plus* V2 CTD/water quality profiler. Seawater samples were collected near-bottom (<5 m) at all stations located within the Tamar Field survey area.

Image 2. ROV-mounted 10-L GO-FLO water sample bottles.

Water column sampling was conducted to provide seawater for the analysis of TSS, TOC, nutrients (TN and TP), total metals, hydrocarbons (alkanes, TPH, and PAHs), and radionuclides (Ra 226 and Ra 228). Seawater samples were collected with clean 10-L GO-FLO water sample bottles mounted on the ROV (**Image 2**) that were tripped using a pneumatic switch.

A seawater sample (≤4 L) was collected to analyze each specified parameter. All samples were placed in precleaned (as appropriate for specified parameters) labeled sample containers. Seawater sampling and handling protocols are summarized in **Table 2**.

Table 2. Processing and storage requirements for seawater samples collected for analysis.

Parameter/Analyte(s)	Minimum Sample Volume	Container Type and Size	Handling, Storage Conditions, and/or Preservation Method	Holding Time
Total suspended solids	1 L	1-L filtered	Freeze; ship on ice	Indefinite
Nutrients (total organic carbon, total nitrogen, total phosphorous)	250 mL	250-mL plastic bottle	Freeze; ship on ice	Indefinite
Metals other than mercury	1 L	1-L narrow-mouth plastic	Nitric acid (HNO_3) to pH <2; cool to 4°C; ship on ice	6 months
Mercury	500 mL	500-mL narrow-mouth fluorinated plastic	HNO_3 to pH <2; cool to 4°C; ship on ice	28 days
Hydrocarbons (alkanes, total petroleum hydrocarbons, and polycyclic aromatic hydrocarbons)	1 L	1-L amber glass bottle	Cool to 4°C; ship on ice	7 days
Radionuclides (radium 226 and radium 228)	4 L	4-L plastic bottle	HNO_3 to pH <2	Indefinite

3.4 SEDIMENT AND INFAUNAL SAMPLING

Sediment and infaunal samples were collected with three hydraulically activated box corers that were deployed with the ROV. Each box corer had a surface area of 0.0625 m^2. The ROV manipulator arm was used to deploy the grabs and collect the sediment and infaunal samples (**Image 3**).

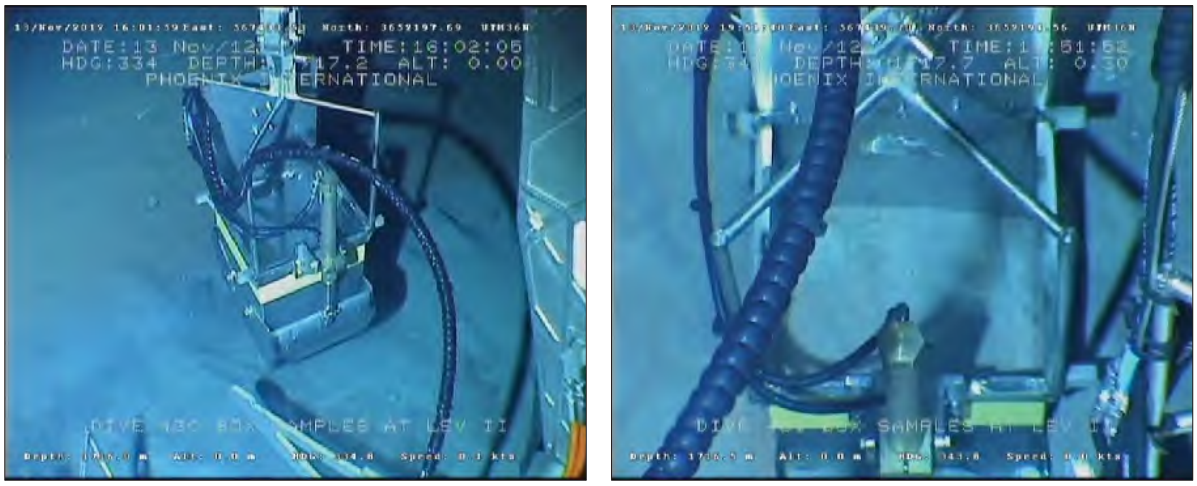

Image 3. Hydraulically activated box corer deployed with the remotely operated vehicle manipulator arm. The box corer was placed over a clean patch of sediment (left) and pushed into the sediment until a sufficient volume of sample was retrieved (right).

Sediment was collected from one of the three ROV box corers for chemical and physical analyses. The top 2 to 3 cm of the sediment core was subsampled for sediment physio-chemical analyses including grain size distribution, TOC, metals, and hydrocarbons (alkanes and PAHs). Analyses were conducted to determine the concentrations of various U.S. Environmental Protection Agency (USEPA) priority pollutant and hydrocarbon-associated metals including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Sediments were also analyzed for aluminum and iron. These metals occur naturally within the environment and can be used as reference metals to detect unnatural concentrations of hydrocarbon-associated metals through correlation. Sediment samples were transferred into precleaned sample containers, frozen, and handled/stored as recommended by USEPA protocols. Sediment sampling protocols are summarized in **Table 3**.

Table 3. Processing and storage requirements for sediment sampling parameters.

Parameter/Analyte(s)	Minimum Sample Weight	Container Type and Size	Storage Conditions and/or Preservation Method	Holding Time
Grain size distribution; total organic carbon	200 g (wet)	250-mL wide-mouth plastic jar	Freeze, ship on ice, and store frozen	Indefinite when frozen
Metals	150 g	250-mL wide-mouth plastic jar	Freeze, ship on ice, and store frozen	Indefinite when frozen
Hydrocarbons (alkanes and polycyclic aromatic hydrocarbons)	150 g	125-mL wide-mouth glass jar	Freeze, ship on ice, and store frozen	28 d

Two ROV box corers were used to collect replicate infaunal samples at each station. The entire contents of each corer were collected and processed for infauna. Samples were wet-sieved through a 0.25-mm mesh sieve with a technique that minimizes trauma to infaunal organisms and facilitates resuspension of sediment (including clay fractions) and separation of infaunal organisms from the sediment. The apparatus consisted of a sample mixing barrel fitted with a spillover drain and was positioned above a large spillover barrel. A 12-in. diameter stainless steel 0.25-mm sieve was mounted between the spillover

drain and over the lower spillover barrel (**Image 4**). The flow rate from the mixing barrel was monitored to prevent overloading on the sieve screen. The sieved sample (containing infaunal organisms, residual sediment, and debris) was consolidated and transferred to a labelled sample container and preserved with an 8% borax-buffered formalin solution.

Image 4. Macrobenthic infaunal sieving apparatus. The apparatus consists of an upper mixing barrel and sieve table over a lower spillover barrel.

The sediment and infaunal sample collected at Station A7 (**Figure 2**) was collected with a Smith-McIntyre grab sampler (**Image 5**). It was necessary to sample Station A7 with a different sampling apparatus because the ROV box corer was not able to penetrate the dense, coarse sediment at this station. Sample size was approximate to that of the ROV box corer, and the methods for sediment and infaunal collection were identical to those described above.

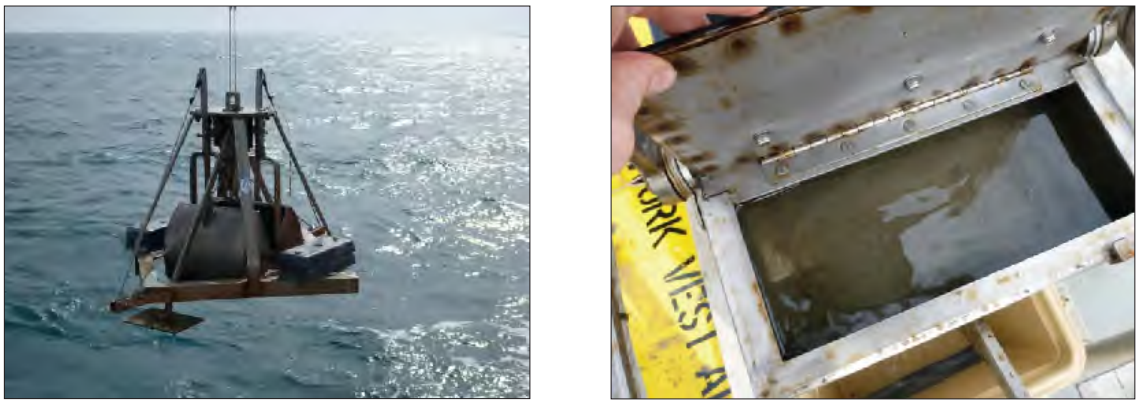

Image 5. Smith-McIntyre grab sampling apparatus: sampling apparatus being lowered into the position at Station A7 (left), and sampling port showing sample integrity with overlying water after retrieval to deck (right).

3.5 VIDEOGRAPHY AND SONAR

Videography and sonar-based data provide visually based monitoring focused on seafloor features in close proximity to the Tamar Field wellsites. Underwater video and forward-looking sonar data were collected along 200-m video transects radiating out from each wellsite at 45˚ intervals (eight transects). The tracks followed by the ROV along designated transects and at the sampling stations were recorded with the ROV's on-board navigation system.

Underwater videographic data were collected with a video camera mounted on the Triton XLS ROV system. The ROV-mounted camera was aimed slightly above vertical to provide a field of view that included the bottom substrate in front of the system. The ROV was maneuvered at relatively slow speeds close to the seafloor to ensure the collection of videographic data that best met survey objectives. Along each transect, video observations were recorded continuously to provide information to determine the spatial extent of topographic features relative to the wellsite. Additionally, the videographic data were used to determine presence/absence and relative abundance estimates for epifauna and demersal fishes within the survey area. Bottom features and faunal observations were digitally marked using VisualSoft software to facilitate expeditious video data analysis. Forward-looking sonar acoustic data were collected at ROV positions to provide information to confirm visual observations about local topographic features.

3.6 QUALITY CONTROL

Quality control (QC) measures were implemented in the field to collect representative samples, allow assessment for potential sources of contamination, minimize data and sample loss, and ensure collection of requisite samples and data. Field QC measures included preparation of sample checklists, collection, and preparation of equipment blanks (rinsates) and splits, completion of checklists, and data checks. QC measures were implemented to meet requirements including the use of qualified/certified equipment, personnel, and laboratories; chain-of-custody (CoC) processes; collection of QC samples (blanks and splits) representing at least 10% of the total number of samples; and detailed documentation of sample and data analysis steps and results.

Cleaning Procedures

To ensure that samples represent natural conditions, sample collection equipment must not cause contamination of the samples and sampling methods must not cause unacceptable changes in samples collected (sampling artifacts). Water samplers, sediment samplers, and sample processing equipment were thoroughly cleaned according to accepted procedures prior to use in the field. Precleaned sample containers were processed by the distributor following appropriate USEPA protocols as specified in the Office of Solid Waste and Emergency Response (OSWER) Directive 9240.0-05A "Specifications and Guidance for Contaminant-Free Sample Containers." All samples were collected with precleaned sample containers.

3.6.1 Quality Control Measures

Equipment Blanks

After the sampling equipment was cleaned, an equipment blank was prepared by pouring deionized water through the equipment and collecting the deionized water rinsate in a precleaned and labeled 1-L sample container bottle, which was then shipped to the laboratory in the same fashion as the other samples.

Field Blanks

Field blanks were prepared by pouring analyte-free deionized water into clean sample containers while in the field. Field blanks were then shipped to the laboratory in the same fashion as the other samples.

Sample Duplicates

QC included duplicate samples for both water and sediment chemistry parameters. Duplicate samples were collected from the same sediment grab sample or Niskin bottle and sent to both the primary analytical laboratory in the U.S. (TDI Brooks [College Station, Texas]) and an Israeli (IMI TAMI Institute for Research & Development Ltd. [TAMI]) and U.S. analytical laboratory (ALS Environmental [Kelso, Washington]) for interlaboratory comparison.

Sea-Bird Profiler Data Check

During or soon after a water column profile cast was completed, the SBE hydrographic data were downloaded and plotted in the field to check that the collected data were within expected ranges for the conditions at the survey area, the equipment was functioning normally, and the configuration and data files were in good order.

Sample Preservation, Storage, and Holding Times

Samples were preserved as specified by applicable regulations or industry practice and transported to the laboratories for analysis within the prescribed sample holding times under appropriate preservation and handling conditions.

Data and Sample Collection Checklists

Prior to the survey, data and sample checklists were prepared by the Chief Scientist and completed in the field as appropriate for QC. Prior to departing each sampling station, the Chief Scientist or his designee reviewed the checklist and physically examined and confirmed data files, logbooks, and sample containers to ensure that the data and required samples were properly collected, preserved, and stored.

3.6.2 Sample Handling and Transport

After sample collection, proper sample handling protocols were followed to ensure valid results were obtained from the analysis of each sample. To ensure proper handling, all stages of sample collection, storage, and handling were documented in a field logbook. Pertinent information concerning field activities and sampling were recorded in the logbook by the Chief and/or Field Scientist.

All samples were transported or shipped under a CoC process. Proper CoC was maintained for all samples, and a CoC record accompanied all samples. Personnel involved with the custody of the sample(s) signed the appropriate forms and ensured that the samples were properly handled, stored, and transported to the analytical laboratory. Sample shipping containers were secured to be leakproof, avoid cross-contamination, and prevent sample loss during shipment.

Sample analysis requests and instructions were prepared to accompany or be sent separately for all samples shipped to the laboratories. The project team confirmed that all samples were delivered and logged in at each designated laboratory. Samples were shipped to the appropriate laboratory for analysis as soon as possible after collection. Transport and shipping were coordinated to ensure compliance with sample holding times.

3.6.3 Document and Data Security

All data collected during field operations (e.g., navigation and positioning, CTD, still and video imagery in digital format, acoustic, etc.) are duplicated and stored on two hard drives (typically, primary laptop and additionally at least one external hard drive). This storage occurs as soon as possible after collection but typically within the same watch or day, depending on the field deployment. Either the Chief Scientist

or Operations Lead ensures that a back-up external drive is included in the project mobilization. While on site, backup media are stored separately from the field computer. During return from the field, the field computer and backup media are transported separately whenever feasible, but at least one copy travels in personal possession. Either the Chief Scientist or the Operations Lead ensures that the data drives are delivered to CSA's Stuart, Florida office. Field notebooks and datasheets are then copied and scanned into a file associated with the job and together with other data are backed up on the data server. The link to these data is shared with the Project Manager to ensure redundant knowledge for future access. The Chief Scientist verifies that the data are put into CSA's enterprise-class storage system. CSA maintains two copies of the data—one live working copy and one copy on archival tape for disaster recovery purposes. All original raw data will be stored by CSA for at least 5 years after the completion of the contract, at which time CSA will contact the client or its representative to determine whether the data should be returned to the client. Upon request, copies of the raw data will be provided to the client or subject to audit by designated client representatives.

4.0 DATA PROCESSING AND LABORATORY METHODS

4.1 HYDROGRAPHIC PROFILES

Digital data files from the SBE19*plus* V2 CTD profiler were processed using SBE data processing software, a proprietary modular family of data processing software specific to SBE oceanographic instruments. The SBE data processing modules were used, as appropriate, to convert the raw data to a text file, extract the desired sections for specific stations, smooth the data, and import the file into a spreadsheet prior to plotting. Further processing prepared the data as diagrammatic vertical hydrographic profiles with SigmaPlot and tabular spreadsheet summaries presented in this report.

4.2 SEAWATER AND SEDIMENT ANALYSIS

TAMI (Haifa, Israel) performed the analysis of sediment metals, excluding mercury. The Geological Survey of Israel (GSI; Jerusalem, Israel) performed analysis of seawater metals and sediment mercury. TDI Brooks (College Station, Texas, U.S.) performed the analysis of seawater and sediment hydrocarbon samples. Weatherford Laboratories (Shenandoah, Texas, U.S.) performed the analysis of sediment grain size and TOC. Chesapeake Biological Laboratory (CBL; Solomons, Maryland, U.S) performed the analysis of seawater nutrients. ALS Limited (Fort Collins, Colorado, U.S.) performed the analysis of sediment and seawater radionuclides. **Tables 4** and **5** outline the analytical parameters, analysis methods, reporting units, and reporting limits of seawater and sediment samples, respectively. Quality assurance (QA) analyses were conducted by ALS Environmental (Kelso, Washington, U.S.), TDI Brooks, and TAMI, research and contract laboratories with extensive experience in the analysis of metals and hydrocarbons in seawater and marine sediments.

Table 4. Analytical parameters, analysis methods, reporting units, and reporting limits of quantification for seawater samples.

Parameter/ Analyte	Digestion/ Extraction Method	Primary Analytical Laboratory	Analytical/Detection/ Quantification Method	Limit of Quantification[1]	CCC[2]	Mediterranean Seawater Quality Standards[P]		Units
						Mean	Max.	
Arsenic	N/A	Geological Survey of Israel	ICP-MS	7	36	36	69	µg L^{-1}
Antimony	N/A		ICP-MS	0.2	500[P]	--	--	µg L^{-1}
Barium	N/A		ICP-MS	0.2	200	--	--	µg L^{-1}
Beryllium	N/A		ICP-MS	0.5	--	--	--	µg L^{-1}
Cadmium	N/A		ICP-MS	0.1	8.8	0.5	2	µg L^{-1}
Chromium	N/A		ICP-MS	5	--[3]	10	20	µg L^{-1}
Copper	N/A		ICP-MS	1	3.1	5	10	µg L^{-1}
Lead	N/A		ICP-MS	0.1	8.1	5	20	µg L^{-1}
Mercury	N/A		Based on USEPA 1631E	0.01	0.94	0.16	0.4	µg L^{-1}
Nickel	N/A		ICP-MS	0.1	8.2	10	50	µg L^{-1}
Selenium	N/A		ICP-MS	7	71	60	150	µg L^{-1}
Silver	N/A		ICP-MS	0.5	--	3	7	µg L^{-1}
Thallium	N/A		ICP-MS	0.1	--	--	--	µg L^{-1}
Vanadium	N/A		ICP-MS	2	50	50	100	µg L^{-1}
Zinc	N/A		ICP-MS	2	81	40	100	µg L^{-1}

Table 4. (Continued).

Parameter/ Analyte	Digestion/ Extraction Method	Primary Analytical Laboratory	Analytical/Detection/ Quantification Method	Limit of Quantification[1]	CCC[2]	Mediterranean Seawater Quality Standards[P]		Units
						Mean	Max.	
Alkanes	Hexane	TDI Brooks	USEPA 1664/8100/8015 GC-MS	0.069 – 0.277	--	--	--	µg L^{-1}
Total petroleum hydrocarbons	Hexane		USEPA SW-846 Modified 8100/8015C	13	--	--	--	µg L^{-1}
PAHs	Hexane	TDI Brooks	USEPA SW-846/8260 GC-MS	0.74 – 2.91	--	--	--	ng L^{-1}
Total nitrogen	Persulfate digestion	Chesapeake Biological Laboratory	diazo colorimetric method	0.01	--	1.0		mg/L
Total phosphorus	Persulfate digestion		ascorbic acid colorimetric method	0.0013	--	0.1		mg/L
Total organic carbon	N/A		High-temperature combustion	0.24	--	--		mg/L
Radium 226	N/A	ALS Limited	USEPA Method 903.1	1	--	--	--	pCi L^{-1}
Radium 228	N/A		USEPA Method 904.0 and SW-846 9320	1	--	--	--	pCi L^{-1}

CCC = Criterion Continuous Concentration; GC-MS = gas chromatography-mass spectrometry; ICP-MS = inductively coupled plasma-mass spectrometry; N/A = Not applicable; PAHs = polycyclic aromatic hydrocarbons; USEPA = U.S. Environmental Protection Agency.
[1] Limits of quantification are the detection limits for metals and reporting limit for alkanes and PAHs.
[2] CCC is an estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in unacceptable adverse effect.
[3] Chromium III = 27.4 µg L^{-1}; Chromium VI = 50 µg L^{-1}.
[P] = proposed.

Table 5. Analytical parameters, analysis methods, reporting units, and reporting limits of quantification for sediment samples.

Parameter/ Analyte	Digestion/ Extraction Method	Analytical Laboratory	Analytical/Detection/ Quantification Method	Quantification Limit	ERL	ERM	Units
Grain size distribution	N/A	Weatherford Laboratories	Laser diffraction particle size analysis	0.1	--	--	µm
Total organic carbon	N/A		Based on European Standard Norm 1484	5	--	--	ppm
Aluminum	HF[1]	IMI TAMI Institute for Research & Development Ltd.	Based on ISO 11885	2	--	--	ppm
Antimony	HF[1]		Based on ISO 11885	1	2	25	ppm
Arsenic	HF[1]		Based on ISO 11885	3	8.2	70	ppm
Barium	HF[1]		Based on ISO 11885	0.5	--	--	ppm
Beryllium	HF[1]		Based on ISO 11885	1	--	--	ppm
Cadmium	HF[1]		Based on ISO 11885	0.5	1.2	9.6	ppm
Chromium	HF[1]		Based on ISO 11885	1	81	370	ppm
Copper	HF[1]		Based on ISO 11885	1	34	270	ppm
Iron	HF[1]		Based on ISO 11885	1	--	--	%
Lead	HF[1]		Based on ISO 11885	5	46.7	218	ppm
Mercury	HF[1]	Geological Survey of Israel	Based on USEPA 1631E	0.02	0.15	0.71	ppm

Table 5. (Continued).

Parameter/ Analyte	Digestion/ Extraction Method	Analytical Laboratory	Analytical/Detection/ Quantification Method	Quantification Limit	ERL	ERM	Units
Nickel	HF[1]	IMI TAMI Institute for Research & Development Ltd.	Based on ISO 11885	1	20.9	51.6	ppm
Selenium	HF[1]		Based on ISO 11885	1	--	--	ppm
Silver	HF[1]		Based on ISO 11885	1	1	3.7	ppm
Thallium	HF[1]		Based on ISO 11885	1	--	--	ppm
Vanadium	HF[1]		Based on ISO 11885	1	--	--	ppm
Zinc	HF[1]		Based on ISO 11885	1	150	410	ppm
Alkanes	Hexane	TDI Brooks	USEPA 1664/8100/8015/GC-MS	0.004 – 0.019	--	--	$\mu g\ g^{-1}$
Total petroleum hydrocarbons	Hexane		USEPA/SW-846 Modified 8100/8015C	1.4	--	--	$\mu g\ g^{-1}$
PAHs	Hexane		USEPA SW-846/8260/GC-MS	0.342 – 0.041	552[2] 4,002[3]	3,160[2] 44,792[3]	$ng\ g^{-1}$
Radium 226	N/A	ALS Limited	USEPA Method 901.1	1	--	--	$pCi\ g^{-1}$
Radium 228	N/A		USEPA Method 901.1	1	--	--	$pCi\ g^{-1}$
Thorium 228	N/A		USEPA, EMSL/LV	0.2	--	--	$pCi\ g^{-1}$

EMSL/LV = Environmental Monitoring Systems Laboratory, Las Vegas; ERL = Effects Range Low; ERM = Effects Range Median; GC-MS = gas chromatography-mass spectrometry; HF = hydrofluoric acid; ISO = International Organization for Standardization; N/A = not applicable; PAHs = polycyclic aromatic hydrocarbons; USEPA = U.S. Environmental Protection Agency.

[1] The HF digestion procedure results in the release of nearly all the metal content of a sample and is believed to be a more accurate estimate of the metal concentrations in all sample matrices.

[2] Low molecular weight PAHs.

[3] Total PAHs.

4.2.1 Seawater

Total Suspended Solids

Acceptable methods for the laboratory determination of TSS include USEPA Method 160.2 and Standard Methods 2540D. TSS concentrations in seawater samples were determined by pouring a known volume of seawater (~1 L) through a preweighed glass fiber filter of a specified pore size and then weighing the filter again to 0.001 mg after rinsing the filter with deionized water to remove salts and drying in an oven to remove residual water.

Total Organic Carbon

TOC concentrations in seawater were determined in a Shimadzu TOC-5000 analyzer using a high temperature combustion method. Samples were treated with hydrochloric acid and sparged with ultrapure carrier-grade air to drive off inorganic carbon. High temperature combustion (680°C) on a catalyst bed of platinum-coated alumina balls breaks down organic carbon into carbon dioxide (CO_2). The CO_2 was carried by ultra-pure air to a nondispersive infrared detector, where CO_2 was detected and quantified.

Nutrients

Seawater nutrient analysis included TN and TP concentrations determined through colorimetric methods in a segmented flow analyzer. TN concentrations were determined by the diazo-colorimetric method after alkaline persulfate digestion. TP concentrations were determined by the molybdo-phosphoric blue colorimetric method after alkaline persulfate digestion.

Total Metals

Total metals (i.e., metals in unfiltered samples) were analyzed principally by inductively coupled plasma-mass spectrometry (ICP-MS) methods. The analysis was by flow injection ICP-MS using an Elan DRC-e Perkin-Elmer without dilution of samples. Analysis of mercury was by atomic fluorescence spectroscopy with a PS Analytical Millennium System.

ALS Environmental's methods for analysis of metals in seawater involved reductive precipitation methods to achieve lower detection limits in a high salt matrix. The seawater samples were treated with iron and palladium carriers, pH adjusted, and then subjected to reducing conditions using sodium tetrahydridoborate (sodium borohydride) then analyzed by ICP-MS. Barium was analyzed by inductively coupled plasma-atomic emission spectrometry (ICP-AES). Antimony was determined in a 1:20 dilution of seawater in a sample and analyzed by ICP-MS. Selenium in seawater was determined by borohydride reduction and atomic absorption spectrophotometry. Seawater samples analyzed for mercury were prepared for analysis by the addition of bromine monochloride solution and analyzed with a Brooks Rand Model III cold vapor atomic fluorescence spectrometer.

Hydrocarbons

Hydrocarbon components in seawater were analyzed using solvent extraction and gas chromatographic techniques. Analytical methods for hydrocarbons were similar for the primary analytical and QA laboratories. The analytical method for alkanes was USEPA Method 1664 (solvent extraction; gas chromatography-mass spectrometry [GC-MS]). The analytical method for TPH was USEPA/SW-846 Modified 8100/8015C. Analytical methods for PAHs include USEPA SW-846/8260 or 8270 or equivalent using an Agilent Model 6890/5973 gas chromatograph-mass spectrometer.

Radionuclides

The Ra 226 in aqueous samples is concentrated and separated by co-precipitation with barium sulfate ($BaSO_4$). Prior to separation, a portion of the sample is removed for ICP-AES determination of the preparation concentration of barium in the sample. The $Ba[Ra]SO_4$ precipitate is dissolved in basic ethylenediaminetetraacetic acid (EDTA) solution, placed in a 40-mL volatile organic analysis vial, purged of any existing radon 222 (Rn 222), and stored to allow quantitative in-growth of Rn 222. After in-growth, the radon is purged into an alpha scintillation cell. The short-lived Rn 222 progeny are allowed to come to equilibrium with the parent radon (~4 hours) before the scintillation cell is counted for alpha activity. The 4-hour in-growth period also allows for the decay of other radon isotopes.

The radon isotopes in a water sample are collected by co-precipitation of barium and lead sulfate and purified by re-precipitation out of a basic EDTA solution. This technique is devised so that the beta activity from actinium 228 (Ac 228), which is produced by decay of Ra 228, can be determined and related to the activity concentration of Ra 228 present in the sample. After a 36-hour period to allow for the in-growth of Ac 228, lead is removed as lead (II) sulfide, and actinium is carried on yttrium as the hydroxide and mounted as the oxalate, and quickly beta-counted on a gas flow proportional counter to minimize decay of the short-lived Ac 228 (~6 hours).

4.2.2 Sediment

Grain Size

Sediment grain size was determined by means of laser (diffraction) particle size analysis using a Malvern 2000 Mastersizer. Particle sizes were computed automatically within the instrument using the Mie Model for light scattering and reported as percent distribution according to size classes representing sand, silt, and clay-sized particles.

Total Organic Carbon

Ground sediments were accurately weighed and then treated with concentrated hydrochloric acid to remove carbonates. The samples were left in acid for a minimum of 2 hours. The acid was removed from the sample with a filtration apparatus fitted with a glass microfiber filter. The filter was placed in a LECO crucible and dried at 110° C for a minimum of 1 hour. After drying, the sample was analyzed with a LECO 600 carbon analyzer.

Total Metals

Analyses were conducted to determine the concentrations of various metals including aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Analysis for all sediment metals except mercury was conducted by acid digestion and with Varian Vista AX inductively coupled plasma-atomic absorption spectrometer and calibrated against prepared standard solutions. Mercury analysis of sediments was conducted using cold vapor atomic absorption spectroscopy and calibrated against prepared standard solutions. The sediment subsample was digested in nitric acid, hydrogen peroxide, and hydrofluoric acid with the release of elemental mercury by the addition of stannous chloride.

Hydrocarbons

Hydrocarbon components in sediments were analyzed by solvent extraction and gas chromatographic techniques. The analytical methods for hydrocarbons included USEPA Method 1664/8100/8015 (solvent extraction; GC-MS) for alkanes, USEPA/SW-846 Modified 8100/8015C for TPH, and USEPA SW-846/8260 or 8270 using an Agilent Model 6890/5973 gas chromatograph-mass spectrometer and calibrated against prepared standard solutions for PAHs.

Radionuclides

For Ra 226, the method involved drying and sieving the sample, sealing the sample in a steel can, and allowing 21 days for the in-growth of the Pb 214 and bismuth 214 (Bi 214) progeny. The analysis entailed quantification of the Pb 214 and Bi 214 progeny, assuming secular equilibrium, and reporting the abundance weighted mean of the lead and bismuth activities as Ra 226. Assuming secular equilibrium, the gamma emissions from Ac 228, which is produced by decay of Ra 228, are determined and related to the activity concentration of Ra 228 present in the sample. Gamma emissions from radionuclides were detected by a semiconductor germanium crystal, which provided a small electronic pulse for each gamma interaction where the pulse height was proportional to the gamma incident energy. These electronic data were converted to digital data by an analog-to-digital converter and stored in a multichannel buffer. The data collected by the multichannel buffer were subsequently interpreted by a complex software program, generating results in units of radioactivity per unit sample volume.

Thorium samples were dried and ground to a fine particle size. In cases where there is high organic matter, the samples are placed in a muffle furnace so that any organic matter is removed by combustion. Tracers were added and dissolution was accomplished using nitric, hydrochloric, and hydrofluoric acids. When actinides were being determined, a hydroxide co-precipitation was performed to pre-concentrate actinides and remove constituents that did not form insoluble hydroxides. The hydroxide precipitate was then re-dissolved, and further purification was performed through various chromatography resins. The purified thorium was co-precipitated with lanthanum fluoride and mounted on a filter membrane for quantification by alpha spectroscopy.

4.3 INFAUNA

Samples were transported to EcoAnalysts, Inc. (Moscow, Idaho. U.S.) for sorting and taxonomic identification. Each infaunal sample was transferred from formalin to ethyl alcohol prior to sorting. Samples were sorted to major taxonomic groups and then distributed to taxonomists for species identification and enumeration. During the taxonomic process, organisms were identified to the lowest practical taxonomic level by EcoAnalysts, Inc. in-house taxonomists. Nematodes were not identified, and oligochaetes and ostracods were only enumerated. Data were recorded on electronic datasheets within the EcoAnalysts, Inc. laboratory information management system and then later output in a Microsoft Excel format.

A variety of statistical routines were applied to the resulting datasets using PRIMER v.6 (Clarke and Gorley, 2006) software, which was used to calculate several univariate community structure indices, including Shannon's H′ (base 2), Pielou's evenness value (J′), and Fisher's log-series *alpha*[1].

4.4 VIDEOGRAPHY AND SONAR

Video data were reviewed to generally characterize the seafloor substrate and associated biological community (i.e., epibiota and demersal fishes). The presence/absence and relative abundance estimates for epifauna and demersal fishes were used to characterize the biological community.

Forward-looking sonar acoustic data collected along the ROV transects provided additional information specific to the localized seafloor topography within the survey area. Representative sonar images were processed to present the acoustic signatures of seafloor topographic features.

[1] Fisher's log-series model of species abundance (Fisher et al., 1943) has been widely used, particularly by entomologists and botanists (Magurran, 1988) and more recently for deep-sea benthic data analysis. Taylor's (1978) studies of the properties of this index found that it was the best index for discriminating among subtly different sites.

The Tamar Field and Pipeline Survey was conducted by CSA personnel from 26 to 31 March 2013 from the M/V *EDT ARES*. The following subsections present the results of the Tamar Field and Pipeline Survey.

5.1 SEA STATE

Weather conditions during survey operations were variable. Sea state varied from calm to 2 m from the west-northwest. Wind direction was also variable, with wind speed ranging from calm to 15 knots.

5.2 HYDROGRAPHIC DATA

Hydrographic profiles of the water column collected on 26 March 2013 at Station TF7 in a water depth of approximately 1,680 m are shown in **Figure 3**. The hydrographic profiles are considered representative of the water column in the survey area.

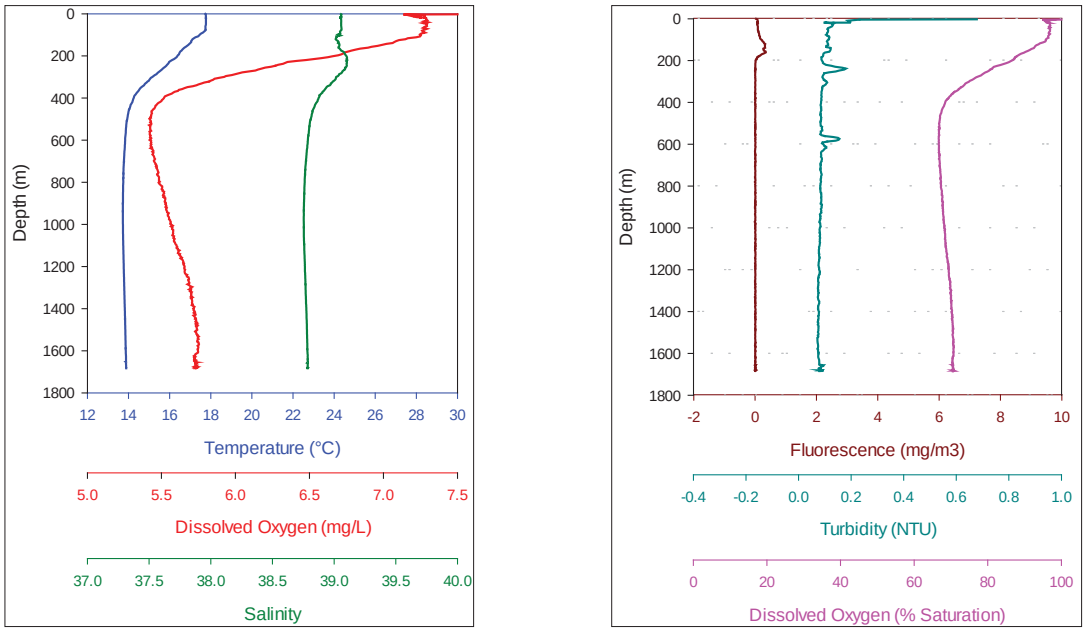

Figure 3. Hydrographic profiles of the water column collected at Station TF7 on 26 March 2013: temperature, dissolved oxygen (mg L^{-1}), and salinity (left), and fluorescence, turbidity, and dissolved oxygen (% saturation) (right).

Surface waters were cool and isothermal (17°C), then water temperatures decreased through the thermocline and stabilized to 14°C through the remainder of the water column to the seafloor. Salinity varied between 38.7 and 39.1 through the halocline (salinity gradient) and gradually stabilized with increasing water depth to 38.7 at the seafloor. Turbidity was low (0.10 to 0.15 nephelometric turbidity units [NTU]) throughout the water column. Photosynthetic activity, which can be used to estimate primary productivity within the water column, was measured with a fluorometer. The photosynthetic maximum occurred at water depths between 50 and 95 m, primarily due to an optimal combination of nutrient and light availability at those depths that promotes phytoplankton growth. Above this layer,

nutrient availability for phytoplankton growth is generally limiting, while below this layer a reduction in light penetration inhibits phytoplankton growth.

The water column was well oxygenated at the surface (7.4 mg L^{-1}) and through the surface-mixed layer before stabilizing to ~5.7 mg L^{-1} above the seafloor. The near-surface depression of DO may be attributed to the actinic effects of sunlight decreasing photosynthesis. The DO stabilization at water depths below 400 m is typical of the Levantine Basin because the amount of organic material sinking from the surface waters is low, which limits microbial respiration at depth (Krom, 1995).

5.3 SEAWATER AND SEDIMENT ANALYSIS

Seawater samples were collected near-bottom from all Tamar Field stations (**Figure 4**) and analyzed for TSS, nutrients, total metals, hydrocarbons, and radionuclides. Sediment samples (**Figure 5**) were collected from all stations located in Tamar Field and along the pipeline. These samples were analyzed to determine grain size and concentrations of TOC, total metals, hydrocarbons, and radionuclides.

5.3.1 Seawater

Total Suspended Solids

TSS concentrations appear to be slightly elevated throughout the survey area (**Table 6**) relative to concentrations that may be expected in the open ocean environment of the eastern Mediterranean and based on direct observations concerning water clarity. The water clarity throughout the water column was very good based on direct video observations, with no visible suspended solids outside the immediate range of the ROV. TSS concentrations averaged 13.4 ± 22.0 mg L^{-1} for the Tamar Field (**Table 6**). The high TSS concentration at Station TF1 (72.0 mg L^{-1}) is likely due to the resuspension of sediments near the seafloor due to ROV operations. TSS concentrations at all stations were higher than the reported concentrations for northeastern Mediterranean surface waters, which ranged from 0.6 to 1.7 mg L^{-1} (Yilmaz et al., 1998).

Nutrients

TN and TP concentrations in seawater samples were low and nearly uniform throughout the water column and survey area (**Table 7**). The eastern Levantine Basin has extremely low levels of nutrients, and the region is considered "ultra-oligotrophic." Nitrate and phosphate concentrations in surface waters in the eastern Mediterranean are one-half their concentrations in the western basin (Bethoux et al., 1992). This severe nutrient deficit is due to the very low net supply of nutrients to the Mediterranean Basin because the Atlantic inflow brings in nutrient-depleted surface waters and there is very little nutrient input from rivers in the eastern Levantine Basin (Krom, 1995).

Total Metals

Results of the analysis of total metals in seawater are provided in **Table 8** along with mean concentrations observed during previous Levantine Basin baseline surveys, Mediterranean Sea water quality standards, and toxicity reference values (marine Criterion Continuous Concentrations [CCCs] from Buchman, 2008). Analytical results for seawater total metals concentrations are found in **Appendix C**. Where USEPA National Recommended Water Quality Criteria (NRWQC) (Buchman, 2008) are not available for some metals, criteria from other countries (e.g., Canada, New Zealand) are provided for reference. Concentrations of antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc were not detected by the primary laboratory. All seawater total metals concentrations in the Tamar Field samples were below the mean and maximum Mediterranean Sea water quality standards and below potentially harmful levels, as defined by CCC values. The recorded barium concentrations in the survey area water column were at ambient levels.

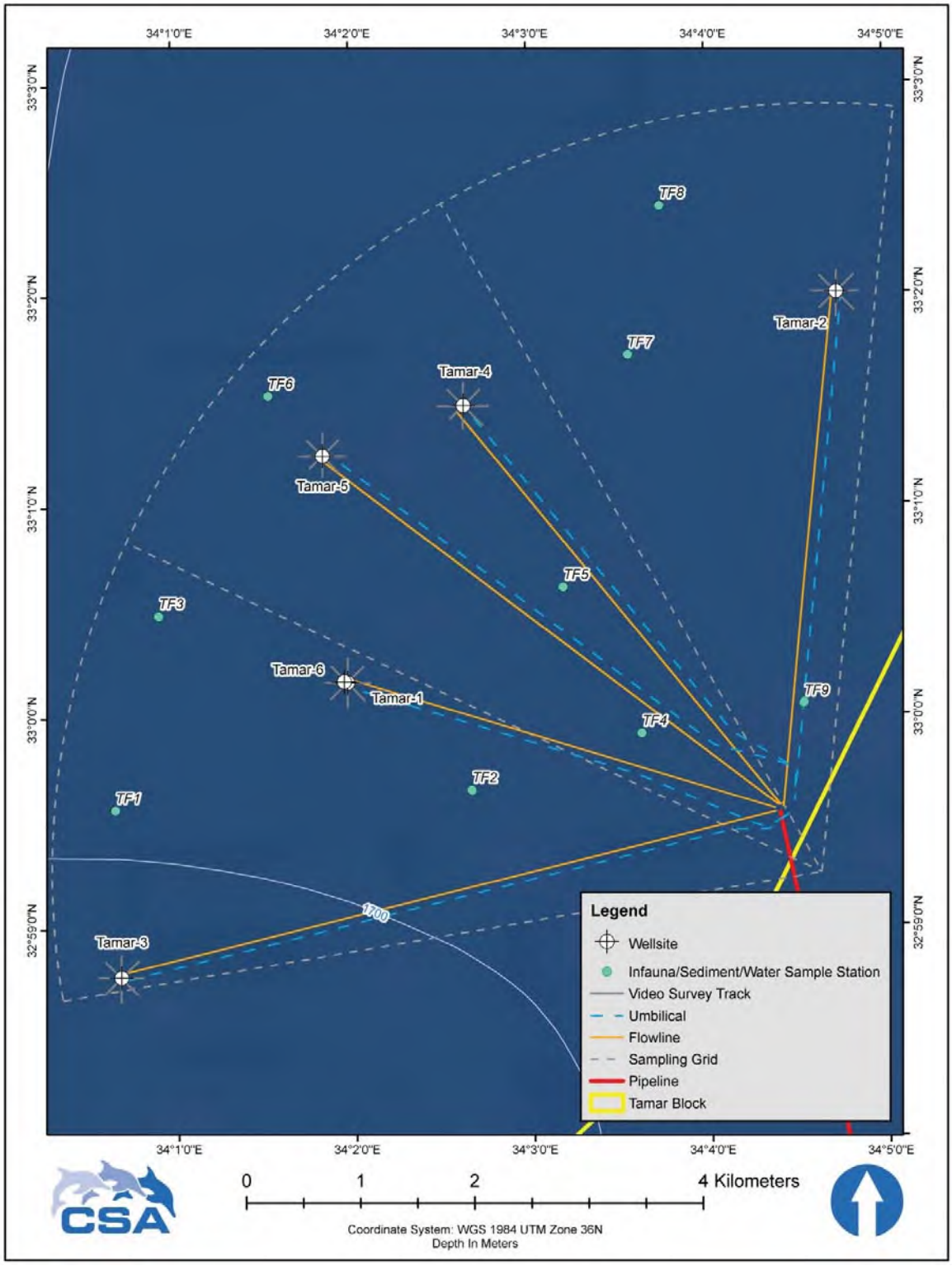

Figure 4. Locations of seawater, sediment, and infauna sampling stations and video survey tracks in the Tamar Field in relation to existing wellsites and infrastructure.

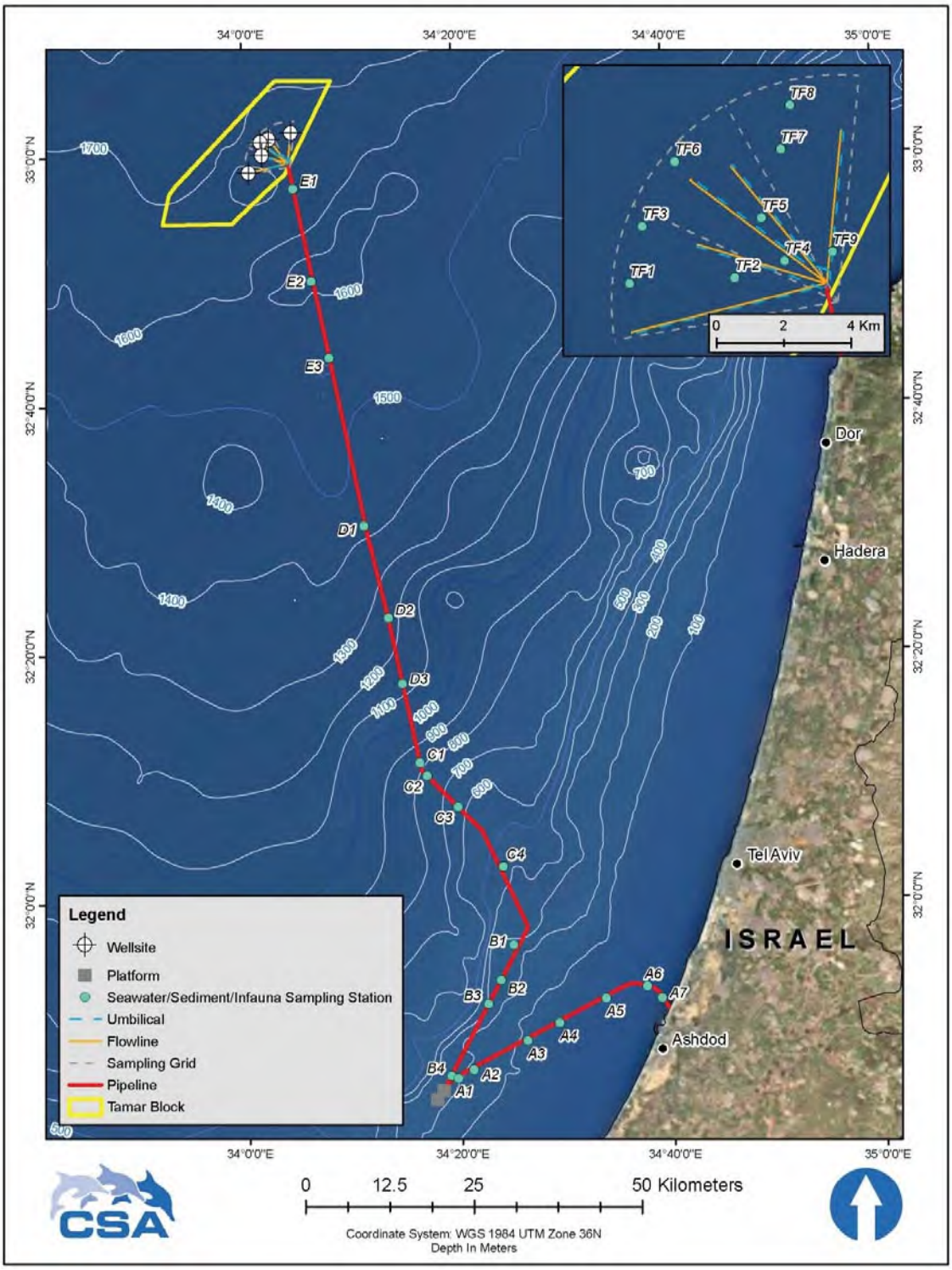

Figure 5. Locations of sediment and infauna sampling stations along the Tamar pipeline in relation to the coast of Israel. Locations of seawater, sediment, and infauna sampling stations within the Tamar Field are shown in the inset.

Table 6. Station concentrations (mg L^{-1}) and mean concentrations (± standard deviation [SD]) of total suspended solids (TSS) in seawater samples collected near the seafloor in the Tamar Field. Mean (± SD) Levantine Basin baseline survey data and the proposed Mediterranean Sea water quality standards in Israel are provided for comparison (MoEP, 2002).

Station	TSS (mg L^{-1})
TF1	72.0
TF2	7.8
TF3	7.2
TF4	7.4
TF5	5.6
TF6	4.3
TF7	4.9
TF8	6.1
TF9	5.6
Tamar Field mean*	6.1 ± 1.3
Levantine Basin baseline data	8.7 ± 6.4
Proposed Mediterranean Sea water quality standards in Israel	≤10 mg L^{-1} above the natural seasonal mean

* The abnormally high TSS value at Station TF1 was most likely caused by the remotely operated vehicle hitting the seafloor at this station; this value was excluded for the calculation of the Tamar Field mean.

Table 7. Station concentrations (mg L^{-1}) and mean concentrations (± standard deviation [SD]) of total nitrogen (TN) and total phosphorus (TP) in seawater samples collected near the seafloor in the Tamar Field. Mean (± SD) Levantine Basin baseline survey data and the proposed Mediterranean Sea water quality standards in Israel are provided for comparison (MoEP, 2002).

Station	TN (mg L^{-1})	TP (mg L^{-1})
TF1	0.20	0.009
TF2	0.13	0.012
TF3	0.14	0.013
TF4	0.14	0.013
TF5	0.26	0.009
TF6	0.14	0.009
TF7	0.16	0.009
TF8	0.17	0.011
TF9	0.20	0.011
Tamar Field mean	0.17 ± 0.04	0.011 ± 0.002
Levantine Basin baseline data	0.43 ± 0.47	0.012 ± 0.012
Proposed Mediterranean Sea water quality standards in Israel	1.0	0.1

Table 8. Metals concentrations (µg L^{-1}) in seawater collected from Tamar Field sampling stations, with comparisons to toxicity reference values (Criterion Continuous Concentration [CCC]) (Buchman, 2008), the proposed Mediterranean Sea water quality standards in Israel (MoEP, 2002), and mean Levantine Basin baseline survey data.

Station	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
TF1	<0.2	<7.0	10	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF2	<0.2	<7.0	10	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF3	<0.2	<7.0	10	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF4	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF5	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF6	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF7	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF8	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
TF9	<0.2	<7.0	9	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
Tamar Field mean	<0.2	<7.0	9.3 ± 0.5	<0.5	<0.1	<10	<1.0	<0.1	<0.02	<1.0	<7.0	<0.1	<0.1	<10	<2.0
Levantine Basin baseline data	<0.2	<7.0	9.0 ± 1.6	<0.5	<0.1	<10	<1.0	<1.0	<0.02	<0.1	<7.0	<0.1	<0.1	<10	<2.0
Method detection limit of primary laboratory	0.2	7	0.2	0.5	0.1	10	1	0.1	0.02	0.1	7	0.5	0.1	10	2
Proposed Mediterranean Sea water quality standards in Israel	--	36	--	--	0.5	10	5	5	0.16	10	60	3	--	50	40
	--	69	--	--	2	20	10	20	0.4	50	150	7	--	100	100
CCC value	500[p]	36	200 BC	100 BC	9.3	50	3.1	8.1	0.94	8.2	71	0.95* [(1/2)]	17 NZ	50 BC	81

ND = not detected; QC = quality control sample.
* = Criterion Maximum Concentration.
[(1/2)] = Criterion Maximum Concentration has been halved to be comparable to 1985 guidelines for minimum data requirements and derivation procedures.
[p] = proposed.
Sources of CCC toxicity reference values: primary entry is the U.S. Ambient Water Quality Criteria; BC = British Columbia Water Quality Guidelines; NZ = Australian and New Zealand Environmental Concern Levels and Trigger Values.

Hydrocarbons

Alkanes and TPH were not detected in seawater from the survey area (**Appendix D**), i.e., all results were below the reported analytical limits of detection. Concentrations of alkanes were not detected by the primary analytical and QC laboratories, indicating that no significant amounts of these hydrocarbons were present in the water column. The method detection limit (MDL) for alkanes ranged between 0.069 µg L^{-1} (tetracosane [C24]) and 0.277 µg L^{-1} (tetradecane [C14]). The MDLs for TPH and all alkanes tested were below the maximum Mediterranean Sea Water Quality concentration of 0.5 mg L^{-1} for mineral oils, fatty substances, and oils (crude oil, hydrocarbons, and lubrication oils) (MoEP, 2002). There are no toxicity reference values available for alkanes in seawater.

Seawater samples were analyzed for the following alkanes:

undecane (C11)
dodecane (C12)
tetradecane (C14)
hexadecane (C16)
octadecane (C18)
eicosane (C20)
tetracosane (C24)
octacosane (C28)
dotriacontane (C32)
hexatriacontane (C36)
tetracontane (C40)

PAH concentrations for analytes in seawater samples and MDLs for the primary analytical laboratory are reported in **Table 9**. Individual PAH concentrations were low, and total PAH concentrations averaged 70.2 ± 52.4 ng L^{-1}. All concentrations were below the mean Mediterranean Sea Water Quality concentration of 5,000 ng L^{-1} for PAHs (MoEP, 2002).

Table 9. Polycyclic aromatic hydrocarbon (PAH) concentrations (ng L^{-1}) and means (± standard deviation) in seawater collected from the Tamar Field.

PAH	MDL	Station									Tamar Field Mean
		TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	TF9	
Naphthalene	2.91	6.79	5.25	5.01	6.32	7.49	6.17	5.45	6.04	5.60	6.0 ± 0.8
Acenaphthylene	1.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	1.44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	0.81	0.421	0.390	0.368	0.37	0.42	1.58	0.41	0.48	ND	0.6 ± 0.4
Anthracene	0.77	ND	ND	ND	ND	ND	3.09	ND	ND	ND	ND
Phenanthrene	2.26	1.45	1.57	1.06	1.15	1.20	14.7	1.08	1.37	ND	ND
Fluoranthene	1.09	ND	ND	ND	ND	ND	21.5	ND	ND	ND	ND
Pyrene	1.37	ND	0.509	0.247	0.347	0.340	17.7	0.200	0.284	0.186	2.9 ± 4.8
Benz(a)anthracene	0.74	ND	ND	ND	ND	ND	13.1	ND	ND	ND	ND
Chrysene /Triphenylene	0.80	ND	ND	ND	ND	ND	9.57	ND	ND	ND	ND
Benzo(b)fluoranthene	2.38	ND	ND	ND	ND	ND	12.9	ND	ND	ND	ND
Benzo(k,j)fluoranthene	2.51	ND	ND	ND	ND	ND	5.39	ND	ND	ND	ND
Benzo(a)pyrene	2.69	ND	ND	ND	ND	ND	10.1	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	1.39	ND	ND	ND	ND	ND	4.78	ND	ND	ND	ND
Dibenz(a,h)anthracene	1.14	ND	ND	ND	ND	ND	1.48	ND	ND	ND	ND
Benzo(g,h,i)perylene	2.51	ND	ND	ND	ND	ND	5.80	ND	ND	ND	ND
Total PAHs	--	**49.9**	**47.7**	**50.1**	**58.8**	**64.3**	**209**	**45.2**	**56.0**	**50.4**	**70.2 ± 52.4**

MDL = method detection limit of the primary analytical laboratory; ND = not detected.

Radionuclides

Results of the seawater analysis of radionuclides (Ra 226 and Ra 228) are provided in **Table 10** and **Appendix E**. Mean concentrations of radionuclides (Ra 226 and Ra 228) in the Tamar Field were 0.12 ± 0.08 and 0.11 ± 0.12 pCi L^{-1}, respectively.

Table 10. Mean and combined mean concentrations of radionuclides (radium 226 [Ra 226] and radium 228 [Ra 228]) in seawater from the Tamar Field. Levantine Basin baseline survey data are provided for comparison.

Station	Concentration (pCi L^{-1})		
	Ra 226	Ra 228	Combined Ra 226 and Ra 228
TF1	0.11	0.20	0.31
TF2	0.11	0.21	0.32
TF3	0.16	0.08	0.24
TF4	0.06	0.00	0.06
TF5	0.10	0.33	0.43
TF6	0.11	0.11	0.22
TF7	0.06	0.00	0.06
TF8	0.03	0.01	0.04
TF9	0.31	0.05	0.36
Tamar Field mean	0.12 ± 0.08	0.11 ± 0.12	0.23 ± 0.14
Levantine Basin baseline data	0.09 ± 0.08	0.18 ± 0.22	0.27 ± 0.23

The USEPA established a maximum contaminant level (MCL) for combined Ra 226 and Ra 228 at 5 pCi L^{-1} (USEPA, 1976). Combined Ra 226/228 concentrations in seawater from the Tamar Field survey area averaged 0.23 ± 0.14 pCi L^{-1}. The MCL is a maximum permissible level of a contaminant that ensures the safety of the water over a lifetime of consumption and also takes into consideration feasible treatment technologies and monitoring capabilities. These data indicate that naturally occurring radium levels in seawater throughout the Tamar Field are extremely low and well below levels of concern.

5.3.2 Sediment

Grain Size

Table 11 and **Figures 6** and **7** summarize the grain size distribution and sediment type (Shepard, 1954) in the Tamar Field and along the Tamar pipeline route. Laboratory reports for grain size analysis are provided in **Appendix F**. Sand percentages were arcsine transformed to normalize the data. An analysis of variance (ANOVA) conducted on the transformed data indicated that there was a significant difference in sand composition of seafloor sediments among the survey strata ($F_{5,24} = 2.74$; $P = 0.04$). A least significant difference multiple means comparison test showed that seafloor sediments collected from the 20 to 200 m depth stratum had a significantly higher percentage of sand than all other strata (t_{24}; $P = <0.05$); sediments from this stratum were classified as sand, sand/silt/clay, or clayey silt. Sediments with in all other strata were composed primarily of clay with a significant silt fraction and were classified as either clayey silt or silty clay (**Table 11**; **Figure 6**).

Grain size characteristics along the pipeline route were generally similar in water depths ≥200 m. At depths of <200 m, the sand fraction of seafloor sediments increased as water depth decreased (**Figure 6**), as would be expected when proximity to the shoreline increases. Sand composition of seafloor sediments collected along the pipeline route are in general agreement with mean sand compositions measured during

Noble Energy environmental baseline and pre-drill surveys previously conducted by CSA at various water depths throughout the Levantine Basin (**Figure 7**).

Table 11. Grain size distribution and sediment type at sediment sampling stations in the Tamar Field and along the Tamar pipeline route.

Depth Strata	Water Depth (m)	Station	Silt (%)	Clay (%)	Sand (%)	Sediment Type
20 – 200 m	20	A7	0.0	0.0	100.0	Sand
	36	A6	34.5	22.9	42.6	Sand/Silt/Clay
	46	A5	47.3	21.9	30.8	Sand/Silt/Clay
	71	A4	61.0	24.9	14.1	Clayey Silt
	95	A3	63.0	28.5	8.5	Clayey Silt
	186	A2	59.5	38.4	2.1	Clayey Silt
	216	A1	62.9	35.2	1.9	Clayey Silt
200 – 300 m	247	B4	46.1	53.6	0.3	Silty clay
	255	B2	55.7	43.7	0.6	Clayey Silt
	257	B3	58.1	41.6	0.3	Clayey Silt
	271	B1	53.7	42.5	3.8	Clayey Silt
300 – 900 m	445	C4	54.5	45.3	0.2	Clayey Silt
	801	C3	48.7	50.8	0.5	Silty clay
	932	C2	47.3	50.4	2.3	Silty clay
	994	C1	56.5	42.8	0.7	Clayey Silt
900 – 1,400 m	1,209	D3	44.8	53.2	2.0	Silty clay
	1,318	D2	44.2	53.8	2.0	Silty clay
	1,399	D1	42.7	51.7	5.6	Silty clay
1,400 – 1,700 m	1,551	E3	41.7	54.5	3.8	Silty clay
	1,608	E2	43.1	53.2	3.7	Silty clay
	1,679	E1	42.1	54.5	3.4	Silty clay
Tamar Field (1,700 m)	1,701	TF9	41.7	55.0	3.3	Silty clay
	1,706	TF2	43.1	53.6	3.3	Silty clay
	1,709	TF3	39.8	54.7	5.5	Silty clay
	1,710	TF4	43.3	53.8	2.9	Silty clay
	1,716	TF1	41.7	52.7	5.6	Silty clay
	1,718	TF5	43.3	53.4	3.3	Silty clay
	1,721	TF7	43.2	53.2	3.6	Silty clay
	1,725	TF6	42.4	54.8	2.8	Silty clay
	1,741	TF8	44.9	49.7	5.4	Silty clay

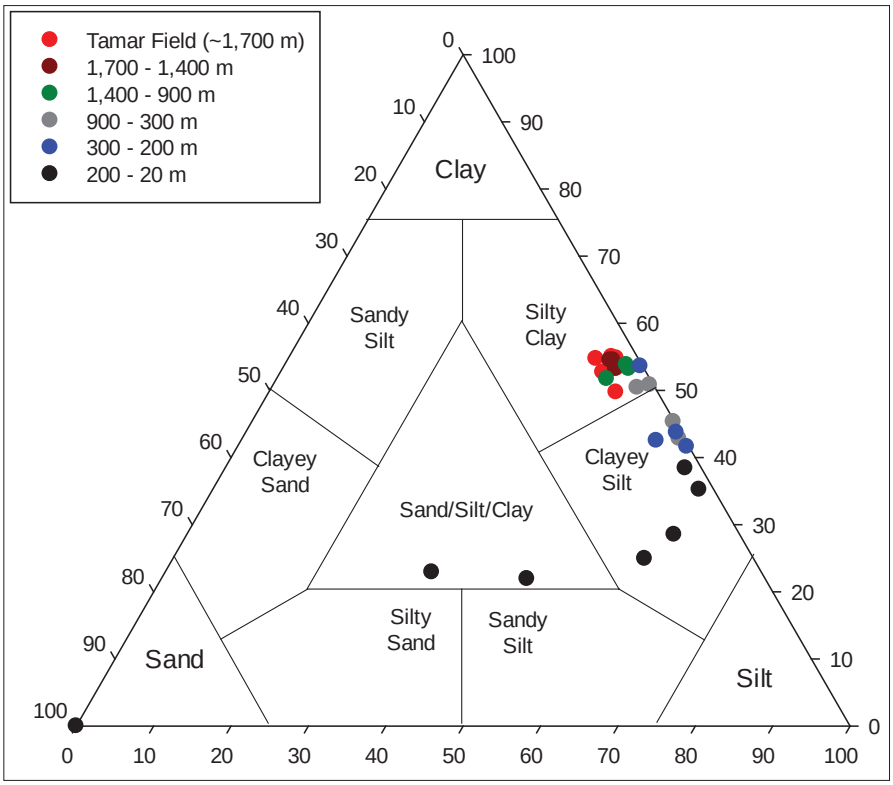

Figure 6. Ternary diagram showing grain size characteristics of sediments collected from Tamar Field and Pipeline Survey strata.

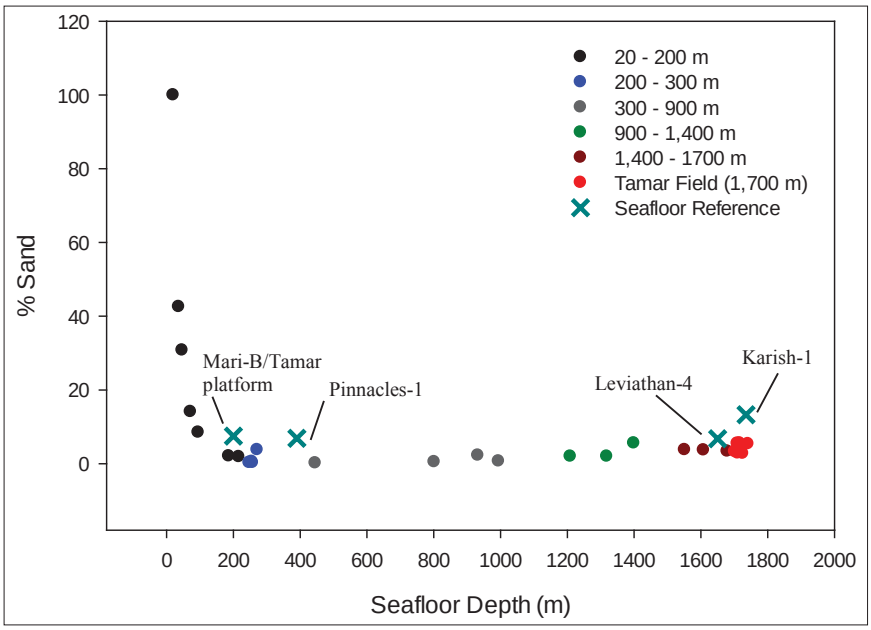

Figure 7. Percent sand composition of seafloor sediments collected from Tamar Field and Pipeline Survey strata. Mean sand compositions from environmental baseline/pre-drill surveys previously conducted by CSA (seafloor reference) are provided for comparison.

Total Organic Carbon

Mean percent TOC content in sediments collected from Tamar Field and pipeline route sampling strata are shown in **Figure 8**. Analytical results for TOC in sediment samples are provided in **Appendix G**. Sediment TOC concentrations were low (0.05% to 0.80%) throughout the survey area. The low TOC content reflects the deep-sea environment and oligotrophic nature of the eastern Mediterranean.

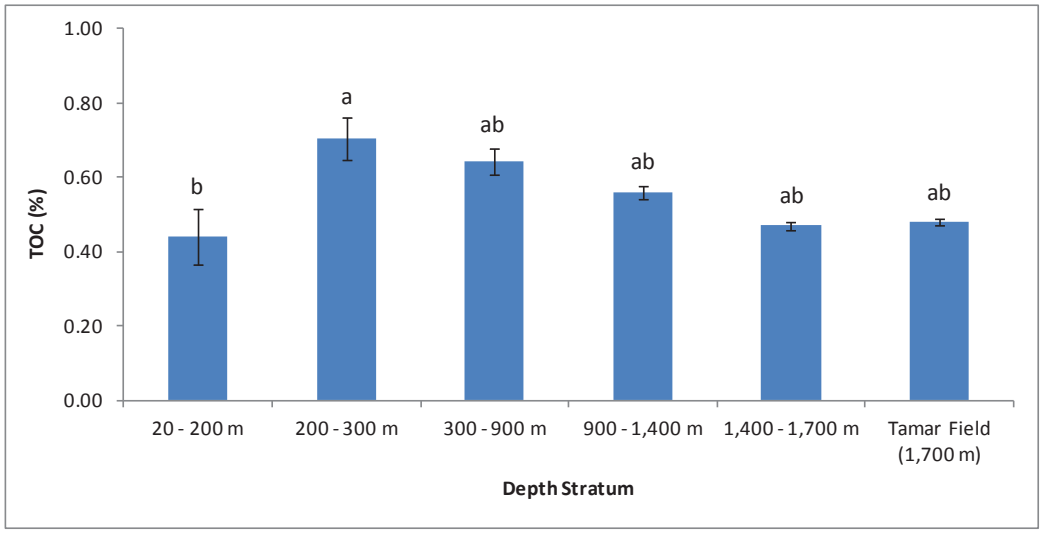

Figure 8. Mean percent total organic carbon (TOC) composition (± standard error [indicated by black error bars]) of seafloor sediments collected from Tamar Field and Pipeline Survey strata. Different letters indicate statistical differences among depth strata.

There was a statistical difference in sediment TOC concentrations among survey strata ($F_{5,24} = 2.71$; $P = 0.04$). A Tukey post-hoc multiple means comparison test indicated that sediment TOC concentrations in the 20 to 200 m and 200 to 300 m strata were significantly different from each other ($t_{24} = 3.11$; $P = 0.048$). Given the low overall percentage of TOC throughout the survey area, these differences are unlikely to be biologically significant.

Total Metals

Values for total metals concentrations in sediment samples are provided in **Table 12**. Analytical results are provided in **Appendix H**.

Total metals concentrations were generally within the range of concentrations found in mean marine sediments (Salomons and Förstner, 1984) and the continental crust (Wedepohl, 1995) (**Table 13**), except for arsenic and copper. Most metals values were generally lower than the Effects Range Low (ERL) and Effects Range Median (ERM) values. Exceptions where a metals concentration was higher than the corresponding ERL value but much lower than the corresponding ERM value occurred occasionally for chromium and copper. Nickel exceeded both the ERL and ERM values at several stations; however it must be noted that mean marine sediment and continental crust concentrations also exceed the ERM value. A concentration below an ERL represents a minimal effects range where biological effects are very rarely observed, while a concentration above an ERM represents an effects range where biological effects are likely to be observed (Long and Morgan, 1990). Reported concentrations of arsenic and copper in seafloor sediments are similar to ambient concentrations reported elsewhere within the Levantine Basin (**Table 13**).

Table 12. Total metals concentrations (ppm) in sediments collected along the Tamar pipeline route. Effects Range Low (ELM) and Effects Range Median (ERM) values (Buchman, 2008) are provided for comparison.

Depth Stratum	Depth (m)	Station	Aluminum (%)	Antimony (ppm)	Arsenic (ppm)	Barium (ppm)	Beryllium (ppm)	Cadmium (ppm)	Chromium (ppm)	Copper ppm)	Iron (%)	Lead (ppm)	Mercury (ppm)	Nickel (ppm)	Selenium (ppm)	Silver (ppm)	Thallium (ppm)	Vanadium (ppm)	Zinc (ppm)
20 – 200 m	20	A7	2.08	<0.50	4.32	299.0	0.31	0.19	72.2	3.12	0.16	1.85	<0.02	9.26	<0.5	<0.50	<0.5	45.6	15.4
	36	A6	4.03	1.60	21.9	176.0	0.86	0.65	55.6	30.1	1.55	25.3	0.08	37.0	0.62	0.59	<0.5	77.3	54.7
	46	A5	6.97	<0.50	14.4	197.0	0.88	0.49	100.0	38.0	3.97	3.4	<0.02	42.4	<0.50	0.84	<0.5	115.0	63.3
	71	A4	6.92	<0.50	19.2	172.0	0.91	0.50	79.0	35.8	4.11	4.11	≤0.02	50.7	<0.50	0.55	<0.5	133.0	74.4
	95	A3	8.51	4.40	20.1	210.0	1.10	0.71	99.0	37.7	5.24	5.24	≤0.02	55.6	<0.50	0.57	<0.5	134.0	74.7
	A3 - QC		--	14.1	ND	294.0	1.26	0.19	93.6	43.2	6.74	0.02	11.4	59.5	ND	0.24	0.58	155.0	89.6
	186	A2	8.09	<0.50	19.5	211.0	1.04	0.65	82.9	41.8	4.45	8.69	≤0.02	53.0	<0.50	0.50	<0.5	122.0	84.4
	216	A1	7.14	<0.50	5.62	134.5	0.57	0.5	1.91	25.9	4.23	4.04	0.07	30.3	<0.50	0.67	<0.5	72.3	50.5
200 – 300 m	247	B4	6.47	0.89	20.5	187.0	1.21	0.75	94.1	48.9	7.27	8.85	0.07	55.9	<0.50	0.65	<0.5	136.5	75.9
	255	B2	5.74	1.03	13.9	166.0	1.29	0.82	98.0	48.1	7.02	9.78	0.13	58.7	<0.50	0.55	<0.5	132.0	80.8
	257	B3	5.79	0.83	14.8	149.0	1.05	0.74	80.8	40.2	6.74	12.2	0.17	47.4	<0.50	<0.50	<0.3	108.0	67.2
	B3 - QC		--	11.1	ND	225.0	1.41	0.19	85.1	46.8	6.68	0.02	9.7	59.0	ND	0.25	0.60	136.0	1.10
	271	B1	6.58	1.51	23.5	206.0	1.14	0.83	99.1	43.7	7.13	10.7	≤0.02	53.4	<0.50	0.55	<0.5	147.0	73.4
300 – 900 m	445	C4	6.73	<0.50	25.2	239.0	1.17	0.76	79.5	44.5	6.94	16.2	0.04	50.3	<0.50	<0.50	<0.5	112.0	69.6
	801	C3	7.88	1.01	21.8	169.0	1.17	0.66	98.9	45.1	6.56	24.3	0.10	58.8	<0.50	<0.50	<0.5	97.8	70.5
	C3 - QC		--	18.1	0.5	271.0	1.62	0.24	82.7	54.5	6.76	0.03	32.1	65.8	ND	0.37	0.67	135.0	93.9
	932	C2	6.97	0.83	22.8	163.0	1.19	0.70	70.2	50.5	6.34	28.9	0.15	39.9	<0.50	<0.50	<0.5	74.2	51.4
	994	C1	6.28	1.17	36.4	243.0	1.36	0.80	72.9	55.0	5.71	40.7	0.06	56.2	<0.50	0.56	<0.5	104.0	72.2
900 – 1,400 m	1,209	D3	9.29	<0.50	12.8	109.0	1.10	0.51	64.9	47.0	6.35	15.9	0.03	48.5	0.85	0.59	0.7	102.0	67.2
	1,318	D2	9.05	<0.50	11.7	97.1	1.10	0.51	64.3	46.2	6.2	11.8	0.04	48.3	<0.50	<0.50	<0.5	100.0	66.2
	1,399	D1	8.76	<0.50	11.1	110.0	1.20	0.60	63.1	47.3	5.95	11.0	0.04	48.2	<0.50	0.51	<0.5	94.9	64.4

Table 12. (Continued).

Depth Stratum	Depth (m)	Station	Aluminum (%)	Antimony (ppm)	Arsenic (ppm)	Barium (ppm)	Beryllium (ppm)	Cadmium (ppm)	Chromium (ppm)	Copper ppm)	Iron (%)	Lead (ppm)	Mercury (ppm)	Nickel (ppm)	Selenium (ppm)	Silver (ppm)	Thallium (ppm)	Vanadium (ppm)	Zinc (ppm)
1,400 – 1,700 m	1,551	E3	9.19	<0.50	14.0	97.6	1.10	0.50	62.5	49.1	6.15	14.5	0.04	47.2	1.00	1.4	0.94	95.5	61.0
	1,608	E2	8.75	<0.50	12.7	95.4	1.00	0.51	62.5	50.9	5.88	13.4	0.10	49.2	<0.50	<0.50	<0.5	95.6	64.9
	1,679	E1	8.47	<0.50	12.5	92.9	1.00	0.44	58.5	49.2	5.50	11.1	0.04	46.8	<0.50	<0.50	<0.5	88.9	56.7
Tamar Field (1,700 m)	1,701	TF9	2.52	<0.50	16.9	185.0	1.10	0.42	69.9	61.0	5.97	31.4	0.05	50.9	0.50	0.66	<0.5	91.6	68.1
	1,706	TF2	7.59	<0.50	13.2	159.0	0.98	0.54	65.6	55.2	5.54	14.1	0.04	47.6	<0.50	1.90	<0.5	84.4	59.2
	1,709	TF3	8.91	0.80	17.9	153.0	1.00	0.44	67.2	58.7	5.79	17.4	0.03	49.6	<0.50	0.92	<0.5	88.6	59.9
	1,710	TF4	9.27	<0.50	14.3	185.0	1.10	0.48	72.7	62.7	6.19	19.1	0.06	59.6	0.85	2.70	<0.5	95.0	70.8
	1,716	TF1	6.66	<0.50	13.3	305.0	0.83	0.47	52.0	46.5	4.66	19.4	0.04	38.5	0.69	0.95	<0.5	68.1	52.9
	1,718	TF5	8.25	<0.50	15.8	205.0	1.10	0.46	67.2	56.9	5.81	15.1	0.04	50.0	<0.50	0.58	<0.5	89.2	64.8
	1,721	TF7	7.97	<0.50	15.6	254.0	1.10	0.37	68.1	57.9	5.72	18.7	0.05	50.5	<0.50	1.10	<0.5	89.7	65.6
	1,725	TF6	7.88	<0.50	13.1	249.0	1.10	0.40	70.2	59.8	5.86	14.5	0.04	52.3	<0.50	1.10	<0.5	93.2	66.1
	1,741	TF8	7.40	<0.50	16.3	139.0	1.10	0.49	73.4	61.6	5.82	13.5	0.05	57.2	<0.50	<0.50	<0.5	99.1	71.2
ERL			--	8.2	--	--	--	1.2	81.0	34.0	--	0.15	20.9	46.70	--	--	--	1.0	150.0
ERM			--	70.0	--	--	--	9.6	370.0	270.0	--	0.71	51.6	218.00	--	--	--	3.7	410.0

-- = not available; QC = quality control sample.

Table 13. Mean (± standard deviation) total metals concentrations (ppm) in sediments collected from the Tamar Field and Pipeline Survey strata, with comparisons to mean and range of metals concentrations within seafloor sediments of the Levantine Basin (CSA surveys), mean marine sediments (Salomons and Förstner, 1984), continental crust (Wedepohl, 1995), and Effects Range Low (ERL) and Effects Range Median (ERM) values (Buchman, 2008). Values exceeding the ERL values are shown in **bold**. Antimony, selenium, silver, and thallium concentrations were below primary analytical laboratory detection limits and are not presented in the table.

Metal	Mean Total Concentration						Mean Levantine Basin	Mean Marine Sediments	Continental Crust	ERL	ERM
	20 – 200 m	200 – 300 m	300 – 900 m	900 – 1,400 m	1,400 – 1,700 m	Tamar Field (1,700 m)					
Aluminum (%)	6.25 ± 2.33	6.15 ± 0.44	6.97 ± 0.67	9.03 ± 0.27	8.80 ± 0.36	7.38 ± 1.98	5.2 ± 3.1	--	7.96	--	--
Arsenic (ppm)	**15.01 ± 7.23**	**18.18 ± 4.60**	**26.55 ± 6.72**	**11.87 ± 0.86**	**13.07 ± 0.81**	**15.16 ± 1.76**	**17.8 ± 4.6**	7.7	1.7	8.2	70
Barium (ppm)	199.93 ± 51.12	177.00 ± 24.81	203.5 ± 43.40	105.37 ± 7.18	95.30 ± 2.35	203.78 ± 55.11	130 ± 60.3	460	584	--	--
Beryllium (ppm)	0.81 ± 0.28	1.17 ± 0.10	1.22 ± 0.09	1.13 ± 0.06	1.03 ± 0.06	1.05 ± 0.09	1.1 ± 0.3	2.0	--	--	--
Cadmium (ppm)	0.53 ± 0.17	0.79 ± 0.05	0.73 ± 0.06	0.54 ± 0.05	0.48 ± 0.04	0.45 ± 0.05	0.6 ± 0.2	0.17	0.1	1.2	9.6
Chromium (ppm)	70.09 ± 33.76	**93.00 ± 8.41**	80.38 ± 12.95	64.10 ± 0.92	61.17 ± 2.31	67.37 ± 6.32	68.4 ± 16.1	72	126	81	370
Copper (ppm)	30.35 ± 13.13	**45.23 ± 4.06**	**48.78 ± 4.95**	**46.83 ± 0.57**	**49.73 ± 1.01**	**57.81 ± 4.86**	**51.8 ± 12.8**	33	25	34	270
Iron (%)	3.39 ± 1.82	7.04 ± 0.22	6.39 ± 0.52	6.17 ± 0.20	5.84 ± 0.33	5.71 ± 0.43	7.3 ± 11.9	--	4.32	--	--
Mercury (ppm)	0.03 ± 0.03	0.12 ± 0.05	0.09 ± 0.05	0.04 ± 0.01	0.06 ± 0.04	0.04 ± 0.04	0.08 ± 0.9	0.19	0.04	0.15	0.71
Nickel (ppm)	**39.75 ± 16.23**	**53.85 ± 4.81**	**51.3 ± 8.39**	**48.33 ± 0.15**	**47.73 ± 1.29**	**50.69 ± 5.96**	**51.7 ± 10.0**	**52**	56	20.9	51.6
Lead (ppm)	7.52 ± 8.12	10.38 ± 1.43	27.53 ± 10.23	12.9 ± 2.63	13.00 ± 1.73	18.13 ± 5.47	16.6 ± 9.3	19	14.8	46.7	218
Vanadium (ppm)	99.89 ± 34.63	130.88 ± 16.49	97.00 ± 16.27	98.97 ± 3.66	93.33 ± 3.84	88.77 ± 8.81	95.7 ± 24.4	150	98	--	--
Zinc (ppm)	59.63 ± 22.86	74.33 ± 5.66	65.93 ± 9.74	65.93 ± 1.42	60.87 ± 4.10	64.29 ± 5.97	76.8 ± 74.3	95	65	150	410

A multivariate analysis of variance (MANOVA) was performed to determine if seafloor sediment total metals concentrations differed significantly among sampling strata. The MANOVA indicated that there was a significant difference in total metals concentrations among strata (Wilks' $\lambda = 0.00$; $F_{65, 60} = 6.0$; $P < 0.0001$). Due to this significant MANOVA result, individual ANOVA tests were performed to determine which metals differed significantly among strata.

There were no significant differences in concentrations of aluminum, chromium, mercury, nickel, vanadium, or zinc among sampling strata ($F_{5,24}$; $P < 0.0001$). There were significant differences among strata in concentrations of beryllium ($F_{5,24} = 4.78$; $P = 0.004$), cadmium ($F_{5,24} = 9.47$; $P < 0.0001$), copper ($F_{5,24} = 10.81$; $P < 0.0001$), and iron ($F_{5,24} = 5.46$; $P = 0.002$); however, these differences are primarily due to a correlation between low metals concentrations and a higher percentage of sand within seafloor sediments ($r = -0.88$ to -0.50; $P < 0.05$).

Concentrations of arsenic ($F_{5,24} = 4.86$; $P = 0.003$), barium ($F_{5,24} = 4.87$; $P = 0.003$), and lead ($F_{5,24} = 5.99$; $P = 0.001$) also differed significantly among strata, although not due to any correlation in sediment grain size characteristics ($r = -0.34$ to 0.36; $P > 0.05$). Arsenic and lead concentrations in seafloor sediments were higher at stations in water depths between 300 and 900 m than in the rest of the survey area (**Table 13**). All arsenic concentrations were at or below the Levantine Basin mean as determined from samples collected in region of no anthropogenic development. All lead concentrations were well below ERL values. Barium concentrations in seafloor sediments were lower at stations in water depths between 900 and 1,700 m than in the rest of the survey area. Barium concentrations in sediments from the Tamar Field stations, which were located in water depths greater than 1,700 m, were similar to barium concentrations in sediments collected from water depths of less than 900 m (**Table 13**).

Hydrocarbons

Alkanes and TPH were detected in sediments at low concentrations throughout the survey area. There are no toxicity reference values available for alkanes in sediment. Mean alkane concentrations per stratum and the primary laboratory's MDL are reported in **Table 14**. Results from all stations are reported in **Appendix I**. The results indicate that no significant amounts of these hydrocarbons are present in seafloor sediments.

Table 14. Mean alkane concentrations in sediments collected from survey sampling strata.

Alkane	Concentration (ppm)						
	Method Detection Limit	Depth Stratum					
		20–200 m	200–300 m	300–900 m	900–1,400 m	1,400–1,700 m	Tamar Field (1,700 m)
Undecane C11	0.016	0.002	0.006	0.005	0.008	0.006	0.000
Dodecane C12	0.019	0.018	0.014	0.012	0.015	0.011	0.010
Tetradecane C14	0.013	0.021	0.016	0.009	0.013	0.009	0.013
Hexadecane C16	0.004	0.019	0.025	0.020	0.033	0.022	0.020
Octadecane C18	0.004	0.058	0.084	0.034	0.039	0.027	0.044
Eicosane C20	0.012	0.038	0.036	0.018	0.025	0.021	0.022
Tetracosane C24	0.005	0.037	0.042	0.038	0.043	0.030	0.045
Octacosane C28	0.011	0.026	0.054	0.044	0.050	0.040	0.036
Dotriacontane C32	0.012	0.026	0.094	0.061	0.060	0.043	0.024
Hexatriacontane C36	0.016	0.006	0.038	0.045	0.046	0.030	0.027
Tetracontane C40	0.019	0.000	0.043	0.049	0.055	0.035	0.000

There was a statistical difference in sediment TPH concentrations among survey strata (ANOVA; $F_{5,24} = 3.59$; $P = 0.014$). A post-hoc multiple means comparison test indicated that sediment TPH concentrations in the 20 to 200 m depth stratum are statistically greater than in most other strata (**Figure 9**), although these differences are unlikely to be biologically significant.

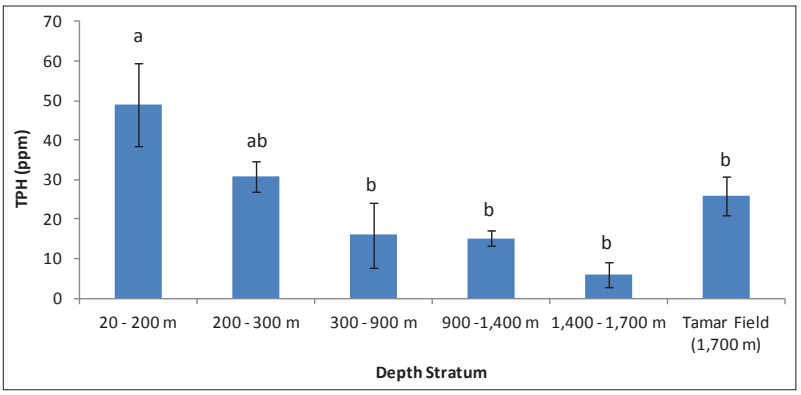

Figure 9. Mean (± standard error [indicated by black error bars]) total petroleum hydrocarbons (TPH) concentrations in sediments collected from survey sampling strata. Different letters indicate significant differences among strata.

PAH concentrations detected in sediments were low throughout the survey area and well below ERL concentrations. Mean PAH concentrations per stratum, the primary laboratory's MDL, and ERL and ERM values (Buchman, 2008) are reported in **Table 15**. ERL and ERM values provide a basis for assessing the relative toxicity of an analyte in marine sediments. ERL values are considered to be indicative of concentrations below which adverse effects rarely occur; ERM values are considered to be indicative of concentrations above which adverse effects frequently occur. These results indicate that no significant amounts of these hydrocarbons are present in the sediments. Results from all stations are reported in **Appendix I**.

Table 15. Mean polycyclic aromatic hydrocarbons (PAH) concentrations in survey sampling strata pipeline route.

PAH	Concentration (ppb)								
				Depth Stratum					
	ERL	ERM	MDL	20–200 m	200–300 m	300–900 m	900–1,400 m	1,400–1,700 m	Tamar Field (1,700 m)
Naphthalene	160	2,100	0.342	2.69	4.01	1.86	3.11	1.34	1.69
Acenaphthylene	44	640	0.041	1.04	0.46	0.27	0.37	0.24	0.30
Acenaphthene	16	500	0.103	0.83	0.77	0.48	0.53	0.37	0.67
Fluorene	19	540	0.183	1.31	1.11	0.39	0.51	0.36	0.63
Anthracene	85.3	1,100	0.115	1.43	1.15	0.33	0.41	0.21	0.26
Phenanthrene	240	1,500	0.208	8.24	6.23	3.03	4.17	2.37	3.76
Fluoranthene	600	5,100	0.333	11.06	5.52	3.50	3.86	2.16	2.79
Pyrene	665	2,600	0.136	8.48	4.84	3.04	3.38	1.88	2.01
Benz(a)anthracene	261	1,600	0.192	6.98	2.29	1.76	2.05	1.13	1.27
Chrysene/triphenylene	384	2,800	0.116	6.83	3.19	2.60	3.11	1.72	1.97
Benzo(b)fluoranthene	--	--	0.203	9.70	4.38	4.05	4.93	2.96	3.72
Benzo(k,j)fluoranthene	--	--	0.098	3.45	1.20	1.27	1.59	0.94	1.17

ERL = Effects Range Low; ERM = Effects Range Median; MDL = method detection limit.

There was a statistical difference in total PAH concentrations among survey strata (ANOVA; $F_{5,24} = 7.52$; $P = 0.0002$). A post-hoc multiple means comparison test indicated that sediment PAH concentrations in the 20 to 200 m and 200 to 300 m depth strata were statistically greater than most other strata (**Figure 10**). These PAH concentrations are well below the ERL (4,022 ppb) and ERM (44,792 ppb) concentrations reported for total PAH concentrations in marine sediment (Buchman, 2008) and are therefore unlikely to be biologically significant.

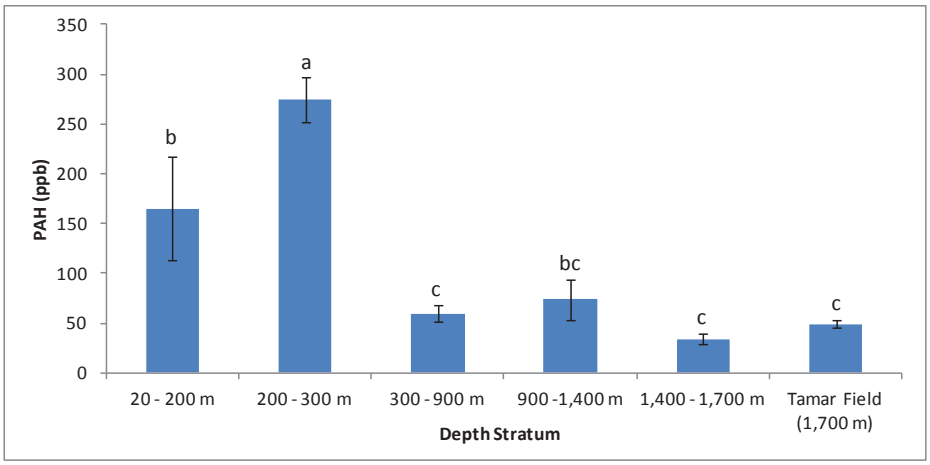

Figure 10. Mean (± standard error [indicated by black error bars]) total polycyclic aromatic hydrocarbon (PAH) concentrations in sediments collected along the Tamar pipeline route. Different letters indicate significant differences among strata.

Radionuclides

Radionuclide samples were collected only within the Tamar Field strata. Mean (± standard deviation) radionuclide concentrations are provided in **Table 16**. Results for each individual sampling station are provided in **Appendix J**. Radionuclide concentrations were low in all samples.

Table 16. Mean (± standard deviaton) concentrations of radionuclides (radium 226, radium 228, and thorium 228) in sediments collected from the Tamar Field.

Station	Concentration (pCi g^{-1})		
	Radium 226	Radium 228	Thorium 228
TF1	0.42	0.72	0.64
TF2	0.45	0.43	0.60
TF3	0.21	0.61	0.56
TF4	0.27	1.06	0.66
TF5	0.39	0.51	0.68
TF6	0.35	0.62	0.73
TF7	0.29	0.28	0.67
TF8	0.52	0.60	0.63
TF9	0.27	0.42	0.72
Tamar Field (1,700 m)	0.35 ± 0.10	0.58 ± 0.22	0.65 ± 0.05
Levantine Basin baseline data	0.47 ± 0.14	0.54 ± 0.24	0.59 ± 0.07

Ambient radium concentrations in most natural soils and rocks are approximately 0.5 to 5.0 pCi g^{-1} of total radium (U.S. Geological Survey, 1999). Ambient concentrations of Th 228 in sediments range from 0.36 to 1.93 pCi g^{-1} (Agency for Toxic Substances and Disease Registry, 1990). USEPA (1998) established a protective health based level for radium and thorium of 5 pCi g^{-1} at the sediment surface as a threshold for the cleanup of the top 15 cm of soil from contaminated U.S. Superfund sites.

These data indicate that ambient radionuclide concentrations in sediments from the Tamar Field strata are considered natural ambient concentrations (Agency for Toxic Substances and Disease Registry, 1990; U.S. Geological Survey, 1999) and are below levels of concern as outlined by the USEPA (1998) protective health based level recommendations.

5.4 INFAUNA

Distributions of species found in Tamar Field and Pipeline infaunal samples according to major taxonomic groups and subgroups are shown in **Tables 17** to **22**. The 60 infaunal benthic samples (30 stations × 2 replicates) yielded 4,826 individual organisms. They were assigned to 14 taxa and 185 taxonomic subgroups. The lowest total abundances (28 individuals per m^2) were recorded in the Tamar Field (**Table 17**), and the highest total abundances (4,157 individuals per m^2) were found near shore in water depths from 20 to 200 m (**Table 22**). **Figure 11** shows that infaunal diversity by taxonomic grouping was generally similar among all survey strata, with polychaetes being the most dominant taxa.

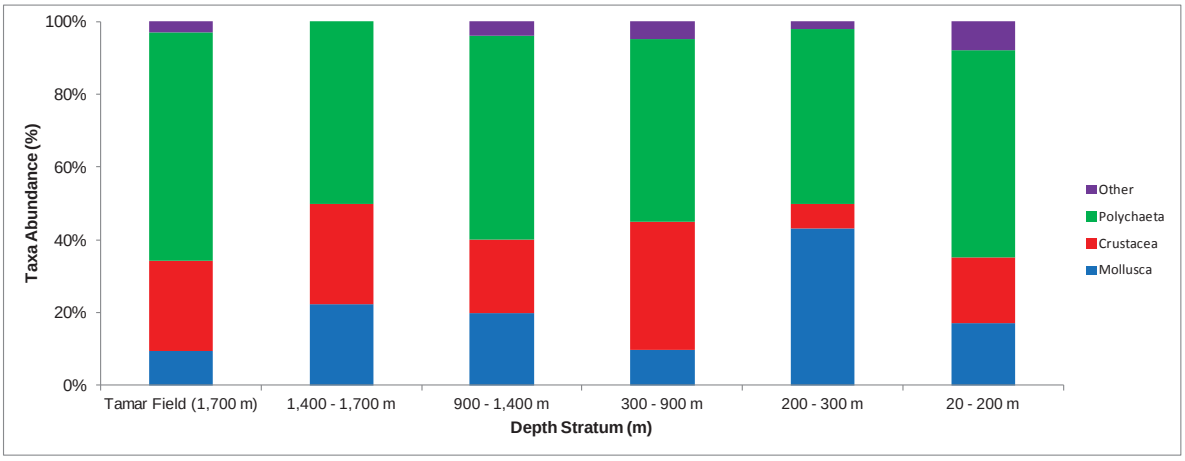

Figure 11. Percent abundance of infaunal organisms (by taxonomic grouping) within the Tamar Field and Pipeline Survey strata. The "Other" category is composed of some combination of the following taxa, dependent upon strata: Platyhelmentes, Nemertea, Pychogonida, Sipunculida, Echiuridea, Echinodermata, Enteropneusta, and Phoronida.

Tamar Field (1,700 m depth) Depth Stratum

In the Tamar Field portion of the survey area, located in a water depth of approximately 1,700 m, polychaete worms were the most dominant taxa and accounted for over 62% of the total infaunal abundance. The polychaete worms *Notomastus* sp. and *Autolytinae* sp. (**Image 6**) were the most abundant organisms at this depth (**Table 17**). Crustacea accounted for 25% of the total infaunal abundance and were primarily composed of *Caridea* sp. (**Table 17**).

Image 6. Specimen of the polychaetous annelids *Notomastus* sp. (left) and Autolytinae sp. (right).

Table 17. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from the Tamar Field strata (1,700 m water depth).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Mollusca-Bivalvia	*Cardiomya costellata*	1	0.89	3
	Bathyarca sp.	1	0.89	3
	Yoldiella sp.	1	0.89	3
Crustacea	*Bruzelia* sp.	1	0.89	3
	Caridea sp.	3	2.67	9
	Asellota sp.	1	0.89	3
	Tanaidacea sp.	1	0.89	3
	Colletteidae sp.	2	1.78	6
Polychaeta	*Notomastus* sp.	6	5.33	19
	Glycera lapidium	3	2.67	9
	Autolytinae sp.	5	4.44	16
	Cirratulidae sp.	1	0.89	3
	Spionidae sp.	3	2.67	9
	Paraonides sp. 1 EcoA	1	0.89	3
	Paraonis sp.	1	0.89	3
Sipunculida	Sipuncula sp.	1	0.89	3
Total		32	28.44	100

1,400 to 1,700 m Depth Stratum

In the portion of the pipeline located in water depths between 1,400 and 1,700 m, polychaete worms were the most dominant taxa and accounted for 56% of the total infaunal abundance. Taxa consisting of crustacea and mollusca-bivalvia accounted for 22% and 28% of all organisms, respectively. Only one or two individuals of each species were collected at this water depth; therefore no species was particularly dominant over any other (**Table 18**).

Table 18. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 1,400 to 1,700 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Mollusca-Bivalvia	Bivalvia sp.	1	2.67	6
	Cardiomya costellata	2	5.33	11
	Yoldiella sp.	1	2.67	6
Crustacea	*Pseudotiron bouvieri*	1	2.67	6
	Tanaidacea sp.	2	5.33	11
	Tanaellidae sp.	2	5.33	11
Polychaeta	*Notomastus* sp.	2	5.33	11
	Glycera lapidium	1	2.67	6
	Polynoidae sp.	1	2.67	6
	Syllis sp.	1	2.67	6
	Cirratulidae sp.	1	2.67	6
	Spionidae sp.	1	2.67	6
	Terebellides stroemii	2	5.33	11
Total		18	48	100

900 to 1,400 m Depth Stratum

In the portion of the pipeline located in water depths between 900 and 1,400 m, polychaete worms were the most dominant taxa and accounted for 50% of the total infaunal abundance. The polychaete worm *Notomastus* sp. (**Image 6**) was the most abundant organism at this depth (**Table 19**). Taxa consisting of crustacea and mollusca-bivalvia each accounted for 20% of infaunal organisms. Mollusca-bivalvia was composed exclusively of *Yoldiella* sp. (**Table 19**, **Image 7**).

Table 19. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 900 to 1,400 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Mollusca-Bivalvia	*Yoldiella* sp.	5	13.33	20
Crustacea	Hyperiidea sp.	1	2.67	4
	Phoxocephalidae sp.	1	2.67	4
	Asellota sp.	1	2.67	4
	Anthuridae sp.	1	2.67	4
	Tanaellidae sp.	1	2.67	4
Polychaeta	*Leiocapitella* sp.	1	2.67	4
	Notomastus sp.	6	16.00	24
	Syllis sp.	2	5.33	8
	Autolytinae sp.	1	2.67	4
	Cirratulidae sp.	1	2.67	4
	Spionidae sp.	2	5.33	8
	Aricidea (*Allia*) *monicae*	1	2.67	4
Echiuridae	*Echiurus abyssalis*	1	2.67	4
Total		25	66.67	100

300 to 900 m Depth Stratum

In the portion of the pipeline located in water depths between 300 and 900 m, polychaete worms were the most dominant taxa and accounted for 50% of the total infaunal abundance, with *Notomastus* sp. being the most dominant polychaete (**Image 6**). The most dominant organism was a crustacean, *Apseudopsis acutifrons* (**Image 8**), that accounted for 25% of the total organisms collected in this depth range (**Table 20**).

Table 20. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 300 to 900 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Nemertea	Palaeonemertea sp.	3	6	3
Mollusca-Bivalvia	Bivalvia sp.	2	4	2
	Tropidomya abbreviata	1	2	1
	Ennucula aegeensis	1	2	1
	Yoldiella sp.	5	10	5
Mollusca-Gastropoda	Pyramidellidae sp.	1	2	1
Crustacea	*Eriopisa elongata*	1	2	1
	Podocerus variegatus	1	2	1
	Bruzelia typica	1	2	1
	Nannastacidae sp.	1	2	1
	Asellota sp.	1	2	1
	Amakusanthura pori	1	2	1
	Agathotanaidae sp.	1	2	1
	Apseudopsis acutifrons	26	52	25
	Tanaellidae sp.	2	4	2
	Typhlotanais angstromensis	1	2	1
Polychaeta	*Neoheteromastus* sp.	4	8	4
	Notomastus sp.	13	26	13
	Ophelia sp.	2	4	2
	Glycera lapidium	1	2	1
	Gallardoneris sp. 1 EcoA	1	2	1
	Sphaerodoropsis sp. 1 EcoA	7	14	7
	Syllis sp.	4	8	4
	Ampharetidae sp.	1	2	1
	Spiochaetopterus sp.	4	8	4
	Diplocirrus sp.	1	2	1
	Spionidae sp.	3	6	3
	Cirrophorus sp.	1	2	1
	Levinsenia sp.	9	18	9
Sipunculida	Sipuncula sp.	1	2	1
Echinodermata	Spatangoida sp.	1	2	1
Total		102	204	100

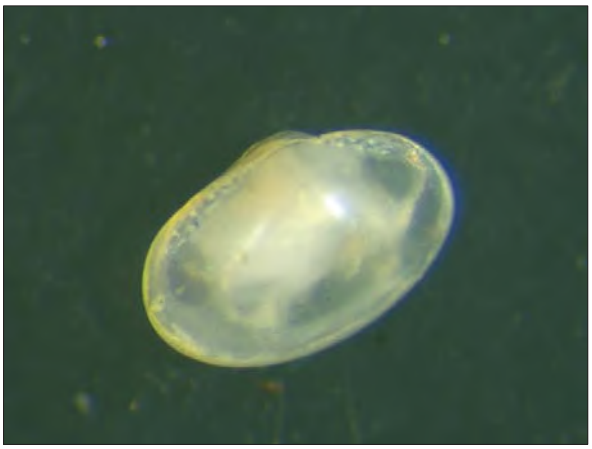

Image 7. Specimen of the bivalve mollusk *Yoldiella* sp.

Image 8. Specimen of the crustacean *Apseudopsis acutifrons*.

200 to 300 m Depth Stratum

In the portion of the pipeline located in water depths between 200 and 300 m, polychaete worms were the most dominant taxa and accounted for 57% of the total infaunal abundance. The most dominant organism in this water depth range was a bivalve mollusk, *Bivalvia* sp. (**Image 9**), that accounted for 20% of the total organisms collected at this depth (**Table 21**).

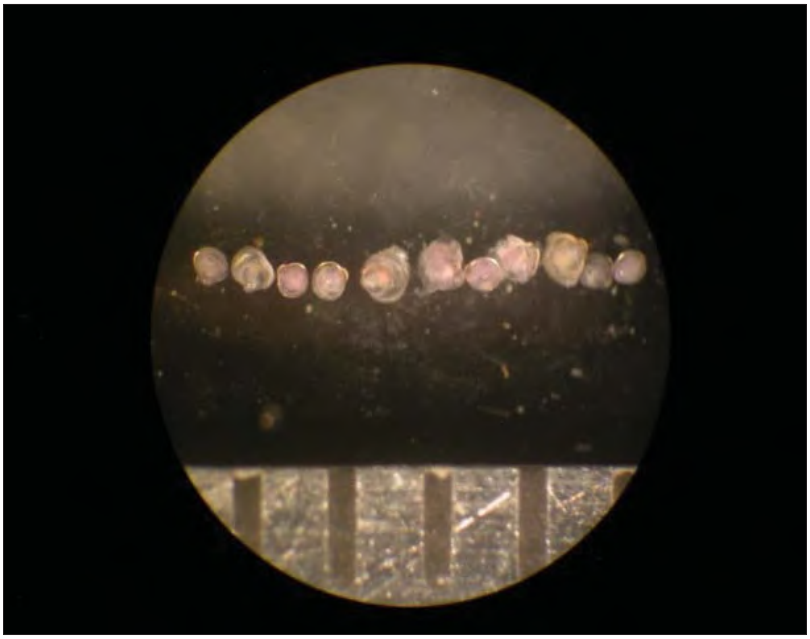

Image 9. Specimen of the bivalve mollusk Bivalvia sp.

Table 21. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations in the 200 to 300 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Nemertea	Lineidae sp.	1	2	0.1
	Palaeonemertea sp.	21	42	2.1
Mollusca-Aplacophora	Neomeniomorpha sp.	1	2	0.1
	Falcidens sp.	39	78	3.9
	Limifossor sp.	2	4	0.2
	Chevroderma sp.	8	16	0.8
	Spathoderma sp.	18	36	1.8
Mollusca-Bivalvia	Bivalvia sp.	212	424	20.9
	Nuculanidae sp.	1	2	0.1
	Nuculidae sp.	16	32	1.6
	Ennucula aegeensis	8	16	0.8
	Ennucula sp.	6	12	0.6
	Axinulus croulinensis	17	34	1.7
	Thyasira sp.	89	178	8.8
	Thyasira biplicata	1	2	0.1
Mollusca-Gastropoda	*Nassarius elatus*	4	8	0.4
	Alvania sp.	5	10	0.5

Table 21. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Crustacea	*Carangoliopsis spinulosa*	24	48	2.4
	Eriopisa elongata	2	4	0.2
	Phoxocephalidae sp.	14	28	1.4
	Eudorella sp.	1	2	0.1
	Asellota sp.	2	4	0.2
	Apseudopsis acutifrons	2	4	0.2
	Colletteidae sp.	11	22	1.1
	Pseudotanais stiletto	8	16	0.8
	Tanaellidae sp.	6	12	0.6
Polychaeta	*Neoheteromastus* sp.	9	18	0.9
	Cossura sp.	32	64	3.2
	Praxillella gracilis	2	4	0.2
	Ophelia sp.	1	2	0.1
	Glycera lapidium	5	10	0.5
	Podarkeopsis sp.	5	10	0.5
	Abyssoninoe sp. 1 EcoA	4	8	0.4
	Gallardoneris sp. 1 EcoA	22	44	2.2
	Ninoe sp.	4	8	0.4
	Nephtys sp.	28	56	2.8
	Drilonereis filum	1	2	0.1
	Pholoe sp.	8	16	0.8
	Ancistrosyllis groenlandica	5	10	0.5
	Litocorsa sp.	1	2	0.1
	Sigalion sp.	1	2	0.1
	Sphaerodoropsis sp. 1 EcoA	5	10	0.5
	Exogone sp.	1	2	0.1
	Syllis sp.	1	2	0.1
	Autolytinae sp.	4	8	0.4
	Cirratulidae sp.	10	20	1.0
	Monticellina sp.	10	20	1.0
	Jasmineira sp.	1	2	0.1
	Spionidae sp.	14	28	1.4
	Prionospio sp.	40	80	4.0
	Spiophanes sp.	7	14	0.7
	Sternaspis sp.	19	38	1.9
	Sternaspis scutata	13	26	1.3
	Aricidea (*Acmira*) *catherinae*	9	18	0.9
	Aricidea (*Allia*) *antennata*	4	8	0.4
	Aricidea (*Allia*) *monicae*	17	34	1.7
	Aricidea (*Aricidea*) *wassi*	61	122	6.0
	Aricidea sp. 1 EcoA	89	178	8.8
	Levinsenia sp.	50	100	4.9
Echinodermata	Ophiuroidea sp.	9	18	0.9
Enteropneusta	*Enteropneusta* sp.	1	2	0.1
Total		1,012	2,024	100

20 to 200 m Depth Stratum

In the portion of the pipeline located in water depths between 20 and 200 m, polychaete worms were the most dominant taxa and accounted for over 47% of the total infaunal abundance. The polychaete worms *Jasmineira* sp. (**Image 10**) and *Prionospio* sp. (**Image 11**) were the most abundant organisms at this depth (**Table 22**) accounting for 13% and 7% of the total organisms collected, respectively.

Image 10. Specimen of the polychaetous annelid *Jasmineria* sp.

Image 11. Specimen of polychaetous annelid *Prionospio* sp.

Table 22. Taxonomic listing and total abundance distribution of major taxa and subgroups in infaunal samples collected from stations located in the 20 to 200 m depth stratum.

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Platyhelmentes-Turellaria	*Turbellaria* sp.	3	3.43	0.1
Nemertea	Lineidae sp.	6	6.86	0.2
	Palaeonemertea sp.	11	12.57	0.3
Mollusca-Aplacophora	Neomeniomorpha sp.	2	2.29	0.1
	Chaetoderma sp.	13	14.86	0.4
	Falcidens sp.	27	30.86	0.7
	Chevroderma sp.	7	8.00	0.2
	Spathoderma sp.	15	17.14	0.4
Mollusca-Bivalvia	Bivalvia sp.	175	200.00	4.8
	Cardiomya costellata	1	1.14	0.0
	Cuspidaria sp.	2	2.29	0.1
	Lyonsia sp.	3	3.43	0.1
	Thraciidae sp.	1	1.14	0.0
	Anadara sp.	4	4.57	0.1
	Glycymeris glycymeris	1	1.14	0.0
	Glycymeris nummaria	1	1.14	0.0
	Corbula gibba	102	116.57	2.8
	Nuculanidae sp.	2	2.29	0.1
	Nuculidae sp.	11	12.57	0.3
	Ennucula aegeensis	8	9.14	0.2
	Parvicardium minimum	37	42.29	1.0
	Parvicardium sp.	5	5.71	0.1
	Loripes lucinalis	1	1.14	0.0
	Lucinella divaricata	1	1.14	0.0
	Abra longicallus	23	26.29	0.6
	Abra sp.	16	18.29	0.4
	Axinulus croulinensis	1	1.14	0.0
	Thyasira sp.	49	56.00	1.3
	Thyasira biplicata	5	5.71	0.1
	Veneridae sp.	50	57.14	1.4

Table 22. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Mollusca-Gastropoda	Gastropoda sp.	2	2.29	0.1
	Ringicula conformis	1	1.14	0.0
	Philinidae sp.	6	6.86	0.2
	Retusa mammillata	1	1.14	0.0
	Volvulella acuminata	4	4.57	0.1
	Eulimella sp.	5	5.71	0.1
	Odostomia sp.	1	1.14	0.0
	Turbonilla sp.	1	1.14	0.0
	Neogastropoda sp.	22	25.14	0.6
	Nassarius elatus	1	1.14	0.0
	Turridae sp.	2	2.29	0.1
	Naticidae sp.	1	1.14	0.0
	Rissoidae sp.	1	1.14	0.0
	Alvania sp.	3	3.43	0.1
	Conomurex persicus	2	2.29	0.1
Mollusca-Scaphopoda	*Antalis* sp.	1	1.14	0.0
Crustacea	*Ampelisca* sp.	93	106.29	2.6
	Leptocheirus sp.	4	4.57	0.1
	Carangoliopsis spinulosa	9	10.29	0.2
	Medicorophium runcicorne	6	6.86	0.2
	Gammaridae sp.	2	2.29	0.1
	Isaeidae sp.	6	6.86	0.2
	Cheiriphotis mediterranea	167	190.86	4.6
	Photis sp.	6	6.86	0.2
	Ischyroceridae sp.	7	8.00	0.2
	Leucothoe sp.	1	1.14	0.0
	Lysianassidae sp.	2	2.29	0.1
	Eriopisa elongata	5	5.71	0.1
	Oedicerotidae sp.	8	9.14	0.2
	Phoxocephalidae sp.	38	43.43	1.0
	Eudorella sp.	4	4.57	0.1
	Brachyura sp.	1	1.14	0.0
	Paguroidea sp.	1	1.14	0.0
	Alpheidae sp.	4	4.57	0.1
	Crangonidae sp.	1	1.14	0.0
	Diogenes pugilator	1	1.14	0.0
	Jaxea nocturna	1	1.14	0.0
	Leptochela pugnax	1	1.14	0.0
	Portunidae sp.	1	1.14	0.0
	Asellota sp.	1	1.14	0.0
	Gnathiidea sp.	3	3.43	0.1
	Isopoda sp.	1	1.14	0.0
	Kupellonura mediterranea	5	5.71	0.1
	Tanaidacea sp.	1	1.14	0.0
	Agathotanaidae sp.	15	17.14	0.4
	Apseudes sp.	77	88.00	2.1
	Colletteidae sp.	10	11.43	0.3
	Cristapseudes omercooperi	127	145.14	3.5
	Leptochelia tanykeraia	7	8.00	0.2
	Pseudotanais stiletto	12	13.71	0.3
	Tanaellidae sp.	3	3.43	0.1
	Typhlotanais angstromensis	25	28.57	0.7
Pycnogonida	Phoxichilidiidae sp.	53	60.57	1.5

Table 22. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
Polychaeta	*Capitella* sp.	1	1.14	0.0
	Leiocapitella sp.	1	1.14	0.0
	Mediomastus sp.	11	12.57	0.3
	Neoheteromastus sp.	6	6.86	0.2
	Notomastus sp.	136	155.43	3.7
	Cossura sp.	42	48.00	1.2
	Clymenella sp.	2	2.29	0.1
	Maldane sp.	2	2.29	0.1
	Micromaldane sp.	1	1.14	0.0
	Praxillella gracilis	5	5.71	0.1
	Rhodine loveni	13	14.86	0.4
	Nereis sp.	4	4.57	0.1
	Alciopidae sp.	1	1.14	0.0
	Ophryotrocha sp.	3	3.43	0.1
	Glycera lapidium	33	37.71	0.9
	Podarkeopsis sp.	6	6.86	0.2
	Abyssoninoe sp. 1 EcoA	10	11.43	0.3
	Gallardoneris sp. 1 EcoA	39	44.57	1.1
	Nephtys sp.	102	116.57	2.8
	Eunereis sp.	1	1.14	0.0
	Drilonereis filum	1	1.14	0.0
	Onuphis sp.	15	17.14	0.4
	Paradiopatra sp.	1	1.14	0.0
	Paralacydonia sp.	2	2.29	0.1
	Pholoe sp.	15	17.14	0.4
	Phyllodoce sp.	2	2.29	0.1
	Ancistrosyllis groenlandica	38	43.43	1.0
	Litocorsa sp.	3	3.43	0.1
	Sigambra tentaculata	127	145.14	3.5
	Polynoidae sp.	3	3.43	0.1
	Lepidonotinae sp.	1	1.14	0.0
	Sigalion sp.	18	20.57	0.5
	Sphaerodoropsis sp. 1 EcoA	15	17.14	0.4
	Exogone sp.	20	22.86	0.5
	Sphaerosyllis sp.	1	1.14	0.0
	Autolytinae sp.	4	4.57	0.1
	Acrocirridae sp.	2	2.29	0.1
	Eclysippe sp.	11	12.57	0.3
	Melinna sp.	22	25.14	0.6
	Spiochaetopterus sp.	8	9.14	0.2
	Cirratulidae sp.	71	81.14	2.0
	Chaetozone sp.	1	1.14	0.0
	Monticellina sp.	70	80.00	1.9
	Diplocirrus sp.	2	2.29	0.1
	Magelona sp.	133	152.00	3.7
	Owenia fusiformis	2	2.29	0.1
	Owenia sp.	2	2.29	0.1
	Pectinaria sp.	6	6.86	0.2
	Poecilochaetus sp.	17	19.43	0.5
	Chone sp.	23	26.29	0.6
	Euchone sp.	3	3.43	0.1
	Jasmineira sp.	457	522.29	12.6
	Spionidae sp.	18	20.57	0.5
	Polydora sp.	44	50.29	1.2
	Prionospio sp.	266	304.00	7.3
	Pseudopolydora sp.	3	3.43	0.1

Table 22. (Continued).

Taxonomic Group	Lowest Practical Identification Level (Taxonomic Subgroups)	Abundance (number of specimens)	Abundance (individuals m^{-2})	Total Fauna (%)
	Scolelepis sp.	1	1.14	0.0
	Spiophanes sp.	16	18.29	0.4
	Sternaspis sp.	3	3.43	0.1
	Sternaspis scutata	3	3.43	0.1
	Polycirrinae sp.	1	1.14	0.0
	Terebellides stroemii	5	5.71	0.1
	Aricidea (*Allia*) *monicae*	10	11.43	0.3
	Aricidea (*Aricidea*) *wassi*	8	9.14	0.2
	Aricidea sp. 1 EcoA	79	90.29	2.2
	Cirrophorus branchiatus	2	2.29	0.1
	Levinsenia sp.	97	110.86	2.7
Sipunculida	Sipuncula sp.	4	4.57	0.1
	Apionsoma murinae bilobatae	2	2.29	0.1
	Thysanocardia procera	4	4.57	0.1
Echinodermata	Ophiuroidea sp.	191	218.29	5.3
	Amphiodia obtecta	7	8.00	0.2
	Amphiura filiformis	1	1.14	0.0
Enteropneusta	*Enteropneusta* sp.	2	2.29	0.1
Phoronida	*Phoronida* sp.	9	10.29	0.2
Total		3,637	4156.57	100

Station Abundance and Diversity Metrics

Individual station abundance and diversity metrics are shown in **Figure 23**. The number of taxonomic subgroups was statistically different among survey strata (ANOVA; $df_{5,24} = 59.24$; $P < 0.0001$). There were a significantly greater number of taxonomic subgroups in stations from the shallower depth strata (20 to 200 m and 200 to 300 m) than in all other strata (**Table 23**, **Figure 12**).

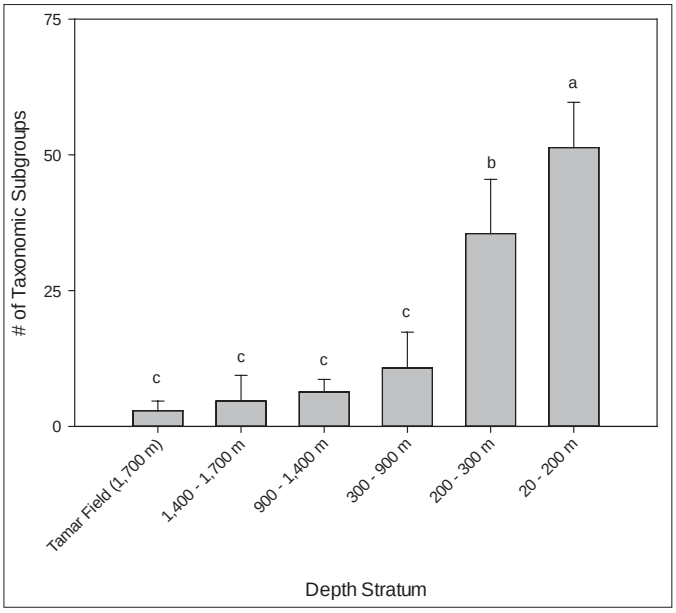

Figure 12. Mean (± standard deviation) number of taxonomic subgroups among survey sampling strata. Different letters indicate significant differences among strata.

Table 23. Benthic community parameters at infaunal sampling stations during the Tamar Field and Pipeline Survey.

Depth Stratum	Station	Number of Taxonomic Subgroups per Station	Number of Individuals per Station	Pileou's Evenness (J')	Log Series Fisher's *alpha*	Shannon-Weiner Diversity (H')
Tamar Field (1,700 m)	1	1	1	--	--	0.00
	2	4	5	0.96	9.28	1.33
	3	1	3	--	0.53	0.00
	4	6	8	0.93	10.91	1.67
	5	4	4	1.00	--	1.39
	6	1	1	--	--	0.00
	7	4	4	1.00	--	1.39
	8	3	3	1.00	--	1.10
	9	2	3	0.92	2.62	0.64
1,400–1,700 m	1	3	3	1.00	--	1.10
	2	10	14	0.97	15.65	2.24
	3	1	1	--	--	0.00
900–1,400 m	1	5	8	0.93	5.71	1.49
	2	5	5	1.00	--	1.61
	3	9	12	0.95	16.36	2.09
300–900 m	1	6	11	0.79	5.40	1.42
	2	11	33	0.73	5.78	1.74
	3	6	16	0.83	3.49	1.49
	4	20	42	0.91	14.96	2.74
200–300 m	1	22	106	0.89	8.44	2.76
	2	46	407	0.80	13.33	3.08
	3	38	224	0.83	13.13	3.00
	4	36	275	0.79	11.07	2.82
20–200 m	1	42	316	0.87	13.00	3.25
	2	41	288	0.81	13.07	3.00
	3	53	558	0.71	14.39	2.83
	4	59	341	0.85	20.59	3.46
	5	59	621	0.79	16.02	3.23
	6	55	1,230	0.63	11.82	2.51
	7	41	283	0.69	13.17	2.57

The number of individuals per station was statistically different among survey strata (ANOVA; $df_{5,24} = 8.82$; $P < 0.0001$), with the greatest numbers of organisms found in the 20 to 200 m water depth stratum (**Table 23**, **Figure 13**).

Pileou's evenness was moderate to high when averaged for each stratum and generally consistent among strata. Stations in the 20 to 200 m water depth stratum had the lowest evenness value (0.63 to 0.87), and stations in the 1,400 to 1,700 m water depth stratum had the highest evenness values (0.97 to 1.00) (**Table 23**).

Species diversity, as calculated by the Shannon-Weiner Diversity Index, was moderate to high (2.51 to 3.46) in stations in water depths < 300 m and low (0.00 to 1.67) in stations in water depths >1,400 m. The Shannon-Weiner Diversity Index operates on a scale of 0 (lowest diversity) to 4 (highest diversity).

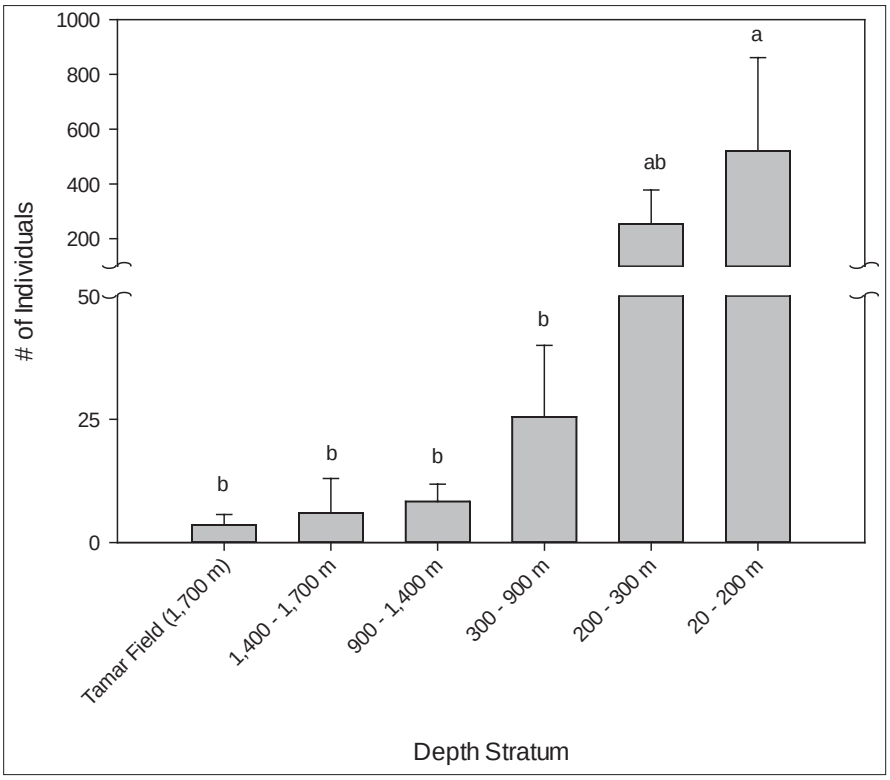

Figure 13. Mean (± standard deviation) number of individuals collected from survey sampling strata. Different letters indicate significant differences among strata. Note scale break in y-axis.

5.5 VIDEOGRAPHY

Results from the video data presented within this report were also presented in the Tamar Environmental Monitoring Program – Visual Survey Report (CSA Ocean Sciences Inc., 2013).

The seafloor of the entire survey area was characterized by a relatively flat topography and soft bottom substrate (**Image 12**). A substantial amount of drilling infrastructure was present on the seafloor near the wellsites. A moderate amount of disturbed sediment was observed, especially near the wellheads (**Image 13**). These disturbances were likely caused by well drilling and completion, pipe-laying, and ROV activities. The areal extent of these disturbances was small compared to the geographic size of the survey area, and no substantial impact on benthic communities was likely.

Anthropogenic debris (i.e., trash bags, glass bottles, assorted plastics) was observed within the survey area, as were drilling muds and cuttings near several of the wellsites (**Image 14**). No hard bottom substrate or chemosynthetic communities were observed within the survey area.

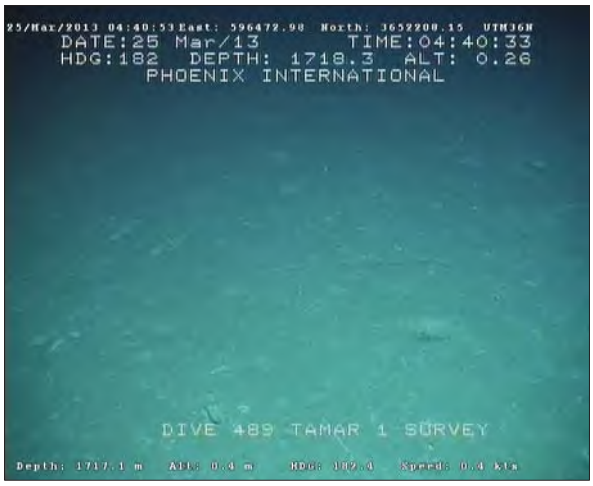

Image 12. The Tamar Field survey area was characterized by smooth and relatively flat soft bottom substrate, as seen in this image collected near the Tamar 1 wellsite.

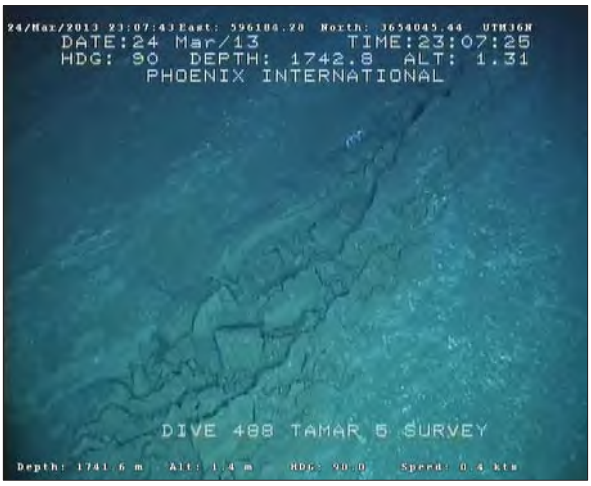

Image 13. Disturbed sediment near the Tamar 5 wellsite.

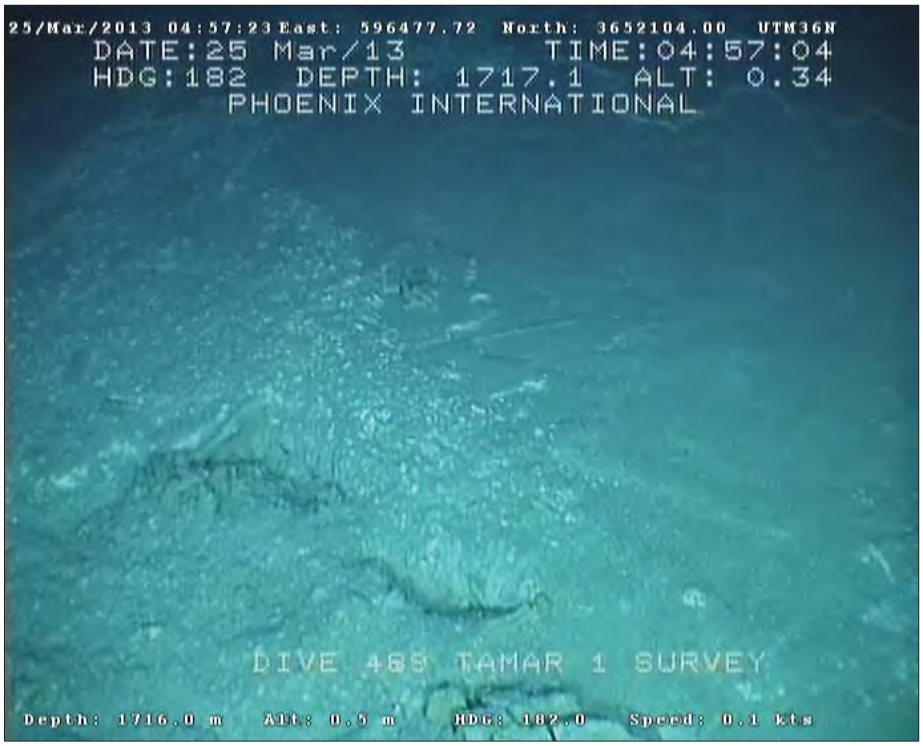

Image 14. Possible drill cuttings on the seafloor near the Tamar 1 wellsite.

Apparent biological activity, including the presence of motile biota and what appeared to be evidence of bioturbation (i.e., biologically maintained burrows and mounds), was observed and mapped within the survey area (**Figures 14** to 1**8**).

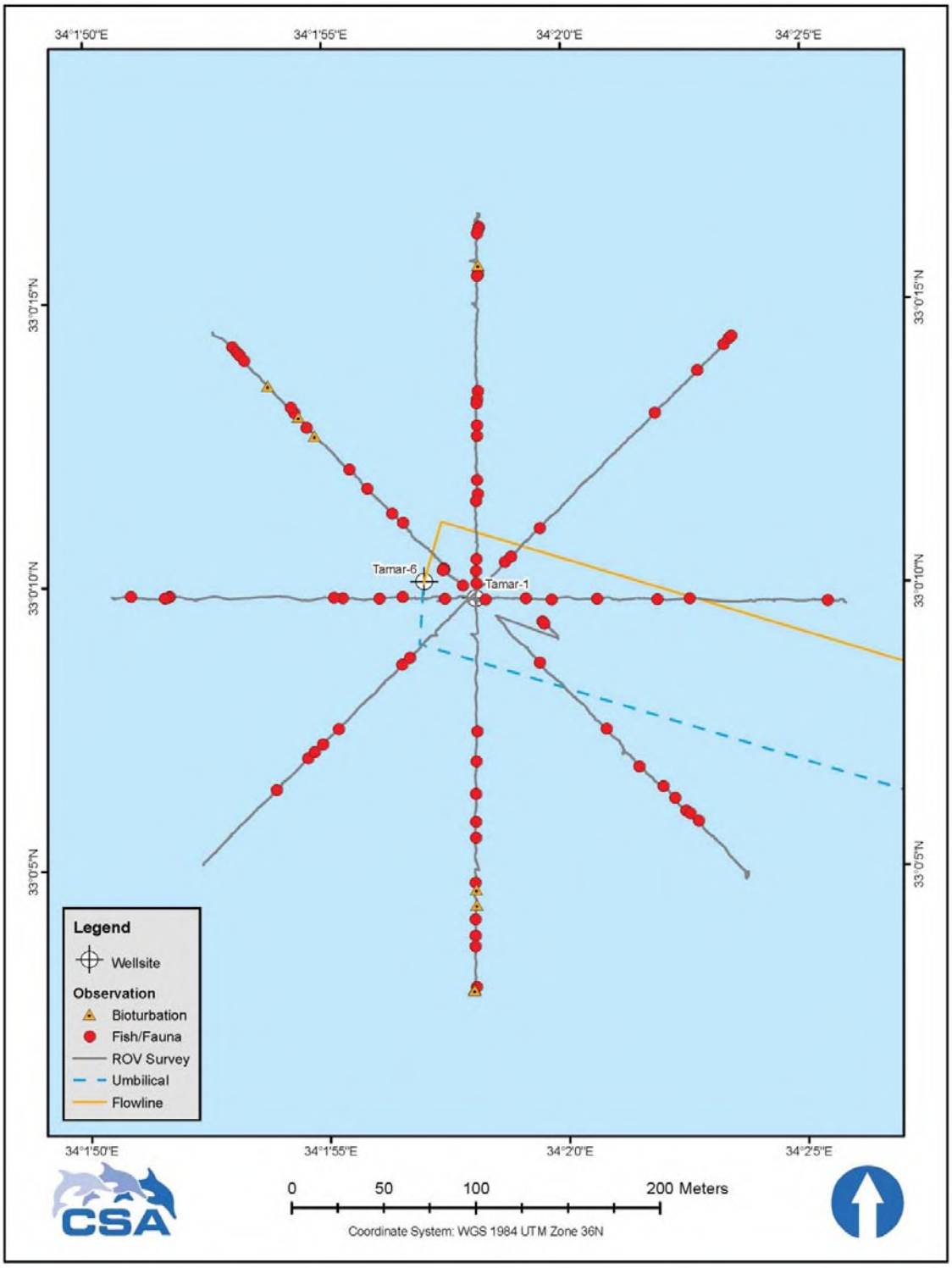

Figure 14. Locations of observations of biological activity along the remotely operated vehicle (ROV) survey track around the Tamar 1 and Tamar 6 wellsites.

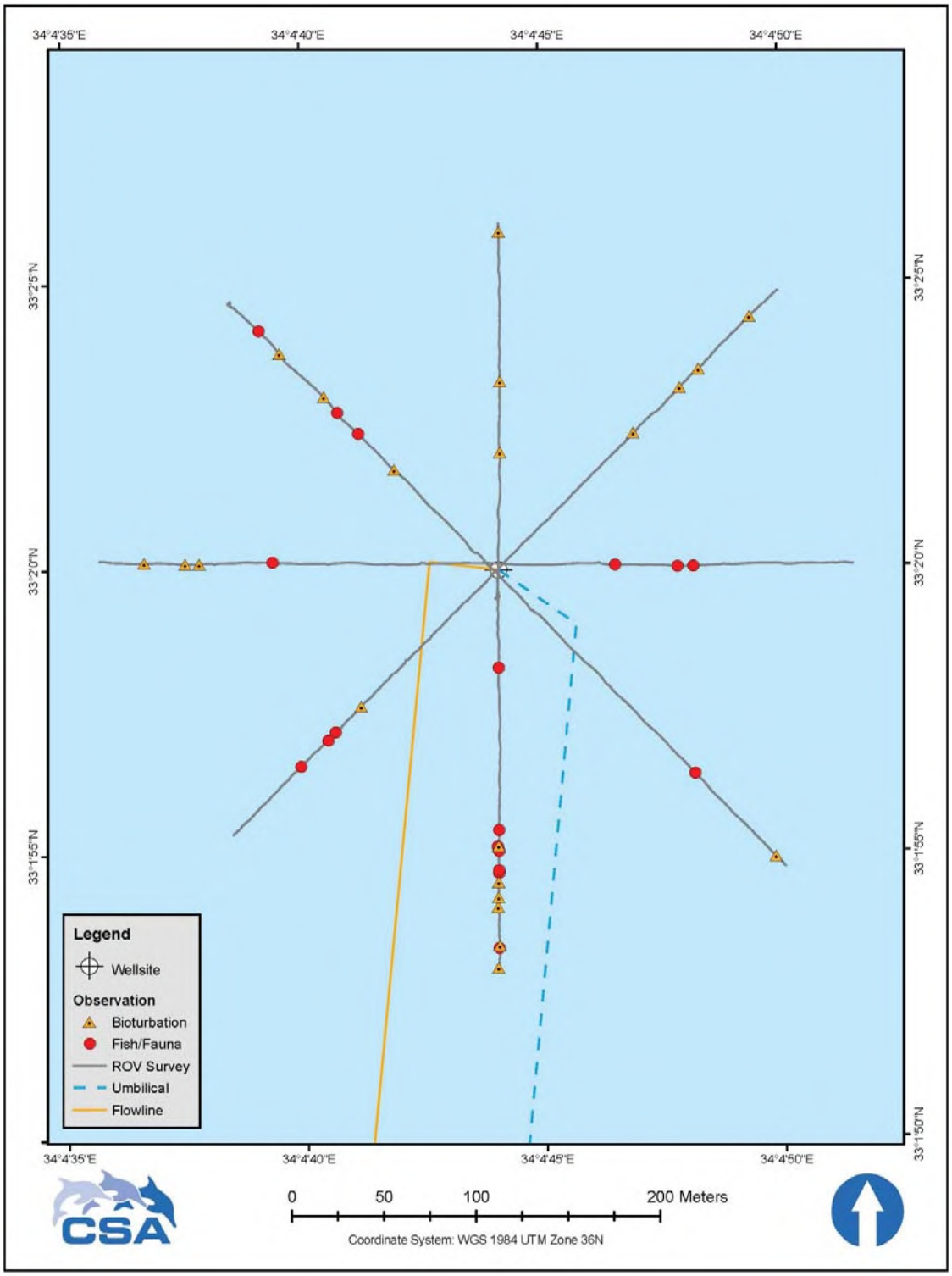

Figure 15. Locations of observations of biological activity along the remotely operated vehicle (ROV) survey track around the Tamar 2 wellsite.

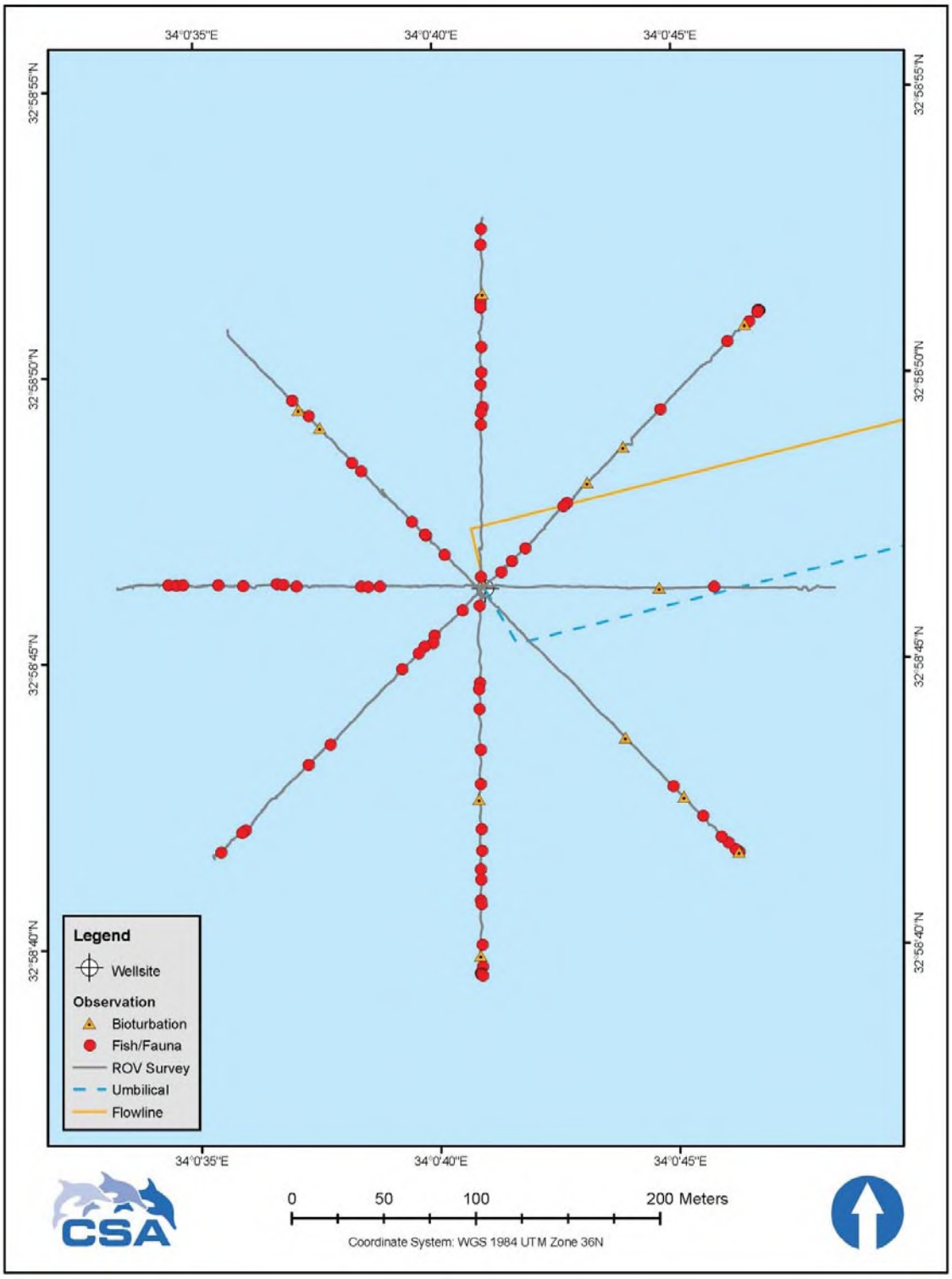

Figure 16. Locations of observations of biological activity along the remotely operated vehicle (ROV) survey track around the Tamar 3 wellsite.

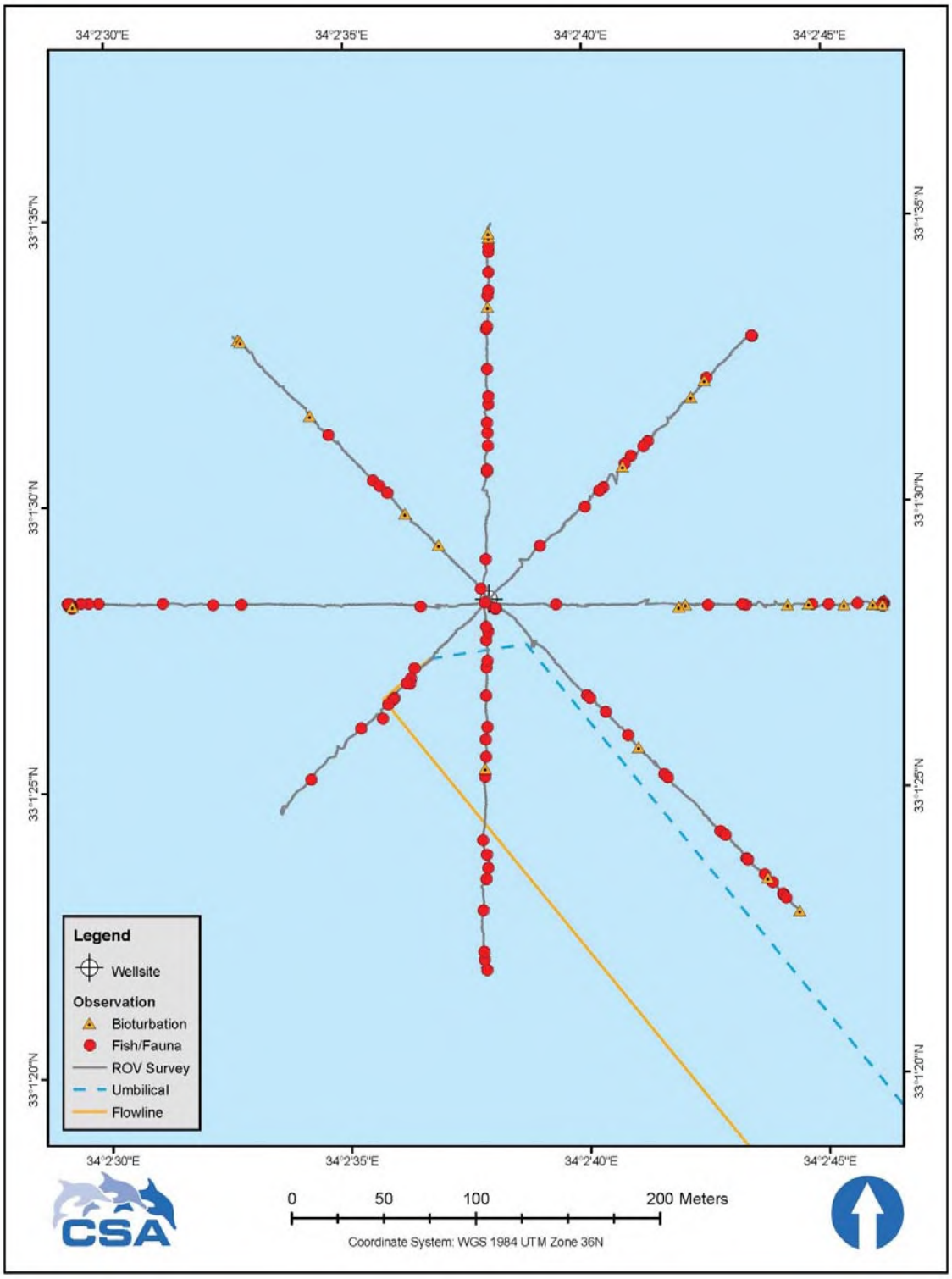

Figure 17. Locations of observations of biological activity along the remotely operated vehicle (ROV) survey track around the Tamar 4 wellsite.

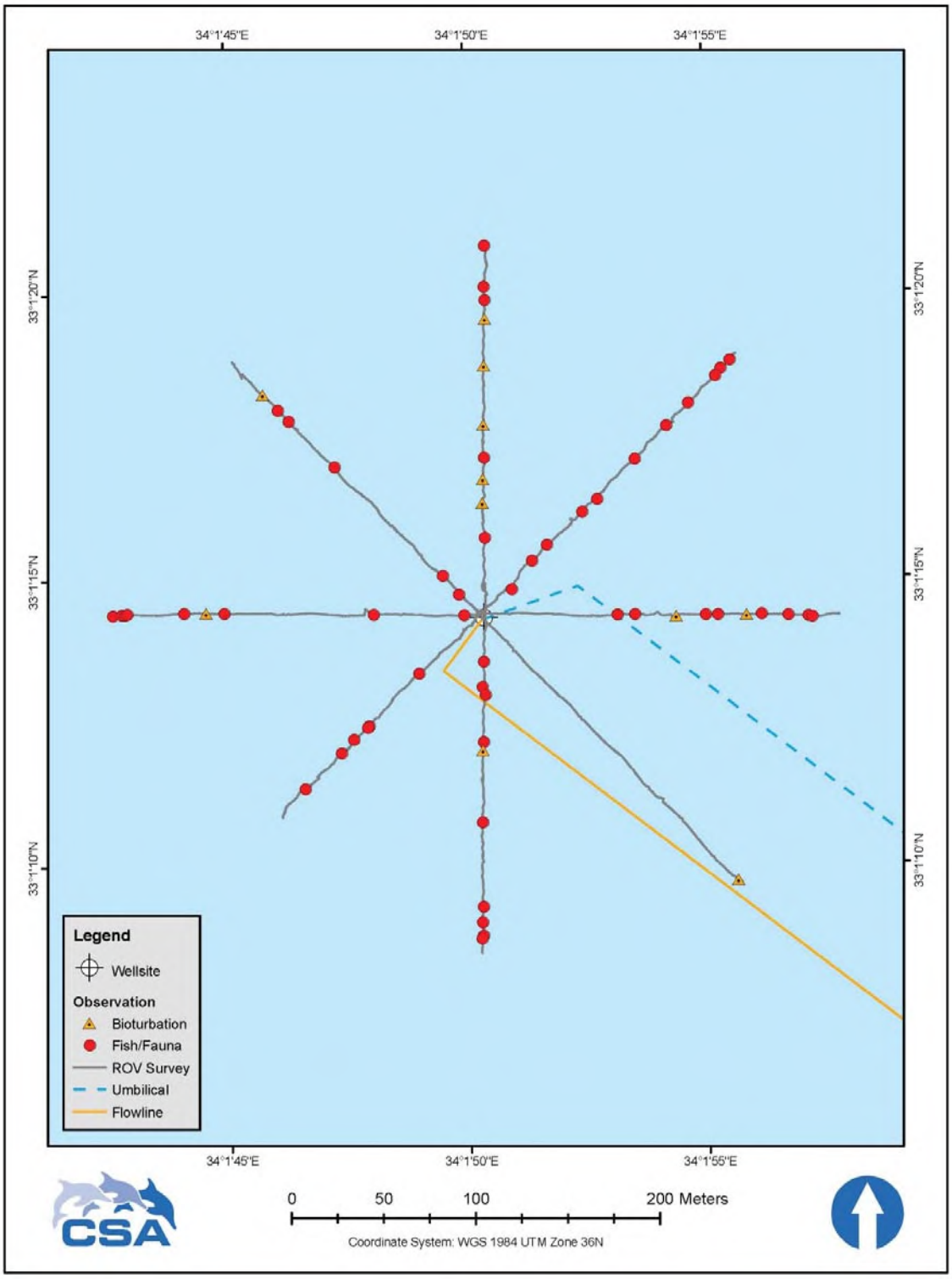

Figure 18. Locations of observations of biological activity along the remotely operated vehicle (ROV) survey track around the Tamar 5 wellsite.

The organisms most commonly observed during the video survey were fish (e.g., tripod fish, *Bathypterois* sp.; **Image 15**) and shrimp (**Image 16**). One crab was seen in an area of disturbed sediment near the Tamar 3 wellhead. Many of the fishes observed during the video survey could not be identified by video analysis (e.g., **Image 17**) because of their positioning relative to the camera or small body size. In all, 29 fishes and 336 shrimp were observed during the video survey. Relative abundances of fishes and shrimp averaged 0.36 and 4.2 individuals per 100 m of transect, respectively (**Table 24**).

Image 15. A tripod fish (*Bathypterois* sp.) perched on its elongated tail and pelvic fin rays observed during the video survey of the Tamar 4 wellsite.

Image 16. A shrimp resting on the bottom of the seafloor during the video survey of the Tamar 4 wellsite.

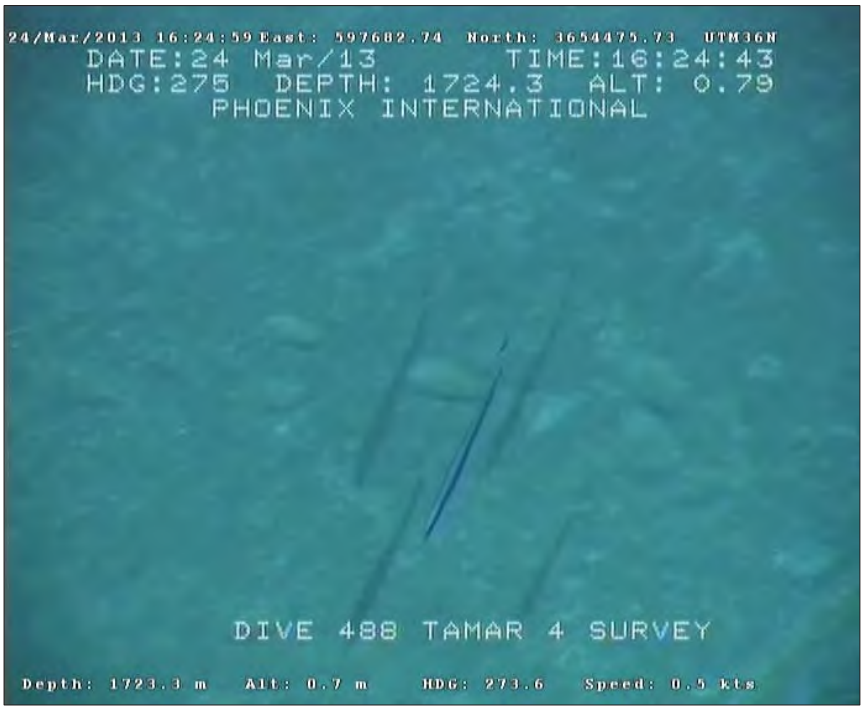

Image 17. An unidentified fish swimming toward the remotely operated vehicle during the video survey of the Tamar 4 wellsite.

Table 24. Total and mean numbers of fishes and shrimp observed at the Tamar Field wellsites. Values for mean numbers of fishes or shrimp observed were scaled to individuals per 100 m of transect.

Wellsite	Number of Transects	Fishes		Shrimp	
		Number Observed	Mean (individuals per 100 m of transect)	Number Observed	Mean (individuals per 100 m of transect)
Tamar 1 and 6	8	7	0.44	83	5.19
Tamar 2	8	3	0.19	15	0.94
Tamar 3	8	2	0.13	80	5
Tamar 4	8	16	1	97	6.06
Tamar 5	8	1	0.06	61	3.81
Total	40	29	--	336	--
Mean		--	0.36	--	4.2

Apparent bioturbation was commonly observed along all video transects and included patterned burrows (small groupings) (**Image 18**) and small (approximately 15 to 30 cm) conical mounds (**Image 19**) likely formed by deposit-feeding worms (Polychaeta).

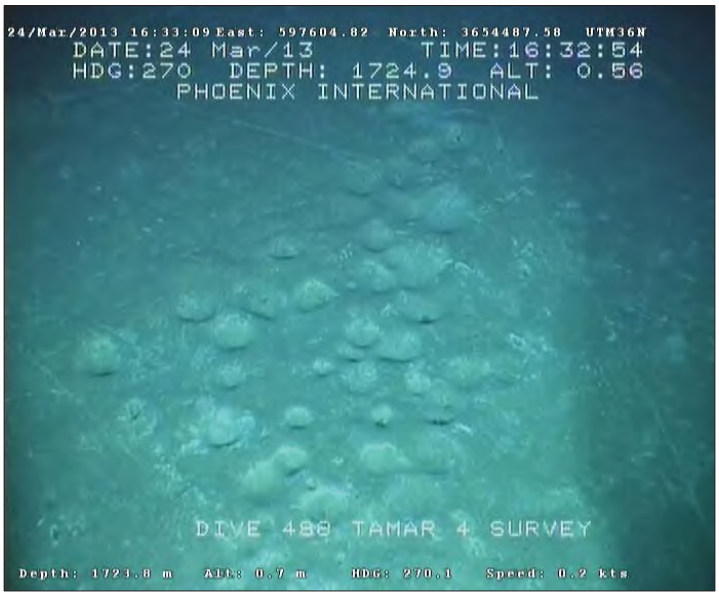

Image 18. Apparent bioturbation such as this small group of burrows seen in the Tamar 4 wellsite video survey area was commonly observed.

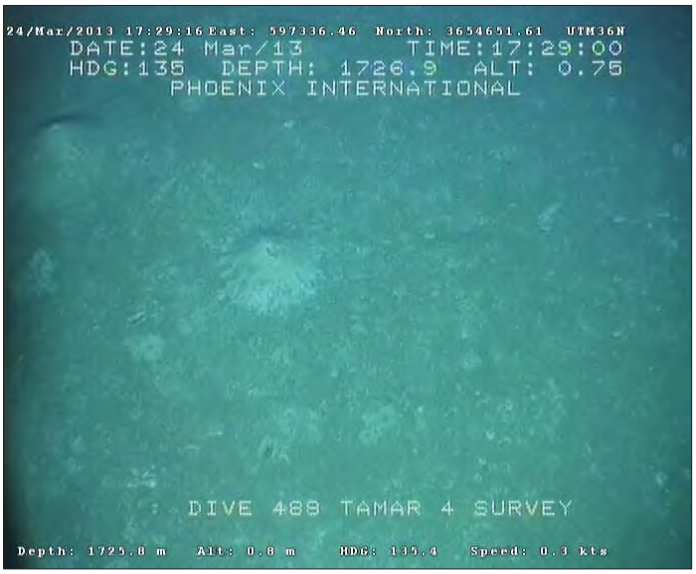

Image 19. Conical mounds likely formed by deposit-feeding worms (Polychaeta) such as these seen during the Tamar 4 wellsite video survey were common within the survey area.

5.6 SONAR DATA

Sonar data were reviewed in real time to confirm topography of seabed features within the survey area. The sonar provided an image based on reflection of acoustic signals from the ROV placed at the center point of the station and extending out a distance of 75 m. In the collected sonar images, elevated features are visually indicated by lighter colors and the depressed features that were shaded from the acoustic signal are indicated by darker colors.

The sonar images had a much larger field of view (75 m) than the video images and provided a better depiction of the seafloor necessary to discern large-scale topographic variations. The sonar data confirmed the information collected from video data, specifically that the survey area around the wellsites was characterized by relatively smooth low-relief, apparently soft substrate (**Image 20**).

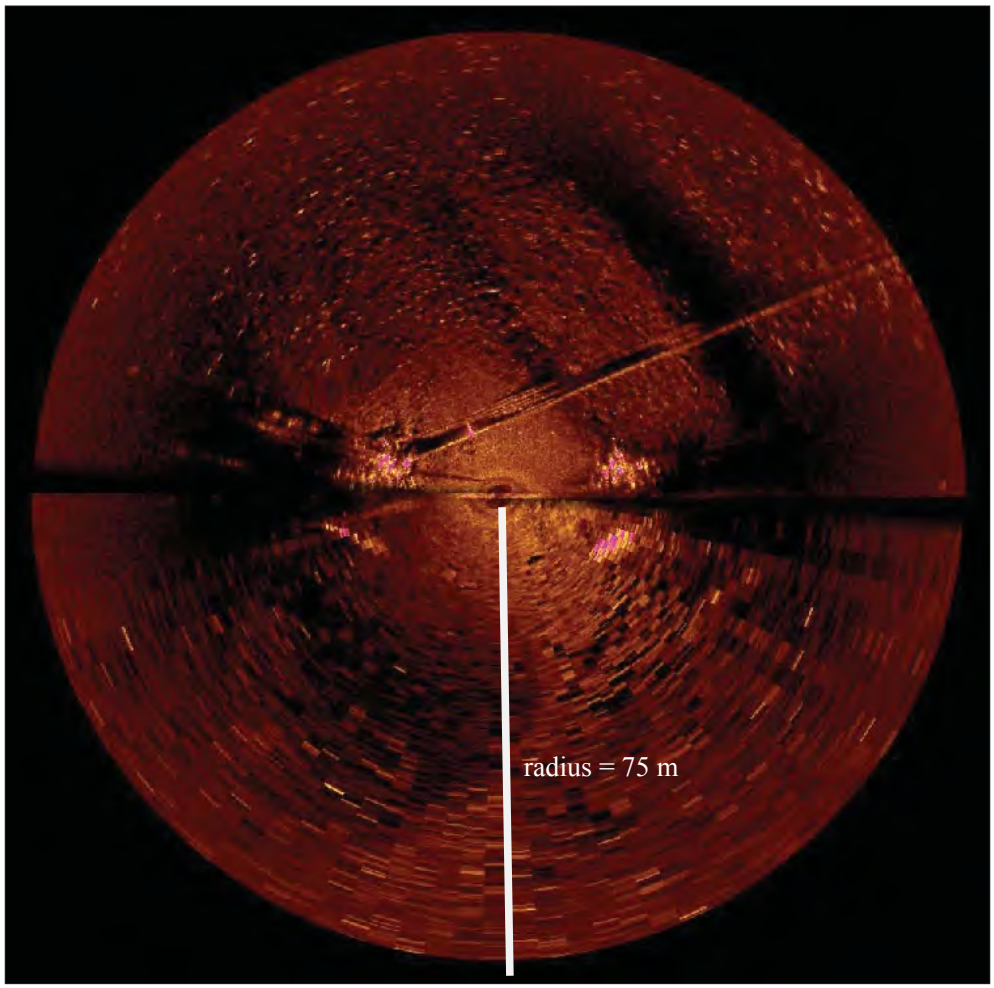

Image 20. Mosaic of forward-looking sonar images (approximately 75-m radius) collected while the remotely operated vehicle was oriented on headings of 0° and 180° at the Tamar 3 wellsite. Light brown areas indicate smooth seafloor topography; darker browns and black areas were shaded from the acoustic signal and indicate depressed areas. Pink areas indicate a high amount of acoustic signal reflection and reveal the presence of drilling infrastructure. A pipeline is visible in the top half of the image. The observed dimpling effect is caused by subtle small-scale variation in the topography, most likely due to the small mounds and burrows present within the survey area.

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APPENDICES

APPENDIX A

Scope of Work/Sampling and Analysis Plan for the Tamar Field and Pipeline Survey

APPENDIX B

Vessel Specifications

APPENDIX C

Seawater Total Metals Analytical Data Sheets

APPENDIX D

Seawater Hydrocarbons Analytical Data Sheets

APPENDIX E

Seawater and Sediment Radionuclide Analytical Data Sheets

APPENDIX F

Sediment Grain Size Analytical Data Sheets

APPENDIX G

Sediment Total Organic Carbon Analytical Data Sheets

APPENDIX H

Sediment Total Metals Analytical Data Sheets

APPENDIX I

Sediment Hydrocarbons Analytical Data Sheets

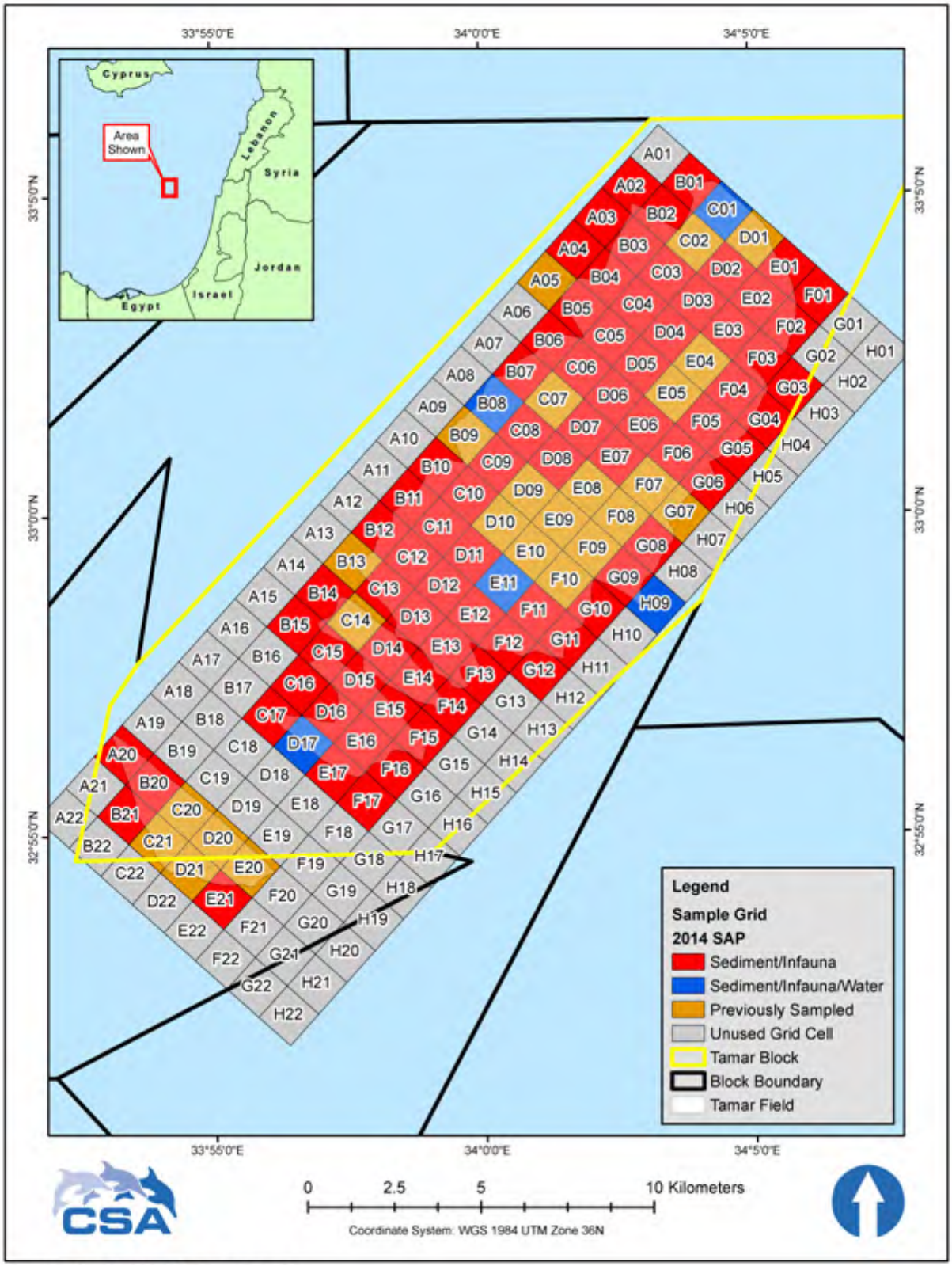

Figure A1. Uniform grid sampling design superimposed over the Tamar Reservoir showing new and previously sampled stations.

APPENDIX B

Framework Guidelines for Preparation of Environmental Document Accompanying License for Exploration Purposes

State of Israel

Ministry of National Infrastructure, and Water
Natural Resources Administration

Ministry for Environmental Energy Protection
Marine and Coastal Division

Kislev, 5774
December 2013

Appendix B: Framework Guidelines for Preparation of Environmental Document Accompanying License for Exploration Purposes – Exploratory (Experimental) Drilling and Offshore Production .
Draft for Public Comment – December 2013

Environmental document accompanying Application for Exploration Drilling (hereinafter: the "Application"), for the performance of trial drilling and maritime production tests (hereinafter: the "Environmental Document").
The Guidelines were written by the Ministry of Energy and Water and the Ministry for Environmental Protection, together with the Nature and National Parks Authority (NNPA), and in coordination with the Ministry of Agriculture and Rural Development, and the Antiquities Authority.
The Document is to be prepared following additional consultation with the Ministry for Environmental Protection and adaptation of the Framework Guidelines to the Application, in accordance with the details below.

General Requirements
A. The Environmental Document will be effected under the responsibility of the authors of the Application, and will include the name of the person responsible for its performance and the names of the professional service providers that participated in its preparation and performance.
B. The Environmental Document will be prepared and performed by a company with experience and expertise in evaluation of environmental impact and marine research. The company by the selected developers of the plan to perform the document must prove a minimum of 10 years experience in the related area.
C. The Company that shall be elected to prepare and perform the Document shall contain a team of experts with proven experience in research into the marine environment of Israel in the following areas: marine ecology, marine biology, a maritime biologist specializing in deep sea systems, marine chemistry, hydrodynamics, sedimentology, geology, atmospheric chemistry and marine geophysics. In the event that it is a foreign company, it shall be assisted by Israeli experts with proven experience in the above areas of content. The team shall be presented at the time of submission of the Application for the approval of the Commissioner and the Ministry for Environmental Protection, if necessary.
D. For the purpose of preparation of the Environmental Document, it shall be possible to rely on relevant information collated during the past decade.
E. The author of the document and the professional consultants shall fill in and sign the appropriate affidavits (Form 1, 2) in the form appearing in section 14(c) of the Planning and Building (Environmental Impact Studies) Regulations, 5763-2003.
F. The Environmental Document will be submitted in Hebrew and in English and will include an extended summary at its start, which shall contain the principal findings, conclusions and recommendations for implementation of the Application. Likewise, a full bibliography and the sources of the data used by the authors of the document, separately for each of the environmental aspects, shall also be attached. Submission of the Environmental Document in English shall only be possible after receipt of prior, written consent. In the event that the Environmental Document is submitted in English, an extended summary will be attached to it containing the main findings, conclusions and recommendations for implementation of the Application in Hebrew as well.
G. The Environmental Document shall be submitted in digital format as well, in a .pdf or .docx file. The drawings in the document shall also be submitted in .dwg and .shp files. Ground and aerial photographs (including orthophotos) used for the document shall be submitted in JPEG, TIFF and

GeoTIFF or ECW or MrSID format, in accordance with the kind of result or other format approved in advance and in writing.
H. The maps and aerial photographs that are submitted on digital media shall be at the highest possible resolution employed in the process of preparation thereof. On the other hand, the maps and aerial photographs that are attached to the hardcopy of the document shall be adjusted, in terms of scale, to the guidelines set out in the relevant section of the document. The maps shall set out the date of preparation and the name of the entity that effected the mapping.
I. The document shall refer to all components of the Application.
J. The document shall contain full reference to every section of the guidelines, in accordance with the order of the guidelines. A document that is submitted in an incomplete form shall be returned without being checked.
K. If a particular section is submitted in a format that is different from the requested format, the change as compared with the guidelines must be set out and explained.
L. The Guidelines are for every drilling site, whether single or multiple, including a salvage drilling site if prescribed.
M. The Application (instructions + plan) must be attached to the Environmental Document that is to be submitted.
N. The Framework Guidelines, following adaptation, shall constitute part of the Environmental Document and shall appear as an appendix thereto.
O. Any privileged information constituting a commercial secret must be noted in order to enable publication of the environmental document without disclosing such information. It is clarified that final discretion with respect to whether material constitutes a commercial secret shall pertain to the Authority provided that the party submitting the material is given notice of such, and leave to present his position if such is not in accord with the Authority's position.
P. The document must be submitted to the Petroleum Commissioner, in one copy and to the Ministry for Environmental Protection, in three copies, as a drafted, continuous and complete paper document, and in digital form as well.
Q. The document shall be approved by the Petroleum Commissioner and the Ministry for Environmental Protection, who shall be assisted by the relevant entities.

1. Chapter A – Description of the current Maritime Environment to which the Application Relates

1.1. General

1.1.1. The subjects set out in this Chapter shall be used for the examination and description of the environmental impacts expected to develop due to performance of the Application.
1.1.2. The Application shall be set out in words, and with maps and graphic descriptions.
1.1.3. The current situation of the deep sea area in the exploration sites, as well as biological, ecological, chemical, sedimentological, atmospheric, geological and hydrodynamic aspects of the scientific data and cultural and heritage sites comprise the basis for forecasting the environmental influences that may arise due to the natural gas and oil exploration and production operations in the surrounds of theses sites.
1.1.4. The background survey set out in Appendix B1 “Framework Guidelines for Preparation of a Background Monitoring Plan for the Marine Environment Accompanying a License for Exploration Purposes – Exploratory (Experimental) Drilling and Offshore Production” shall serve as the basis for the description of the marine environment within the area of the Application.

1.2. Boundaries of Application and Area of Influence

1.2.1. The detailed area of the Application (blue line): shall include the maritime area within a radius of up to 2 km around each of the gas and oil exploration sites, in the sea opposite the Israeli coastline, including a salvage drilling site if planned. The maritime area will include the water column, seabed and sub-seabed, and the maritime infrastructure and facilities situated at this site.
1.2.2. In the event that the drilling site is situated less than 1 nautical mile from the coastline, the area of the Application shall also include the area of the “coast” as defined in the Preservation

of Coastal Environment Law and along a 1 km strip parallel to the drilling site.

1.2.3. The area of impact of the Application shall include the entire marine and coastal area that might be affected environmentally as a result of ongoing operations or a fault in any of the exploration sites, including ecological impacts, acoustic impacts, air quality, appearance from the coast, and hazardous materials. **It is clarified that the area of impact varies depending on each of these matters and therefore, the author of the document must consult with the Ministry for Environmental Protection in order to obtain a specific delineation of the various impact boundaries, prior to preparing the document**.

1.3. Maps and Orthophoto

1.3.1. The location of the exploratory drilling shall be described in words and its location noted on the international Lat-Long grid and its coordinates on the New Israel Grid, where possible, and will be marked on all of the maps and sketches in the document.

1.3.2. The distance between the drilling site and points of note on the coast (Rosh Hacarmel, Hadera, Ashdod) and the perpendicular distance from the coast.

1.3.3. An orthophoto will be required where the distance of the exploration drillings is less than 1,000 m from the coastline.

1.3.4. A general depth map must be presented at a scale of 1:250,000 of the deep sea off the coast of Israel, with the location of the drilling sites, existing and proposed maritime boundaries and areas and shipping routes being noted on it.

1.3.5. A series of regional depth maps must be presented at a scale of 1:20,000, at a radius of 2 km from each of the sites, with the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand), fractures, land-slides and above- and underwater infrastructures and facilities found in each region being noted on it. The differences between the depth contours on the maps shall be 5 meters and the mapping data shall be the most up-to-date in existence. If there is information at a radius of more than 2 km, it should be presented too.

1.3.6. If there is maritime agricultural activity within a field of less than 30km from the exploratory drilling, the location of such activity and the location of the drilling site must be noted on a map at a scale of 1:50,000.

1.3.7. Detailed depth maps of the Application area (blue line) are to be set out at a scale of 1:5,000 around each of the sites, and mark on them the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand) and above- and underwater infrastructures and facilities found in each region. The differences between the depth contours on the maps shall be 1 meter and the mapping data shall be updated to the last decade. Likewise, the sedimentological characteristics of the seabed shall be based on a granulometric and mineral survey correctly representing the sediment in the detailed area of the plan.

1.3.8. In the event of exploratory drilling at a distance of less than 1 nautical mile from the coast, the land zoning and uses in the relevant coastal area must be marked (see section 1.2.2) as well as the physical data including the type of coverage (rock or sand, cliffs), coastal sensitivity to oil pollution, on a coastal water oil pollution sensitivity map (the map is accessible on the internet), existing and proposed marine reserves, maritime infrastructure, culture and heritage sites and antiquities, declared and undeclared bathing beaches, residential areas (existing and planned), public institutions, nature reserves and national parks, roads, engineering facilities and infrastructure lines relating to energy systems (petrol, gas, electricity), desalination plants, drainage and sewage lines, fuel reservoirs, hazardous material reservoirs, communications facilities and lines and other uses.

1.3.9. Maritime transportation and infrastructure systems, electricity infrastructure and facilities, communications and energy lines, corridors, pipelines and terminals for various infrastructures (gas, petrol, hazmat, RO, etc.) in the Application area must be set out on a maritime map at a scale of 1:20,000 together with a verbal description,

1.4. Geological, Seismic and Sedimentological Characteristics

An exhaustive and detailed geo-hydrological description of the site, including:

1.4.1. Describe, in words, the general geographical location of the exploration drilling sites, their proximity to seismically active areas and the rock foundations upon which they will be

constructed.

1.4.2. A general geological / geomorphological map must be set out at a scale of 1:200,000 of the sea off the coast of Israel, and mark thereupon the location of the exploration drilling sites. On this map, mark geological fractures, with an emphasis on fractures that are active or that are suspected of being active. Fractures described as being "suspected of being active" by the Israel Geological Institute or similar entities shall be deemed to be active unless it is proven that they are not active using the usual methods (conduct of research and geophysical cross-sections, and paleoseismological analysis). Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides and other geological and morphological phenomena which are notable.

1.4.3. Set out a series of regional geological / geomorphological maps at a scale of 1:20,000, around all of the sites, and mark geological fractures on them, with an emphasis on active (young) fractures or fractures suspected of being active. Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides, active landslides, rocky infrastructure exposed above the ordinary seabed, and other geological and morphological phenomena which are notable.

1.4.4. If the drilling mud and cutting discharge are to be discharged and/or dumped at sea, set out the area of dispersal of the mud and other cutting discharge on a geophysical survey conducted via side-scan sonar and underwater information, physical changes in the seabed due to the effects of anchoring and excavation, the build-up of waste, etc.

1.4.5. Describe in detail the rock infrastructure at each of the exploration drilling sites. Set out detailed information that might clarify the characteristics of the land (for instance: the speed of shear stress waves, the depth to the bedrock, characteristics that affect non-linear conduct, etc.).

1.4.6. Address the possibility of the existence of active geological fractures in the area of the Application and the near environment.

1.5. Hydrodynamic Regime

1.5.1. Describe the characteristic wave regime within the area of the Application. This description shall be based on wave characteristics measured in the south eastern Mediterranean in general, and off the coast of Israel over the last 20 years in particular.

1.5.2. Set out the statistical breakdown of wave characteristics within the timeframe of one year (significant and maximum height, direction, cycle time at the top of the spectrum, and average cycle time), and within a longer timeframe of 5, 10, 20, 50 and 100 years, statistics of storm durations for various maritime conditions.

1.5.3. Refer to the affect of waves in extreme storms and the possibility of the development of killer waves, including due to a seismic source, on the stability of the marine structures within the area of the Application.

1.5.4. Describe the regime of the currents in the area of the Application, created due to the winds, and other oceanic variables (for instance: astronomic tides, Coriolis force, jet streams along the edge of the continental shelf, seasonal changes of seawater mass, temperature, salinity, etc.). This description shall be based on meteorological-oceanographic information collected since the mid-20th Century, in the Eastern Mediterranean in general and along the coast of Israel in particular.

1.5.5. Set out the statistical division of the wind regime in the Eastern Mediterranean, including the annual frequency of wind directions, wind magnitude (including gusts), seasonal effects, and extreme winds. The minimum resolution shall be 22.5° for wind direction and 2 m/s for speed.

1.5.6. Describe the current regime in the Application area or in an adjacent area, including statistic split subject to presentation of the source of the information, to the extent that such information is available.

1.6. Nature and Ecology

1.6.1. The condition of marine mammals, sea turtles, permanent sea birds, migrating birds (based on seasons and hourly distribution), and species of pelagic fish located in the drilling region,

must be presented in accordance with information from the most up-to-date professional literature and from field surveys and population sizes must be estimated.

1.6.2. The natural monuments affixed to the seabed (benthic) must be presented. The species within the area of the Application and within the area of its impact (as described in section 1.2.3) must be described including micro and macro algae, seaweeds, seabed dwelling fauna, sedentary or territorial. In addition, describe the coastal natural monuments, as the case may be, situated within the area of the Application and within the area of its impact (as described in section 1.2.3). The information regarding natural phenomena will be in reliance upon a detailed biological survey (Appendix B1) which will be conducted within the area of the Application and the area of impact, and on information, if such exists in this area, from prior surveys. The information included shall be set out in tables, maps, graphs, pictures, video, and shall be accompanied by a detailed verbal description of the findings and with lists of inventory, including scientific names based on taxonomic classification. Note the presence of rare, unique or delicate organisms.

1.6.3. Set out the various habitats that exist in the body of water, and in the various seabed environments including hard surface areas, sponge gardens, deep coral reefs, seaweed carpets. A detailed description must be provided of fauna and flora societies in each of these habitats, including coverage percentages, and taxonomic information regarding the identity of species in the region. A map of the various habitats in the area of the Application must be included.

1.6.4. Pursuant to the above sections, a detailed analysis must be conducted of the information including on the basis of the following issues:

1.6.4.1. Identification of the creatures to a species level or to the most detailed taxonomical level possible.

1.6.4.2. Density of individuals.

1.6.4.3. Richness of species (in the various taxonomic groups).

1.6.4.4. Variety, the appropriate index must be chosen from the acceptable variety indexes such as: Shanon-Wiener, Simpson (2004) ,Magurran, and give reasons for the choice.

1.6.4.5. Fixed and mobile species.

1.6.4.6. “Target species”: key species, species of commercial value, most common species (breeding season, egg-laying season, area in which drilling operations will be tolerable, heavy metals and organic contaminants in target species).

1.6.4.7. Classification of species based on origin: Mediterranean-Atlantic, species with broad geographical distribution, invasive species.

1.6.5. Fishing areas within the area of the Application must be set out. Set out trawler fishing routes, fishing (note the kind of fishing - rod fishing, etc.), and show the data on a map at a scale of 1:20,000 and on a GIS layer, and the quantities of fish collected over a monthly and annual cross-section.

1.7. Sea Water and Sediment Quality

1.7.1. Set out the characteristics of the sea water and sediment quality within the area of impact, around each of the sites. The information regarding the quality of the seawater and sediment shall be based on a seawater and sediment quality survey (Appendix B1) which shall be conducted in the area of impact of the Application and on additional relevant information if any in this area, from the monitoring plan and previous surveys. The information included shall be set out in maps, graphs and shall be accompanied by a detailed verbal description of the findings.

1.7.2. Set out the quantity of floating material in the water column, in a variety of marine climatic conditions (winds, waves, currents). The presentation of this data shall be based on sediment samples in accordance with Appendix B1 and on additional relevant information if such exists in this area. The level of turbidity of the water shall be measured at the surface, in the center of the water column and near to the seabed at each of the sites. Likewise, set out the climatic conditions at the time of taking the samples.

1.7.3. Set out the levels of chlorophyll in the water column, within the area of the Application. Likewise, an assessment of the dispersion of chlorophyll must be conducted over the entire

area of impact, using remote sensing methods.

1.7.4. Describe, in detail, the chemical characteristics of the water column (dissolved oxygen, pH, salinity, temperature, fertilizers), within the area of the Application, around each of the sites.

1.7.5. Describe, in detail, the chemical characteristics of the sediment within the above area of the Application. The description shall focus on toxic substances, on chemical derivatives of heavy metals, TOC, PAH, SBF and their derivatives (including the results of decomposition), oxygen concentration in sediments. The sediment sampling system (the number of stations and their location) will be approved prior to performance as is set out in Appendix B1.

1.7.6. Likewise, describe the characteristics as set out in sections 1.7.5 and 1.7.5B of the fauna on the hard bed (if any) and of the fauna on the soft bed and of the fauna within the bed (in filtering animal tissue such as clams, snails, worms, polychaetes and crabs and fishes). The scope of this sampling will be approved in advance.

1.8. Culture and heritage sites

The information regarding antiquities and cultural heritage sites shall be based on a detailed archeological survey or as a result of processing following a remote sensing survey (side sonar scanner, multives, ROV movies, etc.) which shall be conducted within the area of the Application and on information that exists regarding the area from prior surveys. The sites known to the Antiquities Authority (both declared and as yet undeclared sites) and other sites containing information about archeological findings or sunken ships from must be included. The total information will be presented on maps at a scale of 1:20,000, and shall include the archeological sites, pictures, videos and shall be accompanied by a detailed verbal description of the findings in the area of the Application and in its close proximity.

1.9. Meteorology and Air Quality

1.9.1. Describe the existing meteorological conditions in the area of the Application and its environs.

1.9.2. Special meteorological conditions that might cause conditions of dispersal that will give rise to high air pollution concentrations in the environment must be noted.

1.9.3. For drilling operations planned at a distance of up to 10 km from the coast, up-to-date information must be presented regarding the state of the existing air quality on land, within a range of up to 10 km from the boundaries of the drilling site. Up-to-date monitoring data of contaminants the concentration of which in the air might be affected as a result of the planned operations must be addressed. The following contaminants and other relevant contaminants must be addressed: NOx, SO2, PM10, PM2.5. The monitoring data will be from the past five years, and will be examined on the basis of the environment and target values (Air Quality Value Regulations, 2011) and if there is no target value, on the basis of the reference value. The availability of the data will not be less than 95% over a period of five years.

1.10. Noise

1.10.1. Set out the magnitude of the sub-marine noise at a number of representative points at each of the sites (as set out in section 1.6 above).

1.11. Marine Transportation System and Infrastructure

On the basis of section 1.3.9, describe, in words, the marine transportation and infrastructure system in the chosen alternative area.

Set out the current operations of the system: Traffic volumes, entry and exit directions of vessels in accordance with the various classes of vessel, fuel containers, fishing boats, maritime farming service boats, yachts, tugboats and small operations vessels, etc.

1.12. Marine farming

1.12.1. Fishing and marine farming operations must be described, if any, at a distance of up to 30 km from the planned drilling site. The location of marine farming sites in the impact area must be set out, along with the species of fish grown and the quantities of total annual growth.

Chapter B – Reasons for Preference of the Location of the Proposed Plan and Possible Alternatives

2.1. General

In this Chapter, set out all of the reasons that gave rise to choice of the site proposed in the Application for Exploratory Drilling, including the salvage drilling site if planned. In addition, please refer to geological and seismic, environmental, planning, engineering and economic aspects, such as proximity to existing and planned infrastructure, exploitation of additional natural resources, impact on natural monuments, air quality, noise, etc. Data from drilling operations done in the past near to the area of the Application, if any, must also be addressed.

2.2. **Location alternatives**: Give details of and explain the various reasons that led to the determination of the proposed site of the exploratory drilling in the Application. Set out the location alternatives examined, the preferred alternative and the reasons that gave rise to the choice of it. The location alternatives will be examined in the exploration zone and for each location alternative, the following criteria, at least, will be examined: Structural analysis issues and the location of the target stratum; marine reserves; regions defined as special regions such as ridges, canyons or deep coral reefs, sponges, clams or other sedentary organisms; proximity to towns and residential areas, visibility and appearance from the coastline; habitats of animals in danger of extinction; shipping lanes; infrastructure, communications and energy lines; current regime; fish reproduction zones and times; fishing lanes; marine farming zones.

2.3. **Technological alternatives:** Set out the various technological alternatives examined and the various considerations that gave rise to the decision to use the technology set out in the Application, including the drilling technology (including vertical, angular, horizontal); the type of platform; BOP; drilling mud and liquids – composition, cutting discharge and drilling mud disposal targets. If use is planned to be made of mineral / oil based drilling mud, set out the criteria and limitations for use of one kind as opposed to another.

2.4. Possible alternative/s for deploying the infrastructures in the future production plan, including possible connection points to the terrestrial transmission system. The alternatives shall be set out in a comparison table, with each topic under examination being ranked, together with the professional reasons for selecting it. A sample table of criteria is attached in Appendix B2.

Chapter C – Description of Actions Stemming from Performance of the Application

3.1. General

This Chapter shall set out a drilling plan including the drilling rig, various sea vessels and aircraft, and the plans for them, and the activities that they will perform. The description of the Application shall include reference to all of the works that will be done, including all matters relating to trial drillings, drilling phases, abandonment or announcement of a discovery and transition to production. This Chapter shall also refer to the various stages of construction and operation. Describe all of the details of the Application as will be examined in Chapter D.

3.2. Description of the Application

3.2.1. General

3.2.1.1. Describe the purpose of the drilling and the type of drilling (natural gas or oil; exploratory; salvage; verification; development; production).

3.2.1.2. Describe the drilling platform including the type of platform, the name of the platform, ownership, date of manufacture, date of upgrade, region of prior operation and fleet specifications.

3.2.1.3. Note water depth at the drilling site and depth of drilling below the seabed (below mud line - BML).

3.2.1.4. Describe the sea vessels and aircraft involved in the exploration application.

3.2.2. Description of Drilling Process

3.2.2.1. Describe, in brief, all of the drilling processes and phases including the actions and materials relating all drilling activities. Note the main operations, depth of drilling under the seabed (BML), under the surface of the water (BWD) and under the platform, for each drilling segment.

3.2.2.2. Attach a schematic sketch showing the depth of the drilling as a function of time,

including appropriate reference to the stages of the drilling and drilling data.

3.2.2.3. Set out a Gantt Chart setting out the drilling activities done in series and in parallel.

3.2.3. Prevention of Oil Blowout

Describe the blowout preventer (BOP) that has proven efficacy and that is designed to prevent oil, gas and/or liquids under the surface such as produced water, saline water from blowing out of the bore into the marine environment. Explain and describe the continuous pressure controls. Set out the standard for periodic testing of all of the means of prevention of blowout or fault.

3.2.4. Protective pipeline and concretization

3.2.4.1. - In accordance with the drilling plan, describe the protective pipeline from the seabed to the target strata.

3.2.4.2. - Describe the concretization of the casement pipelines in the drilling, in order to prevent possible leaks and the transition of liquids from the bore into the seawater.

3.2.4.3. - Describe the method of construction and concretizing of the bore with reference to the timeframes of the principal stages in drilling the bore.

3.2.4.4. - Describe the composition of bore concretization materials.

3.2.4.5. - Set out the manner in which the quality of concretization is ensured during drilling, the method of testing such and the standard used for testing.

3.2.5. Testing of drilling pipelines

- Describe the references required for ensuring that drilling and protection pipelines are in order and the method of testing such, with all of the components thereof.

3.3. Production Tests

3.3.1. describe the planned production test method, the phases thereof, the order of activities, the equipment and the possible methods thereof, and set out the reasons for such. Set out the various indexes that will be examined such as maximum production of all production components (gas, oil, water, condensate), pressure, description of oil and/or gas including sulfur, nitrogen, CO_2, etc.

3.3.2. In cases where use of chemical substances is planned in the production test, set out the substances that will be used in the production tests, the commercial names of such substances, their quantity, concentration, chemical composition and function including chemical formula, CAS (Chemical Abstract System) Number, and MSDS (Material Safety Data Sheet) and include them in the chemical table in section 3.6.

3.4. Noise Hazards

Set out details of the mechanical equipment and the noise levels from the dominant sources characteristic of each form of technology. Set out details of the duration of the drilling, the hours of work each day, the number of sea vessels that will operate at the same time, throughout the hours of the day, and the aircraft involved in the work. Set out details of the frequency and magnitude of the noise that will be generated during the course of work at various distances from the source of the noise. If the drilling is less than one km from the coast, check the existence of noise-sensitive uses that may be exposed to noise levels that rise above what is permissible under the Prevention of Nuisance (Noise Prevention) Regulations, 5753-1992.

3.5. Air Quality

3.5.1. Describe the sources of emissions of contaminants into the air from the planned operations during the drilling and production testing stages, including: Energy facilities, flare / vents, unfocused emissions and other sources.

3.5.2. For all sources of emissions presented, set out the regime for the activation, the type of fuel, the contaminants emitted and other data necessary for evaluating emission rates. The rates of emissions of contaminants shall be estimated on the basis of manufacturer's data, measurements or calculations on the basis of EPA-AP42 methodologies or on the basis of other methodologies upon prior approval.

Faults that might give rise to increase emissions of air contaminants into the environment, the emission of additional contaminants such as H_2S or the generation of odor hazards to the

populace (at sea and on land) must be addressed and the measures for preventing air contamination hazards must be set out for each possible fault.

3.6. Hazardous Materials

Describe and set out all of the hazardous materials planned to be used, including drilling and production testing liquids. The following details must be noted for each material:
Chemical composition, commercial name, CAS identification number, UN number and MSDS - Material Safety Data Sheet. Quantity, purpose of use and method of use, location on the platform (together with a sketch), storage and batching, method of treatment and removal.

3.7. Sources of Discharge into the Sea

3.7.1. General – ongoing activities

3.7.1.1. Describe all of the sources of discharge into the sea, and describe, for each source, the processes that give rise to the discharge and a flowchart of the process. The flows that must be presented include: Drilling mud, cutting discharge, cooling water, reverse osmosis concentrate water, organic kitchen waste (where the drilling is located more than 12 nautical miles from the coast), sanitary effluent / waste ("black water"), "gray" rinse waters, washes from the oil separation facility, cement surpluses.

The following information will be given for each source of discharge into the sea. For drilling mud and cutting discharge – see also the specific instructions in section 3.7.2.

3.7.1.2. Describe the processes that create the flow together with a drawing of the processes.

3.7.1.3. Describe the treatment processes, if any, including physical data of stocking units, engineering and operational data for each treatment facility (the area of the facility, the volume of each unit, capacity, duration of presence, etc.); means of monitoring and control of each process / treatment; attach a schematic drawing for each treatment facility.

3.7.1.4. Set out the list of additives in each production and treatment process, the quantity of each additive, its function and the method of addition of it; attach information sheets (MSDS) for each additive, with an emphasis on ecological information for the marine environment, and possible impacts on fish farming and wild fish.

3.7.1.5. Describe the flow times including whether the flow is continuous or interrupted, fixed or variable (hourly / daily / other), and what the conditions and/or processes are that determine the quantity and/or times of flow.

3.7.1.6. Describe the method of discharge into the sea of each and every source and whether the discharge is effected separately / separate source or together with other discharges. In describing the source, set out the physical characteristics of the source / source pipe and the depth of the source with respect to the surface of the water / the seabed.

3.7.1.7. Quantities: Set out the quantities of each source, set out the information in accordance with maximum hourly, maximum daily, maximum monthly and total quantity during the course of the drilling. Set out the method of controlling quantities / amounts pumped into the sea (wharf based capacity meters, water meters, other - give details). Quantity data shall be presented in cubic meters.

3.7.1.8. With respect to the discharge of sanitary waste ("black water") and shower / wash water ("gray water"), set out the quantity in cubic meters / day / person, for each separate source.

3.7.1.9. Quality: Describe the composition of each source. Set out the information on the basis of data from similar facilities, including the conduct of laboratory tests. This information shall include contaminant concentration data, and total contaminant load discharged into the sea (in tons) including the provisions set out in section 3.7.4 (qualities) Note, for each source of pumping, the source of the information regarding the composition of it.

3.7.1.10. Give details as to whether there are land-based alternatives for each pumping source. If not, give reasons and details regarding the way in which this subject was checked.

Cutting discharge, drilling mud and left-over cement (drilling mud relates to any addition of liquids and materials used for drilling purposes).

3.7.2. Cutting discharge:

3.7.2.1. Quantities: Set out the quantity of cutting discharge (tons) and volume (cubic meters) discharged into the sea as follows: In each of the drilling segments, by drilling diameter; in the stage in which the drilling takes place without recycling and the cutting discharge is placed around the the wellhead directly on the seabed; in the drilling stage which is done with recycling, when the cutting discharge is brought up to the platform with the drilling mud; total quantity of cutting discharge discharged into the sea.

3.7.2.2. Treatment and removal of cutting discharge – describe the method of treatment and removal of cutting discharge.

3.7.2.3. If the cutting discharge removal destination is at sea, describe the piling up of cutting discharge and drilling mud on the seabed. Assess the radius and area affected by this process.

3.7.3. Drilling mud and left-over cement:

3.7.3.1. Quantities of drilling mud – set out the total quantity and volume of drilling mud (cubic meters and tons), for the stage of the drilling without recycling when the drilling mud is placed near to the drilling bore on the seabed, and for the stage of drilling done when the recycled drilling mud is brought back up to the platform with the cutting discharge and total quantities of the drilling mud discharged into the sea.

3.7.3.2. Set out the composition of drilling mud in a table, including: The name of the material, the function of each material, the quantity of each material in each segment of drilling and the total quantity of materials in each segment of the drilling, totals of all materials in each segment of the drilling and total quantities of all materials in the entire drilling process. This data shall be presented in cubic meters, transition units (SG) and tons. Note which of the drilling stages the discharge into the sea takes place in, what quantity is being discharged at each stage, and the total. This data shall be presented in cubic meters and tons.

3.7.3.3. Describe the way in which the various substances are added to the water and to other drilling liquids (creating the drilling mud). In reliance upon the above, please also refer to the quantities of water / other drilling fluid that are added during the course of drilling, due to losses of water / fluids / drilling mud back into the rock strata.

3.7.3.4. For each component and material, information sheets (MSDS) must be presented, including ecological information regarding the marine environment (toxicity, biodegradability, bioaccumulation) and concentrations of each component that might be pumped into the sea.

3.7.3.5. Chemicals / additives: Set out in a concentrated table data on chemicals, based on source of use (drilling mud, cement, etc.), based on information sheets, including: the name of the chemical, its CAS number, the composition of the chemical (in the event of a compound, set out each substance and composition, and the percentage of it in the compound), ecological information including the results of toxicity tests, biodegradability, bioaccumulation and the level of its impact / toxicity on the marine environment. Wherever there is no information, write “no information”; and note the level of environmental risk according to OSPAR / the Norwegian Method (green, yellow, red, black).

3.7.3.6. Describe the method and frequency of the various tests conducted in mud and drilling liquids, including materials pumped into the drilling mud preparation system and the standards under which the tests are conducted.

3.7.3.7. Biological toxicity test – set out the tests conducted for testing biological toxicity in drilling mud / surpluses from the treatment facility pumped into the sea and set out where such tests are performed and the source of the data; examine and present the extent to which the existing toxicity tests accord with the deep sea conditions in the Eastern Mediterranean Deep Sea Basin. Attach an expert opinion regarding the extent

to which the tests comply, and his recommendations regarding the conducting of compatibility tests for the deep sea conditions in our region.

3.7.3.8. Drilling mud treatment – describe the areas and methods of organization and the facility for the treatment of drilling mud, separation of the cutting discharge from it, testing the composition of it and details of the additives planned for the treatment facility, including the list of additives, the function of each substance, the method of placement of it, etc. Losses of drilling mud must be addressed, and estimates given as to the percentage lost, quantities (in tons) and volume (in cubic meters).

3.7.3.9. Attach sketches, including notation of physical data of units of production / processes / treatment and return of drilling mud, including work areas, volumes of treatment facilities, durations, etc.

3.7.3.10. Describe the stages of drilling in which use is made of cement, and the processes in respect of which left-over cement is discharged into the sea.

3.7.3.11. Cement quantities: Set out the total quantity of cement in each of the stages of drilling and the total quantity in use (tons). Estimate and set out the quantities of cement that are to be discharged into the sea.

3.7.4. Information on quality of discharges into the sea:

Set out the information on the quality of discharges into the sea so as to include information on chemical composition as follows: This information will be based on tests from similar facilities and processes from the past five years, subject to the existence of such, and details of the source of the information.

3.7.4.1. Discharges originating in the drilling mud: Set out the chemical composition of the water, including: An extended metal scan (ICP, mercury in AA); GCMS scan for organic materials with probability percentages, half-quantity concentrations and summary; detailed VOC scan (head space) with probability percentages, including half-quantity concentrations and summary; TOC; TSS; BOD; mineral oil (FTIR); PAH; turbidity; free chlorine; phenol; cresol; pH; AOX; DOX; species of nitrogen (nitrate - NO_3; nitrite - NO_2; ammoniac nitrogen NH_4-N; Kjeldahl nitrogen TKN; total nitrogen - calculated); phosphorus - P; sulfide; TDS; chlorides; the information shall be presented as concentration (mg/L) and as load (weight per unit of time).

3.7.4.2. Discharges originating in the cutting discharge: Set out metal composition: Ag, As, Cd, Cu, Cr, Hg, Ni, Pb, Zn; organic matter (TOC); radioactive materials Pb-210, Th-228, Ra-226, Ra-228.

3.7.4.3. Discharges from the wash treatment facility: Set out the chemical composition of the water, including: An extended metal scan (ICP, mercury in AA); GCMS scan for organic materials with probability percentages, half-quantity concentrations and summary; detailed VOC scan (head space) with probability percentages, including half-quantity concentrations and summary; TOC; TSS; BOD; DOC; turbidity; phenol; cresol; pH; AOX; DOX; mineral oil (FTIR); species of nitrogen (nitrate - NO_3; nitrite - NO_2; ammoniac nitrogen NH_4-N; Kjeldahl nitrogen TKN; total nitrogen - calculated); phosphorus - P; sulfide; TDS; chlorides; the information shall be presented as concentration (mg/L) and as load (weight per unit of time).

3.7.4.4. Discharges from sanitary effluent treatment facility: Set out the chemical composition of the water, including: BOD; TSS; TOC; turbidity, free chlorine, oils and lipids (FTIR), mineral oil (FTIR), species of nitrogen; sulphide; detergents (MBAS); pH; fecal coli per 100 mL, streptococcus per 100 mL, extended survey of metals (ICP), TDS; the information shall be presented as concentrate (ML) and load (mass per unit of time – mass / month or mass / year).

3.7.5. Describe the measures and structure of the platform for the purpose of separating clean upper water, in the event of rain, from oily lower water intended for treatment prior to release into the sea or removal to land.

3.8. Waste

Describe the quantity of the waste expected to be created, including kitchen waste, dry waste, other waste created as a result of the drilling process, except for waste set out in the section regarding

sources of discharge into the sea as set out in section 3.7 above.

3.9. Closure / Abandonment of Drilling Site

Describe the details of the actions required for closure of the drilling site and the order of performance thereof, including permanent abandonment or temporary abandonment. Describe the measures for closing the wellhead, the target strata, and other conducting strata for two alternatives, abandonment and restoration of the previous condition; declaration of a discovery and transition to production. In the event of closure of the wellhead, the standard under which the closure means are installed must be set out. Set out the list of chemicals planned for use in closing the well and include these in the table of chemicals in section 3.6 together with information sheets. Attach a schematic drawing of a cross-section of the drilling prior to closure of the drilling and after closure (temporary / permanent).

Chapter D – Evaluation of the Environmental Impacts expected to develop due to Performance of the Application and the Measures to be taken to Prevent / Minimize such

In this Chapter, the various topics expected to have an environmental impact shall be set out graphically and verbally, including impact on moving or stationary species within the areas of the Application and its close and remote environs, in accordance with the provisions of section 1.2.3. The description of the environmental impacts and the sources of these shall be both qualitative and quantitative. The variety of activities expected to take place at the drilling site must be set out. With respect to each subject, an explanation shall be given as to whether it is necessary to prevent or reduce the negative environmental impacts and what means must be employed in order to prevent or reduce such, if any.

In the event that during the course of preparation of the Application, influences or other findings are found that are not mentioned in this document, these must be addressed and means must be proposed for reducing the impact in the document.

4.1. Assessment of Potential Impact on Marine Environment

4.1.1. Assess the maximum scope of the impact of the drilling rig, including anchors, on the seawater, the seabed, and the coast, as the case may be, and set out the basis for the information and the method of effecting the assessment.

4.1.2. In the event that the discharge target for the cutting discharge and drilling mud is at sea, assess the extent of impact on the environment in accordance with an evaluation of the radius and the area affected by the process, as set out in section 3.7.2.3 and set out the tests, actions and frequency thereof in order to minimize harm to the marine environment.

4.1.3. In the event of proximity to natural monuments identified in accordance with section 1.6, existing and proposed nature reserves, culture and heritage sites and marine farming facilities, the methods of action to remove the cutting discharge and the drilling mud to an alternative marine site and/or to a site on dry land are to be examined and presented.

4.1.4. Examine and present the possibility of reducing and minimizing the placement of discharge and drilling mud directly onto the seabed during the course of drilling from the drilling segment prior to installation of the riser, such as by using an RMR SYSTEM.

4.1.5. Assess the maximum scope of the impact of the drilling liquids at the time of effecting the production tests on the seawater in the area of the Application.

4.1.6. Simulation (a digital three-dimensional hydrodynamic contaminant dispersion model) for drilling mud of the dispersion zone of the drilling mud and other mining liquids – each case must be considered on its merits on the basis of environmental data and location relative to the coast, the quantity of mud and discharge and the duration of time of the drilling or discharge into the sea. This matter will be coordinated and approved in advance and in writing. If simulation is required, the model must be approved and is to be presented in a preliminary document which shall contain a description of the type of model, calibration characteristics, commencement conditions, language conditions, the grid of the model and other parameters required in order to activate the model. After approval of the conditions and calibration of the model, the scenarios for modeling the dispersion of contaminants from a hydrodynamic point of view will be set, in various climatic conditions.

4.2. Production Tests

Describe all of the means for ensuring that under no circumstances will there be any connection (transfer of liquids or gases) from the area where the production tests are taking place and the water-carrying strata and expansion of the fuel composition (liquid and gas) underground or in the marine environment.

4.3. Environmental Impacts of Sea Pollution Event by Oil based on Extreme Scenarios

4.3.1. Please describe the current field and the movement of the oil stain along the Israeli coastline from the drilling bore in detail and in stages. This description should rely, inter alia, on the results of activation of a three-dimensional hydrodynamic model, which has been fed with wind data and the other necessary hydrodynamic characteristics. The hydrodynamic model must set out, precisely, the field of currents in accordance with the layout of the local seabed up to the Israeli coastline.

4.3.2. If the oil slick will, based on the findings of the hydrodynamic model, penetrate the shallow portion of the continental shelf off the coast of Israel, describe via the appropriate hydrodynamic model for simulating the hydrodynamic processes in the coastal environment the current regime in the area affected mainly by local winds and waves, and analyze the impact of such currents on dispersal of the oil slick on the coastal environment.

4.3.3. In running the model and in all of the calculations stemming from it, please take into account the worst-case scenario of 30 continuous days of discharge into the marine environment, at a maximum daily capacity in accordance with the drilling data. The type of oil in the model must be the most resilient oil expected in the reservoir and/or in accordance with the worst-case scenario data.

4.3.4. Please run each of the four most common sea conditions on Israeli beaches for a period of 30 days:

4.3.4.1. Extreme winter wave storm: 9.12.2010 - 08.01.2011

4.3.4.2. Winter wave storm: 26.01.2008 - 14.02.2008

4.3.4.3. Summer swell: 17.07.2008 - 16.08.2008

4.3.4.4. Strong North-Easterly wind (Spring and Autumn): 25.09.2007 - 25.10.2007

4.3.5. Please explain in clear detail all of the data and estimates for the maximum daily quantity of oil set out in the document, and the general quantity during the course of the current scenario, without 30 day control, including formulas and calculations. Please clarify the objective difficulties in evaluating the expected quantities and the possible areas of imprecision. Please address the relevance of the modeling method performed and expand, in the explanation, on the relationship between the results of the model and the actual anticipated assessment based on international knowledge and experience from past oil pollution incidents. Explain the nature of the oil spill over the water, including the thickness and expected spread of it, and the environmental significance of the thickness and spread of the spill.

4.3.6. Please analyze, on the basis of the findings of the model, the results of the spread of the oil stain from the drilling bore and give a detailed explanation of the environmental significance of the results of the model. Please refer to the marine environment in general and to the coastal area and the various sites therein in particular. Give details and explain the environmental and other implications that might arise from an oil spill incident at sea under the various scenarios, vis-à-vis the various environments. Including a description of sensitive areas that might be affected by a pollution incident (based on a map of sensitivity of beaches to sea pollution by oil. The map is accessible on the internet and a copy may be obtained from the Marine and Coastal Division as a GIS layer). Address the various significances, including:

4.3.6.1. The impact on the ecosystem in general, and on the various species in particular.

4.3.6.2. The impact of the various uses including an assessment of the measures required to remedy the damage and to restore the previous condition, an assessment of the length of time during which uses might be harmed and a general assessment of the costs of restoring the previous condition, all in accordance with open reports of international experiences.

4.3.6.3. Please address the following environments: The open sea environment, including a distinction between deep water and the critical transition zone, the seabed, beaches used for swimming and leisure, rocky beaches and/or sandy beaches that are rich in biota, marinas, moorings, marine anchorages and ports, power station cooling water suction plant and coal terminal, reverse osmosis plants and fish farm cages.

4.3.7. Set out an oil spill spread model (name of model, name of manufacturer and representative calibration data), and output data, for the prior approval of the Ministry for Environmental Protection (Marine and Coastal Division), prior to running the model. For the purpose of approval of the calibration stage, please set out a document describing, in detail, the boundary conditions and the starting conditions of the model, and the various variables and non-variables chosen for the purpose of running the model. The following are the details, variables and conditions that are required for the approval:

4.3.7.1. General

4.3.7.1.1. The name of the model.

4.3.7.1.2. A brief description of the model.

4.3.7.1.3. Reasons for adapting the proposed Eastern Mediterranean Sea (oil) spill simulation model.

4.3.7.1.4. Examples from around the world for use in the proposed spill simulation model.

4.3.7.2. Meteorological-Physical Conditions and Variables

4.3.7.2.1. Conditions of edge of model (boundaries and surface)

4.3.7.2.2. Conditions of commencement of model.

4.3.7.2.3. Resolution of model, both horizontal and vertical.

4.3.7.2.4. Characteristics of starting data for model: winds, currents, sea level, temperature, salinity, etc.

4.3.7.2.5. Bathymetry.

4.3.7.3. Chemical Variables

4.3.7.3.1. Type of oil.

4.3.7.3.2. Quantity of oil emitted per unit of time.

4.3.7.4. Calibration and Verification of Model

4.3.7.4.1. Methodological description and explanation of the proposed method of calibration.

4.3.7.4.2. Presentation of the variables required for calibration for the purpose of achieving the requisite model performances.

4.3.7.4.3. Presentation of calibration findings (in figures, tables, and a verbal explanation).

4.3.7.4.4. Methodological description and explanation of the proposed method of verification.

4.3.7.4.5. Presentation of verification findings (in figures, tables, and a verbal explanation).

4.3.7.5. Scenarios for Examination

4.3.7.5.1. Analysis of the usual and extreme hydrodynamic characteristics in the area and environs of the drilling bore.

4.4. Light Hazards

The effect of lighting and the planned production tests required for performance of the Application on the environment must be examined and measures proposed for reducing expected light hazards.

4.5. Noise

Assess the expected impact of noise on animals in the environs of the drilling. Give details of the local species that might be harmed by such noises (with an emphasis on pelagic animals such as fish, whether wild or caged, marine mammals, turtles), and measures for reducing damage.

4.6. Nature and Ecology

4.6.1. Assess the level of sensitivity of the animals and the possible impacts of construction of the

rig on habitats as described on the habitat map in section 1.6.

4.6.2. Describe rehabilitation at the end of drilling work and abandonment or commencement of the operational period.

4.7. Culture and heritage sites

Check the impact of performance of the plan on declared sites and on sites that may be discovered and exposed during the performance of the Application.

4.8. Air Quality

4.8.1. Set out a table that concentrates the rates of emission of air contaminants set out in section 3.5 from any source, and the method of calculation / evaluation of them.

4.8.2. Set out the measures and actions planned to be taken to reduce emissions from all sources set out in section 3.5, and the efficacy thereof, and address the best available technology (BAT) for complying with international requirements. For facilities / operations in respect of which there are requirements in TA-Luft 2002, address compliance with such requirements. Describe the ongoing maintenance of these facilities. In particular, address the treatment of problems relating to H_2S emissions into the air, in routine operations or in the event of faults.

4.8.3. Assess what faults might be expected to cause harmful material emissions into the air causing danger to elements of the population or to shipping. The following sections (4.8.4-4.8.10) will be added for applications for drilling at a distance of less than 10 km from the coast.

4.8.4. Assess the impact of emissions of the following contaminants: SO_2, NO_x, PM_{25}, PM_{10}, on the quality of the air in the environs of the bore, by running an acceptable dispersion model such as AERMOD or another model. The author of the document must obtain the prior approval of the model chosen before running it. Set out all of the input data taken for the purpose of running the model (emission rates, temperature, stack diameter, meteorological data, etc.), including the reasons for any presumptions, if any.
Meteorological data for running the model shall be taken from the meteorological station near to the coast, upon coordination with the Ministry for Environmental Protection.

4.8.5. The results of running the model shall be examined in a defined area up to the rate in which concentrations of 10% of the environmental standard are obtained. Within this range, if additional emissions sources exist, another model must be run that includes the existing and approved emissions sources, including roads, power stations and factories.

4.8.6. The model shall be run on a Cartesian grid, and individual receptors must be shown in areas where existing and approved sensitive land uses are in existence.

4.8.7. The results of running the model shall be examined with respect to environmental values and goals (Air Quality Value Regulations, 2011). If there is no target value in the Regulations, the results must be examined with respect to the reference values. The results shall be presented in tables and graphically via isoplates, on a background map. The percentage contribution of each source to the emission of each contaminant must be set out.

4.8.8. Calculate dispersal of the contaminants in scenarios of faults for severe weather conditions.

4.8.9. Set out the measures and actions planned to be taken to reduce emissions from all sources set out in section 3.5, and the efficacy thereof, and address the best available technology (BAT) for complying with international requirements. For facilities / operations in respect of which there are requirements in TA-Luft 2002, address compliance with such requirements. Describe the ongoing maintenance of these facilities. In particular, address the treatment of problems relating to H_2S emissions into the air, in routine operations or in the event of faults.

4.8.10. A magnetic medium must be attached to the Environmental Document containing the input data for the calculations, the results of the calculations, and meteorological data files.

Waste

Describe the methods of treatment and removal of waste, as set out in section 3.8 above.

4.9. Hazardous Materials

4.9.1. Set out the measures for reducing risks from hazardous materials in accordance with the details in section 3.6 above.

4.9.2. Describe and set the measures for treatment in the event that hazardous materials are discovered during the course of the drilling, including H_2S.

4.9.3. Set out the method of treatment in emergencies (hazardous material event) and the means for minimizing risks, including passive and active measures such as batches detectors.

4.10. Preparations for Earthquakes

Prepare emergency procedures or a chapter of existing emergency procedures for the handling of earthquakes. These procedures must address all exceptional situations, including: failure of communications and contact, inability to reach emergency forces, partial emergency team, etc.

4.11. Fishing and Marine Farming

4.11.1. Describe the impacts of the exploratory drilling on fishing activity and the ways of reducing such impacts, in the event of harm to fishing and marine farming.

4.11.2. Describe a veterinary monitoring plan to examine the impact of the drilling on questions of fish health and public health in the event of intensive marine farming, or alternatively set out coordination with growers regarding implementation of a monitoring plan and risk assessment approved by the veterinary services.

4.12. Safety and Protection

Assess the safety range required around the bore against harm to existing infrastructure and sea vessels.

4.13. Monitoring and Control Program

4.13.1. Describe the monitoring and control methods for each source discharged into the sea. Note, inter alia, what tests are planned to be done continuously, which are done visually and which are done in laboratories on the platform, which are done at external laboratories, and at what frequency.

4.13.2. Describe the method of taking samples in order to obtain representative samples, for continuous / visual / laboratory sampling.

4.13.3. Describe the calibration and maintenance actions on monitoring and control instruments.

4.13.4. A background monitoring report of the marine environment must be submitted in accordance with Appendix B1.

4.14. Closure of Drilling Site

Examine the impact of closure of the drilling site on the environment and the means required to prevent such impacts, including the removal of materials, equipment and waste.

Chapter E – Proposal for Application Guidelines

General:

5.1. This Chapter shall set out all of the proposals for setting the guidelines of the Application, at the level set out as being required for detailing the possible impacts set out in the chapters of this document, and the measures that are to be taken in order to prevent or reduce such.

5.2. The guidelines shall refer to the actions that must be taken or not taken in the entire area of the Plan, during the course of drilling and throughout the various phases of performance thereof, and following completion thereof.

5.3. The guidelines shall be for the grant of a drilling permit.

5.4. The guidelines shall relate to the installation and operation of systems to track and monitor the effects that flow or that may flow from this Application.

5.5. The guidelines shall relate to the actions that must be done throughout the area of the Application, upon the making of a decision to perform drilling and up to closure of the drilling site within the area of the Application.

5.6. The guidelines shall include the following topics, inter alia:

5.6.1. Guidelines for the phases of performance of drilling and production tests.

5.6.2. Guideline for the handling of hazardous materials.

5.6.3. Guidelines for the reduction and prevention of harm to land and to seawater and the

coastline, and including harm to the marine ecology, fishing and marine farming.

5.6.4. Guidelines for preservation of fauna and flora in the area of the Application including instructions for the prevention of harm to pelagic species whose presence around the drilling rig might be increased, such as sharks, marine mammals and birds.

5.6.5. Guidelines regarding the collection of data for the purpose of monitoring and tracking the quality of seawater, sediment, currents, fauna and flora and marine farming in the environs of the bore.

5.6.6. Guidelines for the construction of various monitoring systems (air, water, waste, mud and cutting discharge, etc.), to operate during the construction and performance of the Application.

5.6.7. Guidelines for performance of a veterinary monitoring plan for marine farming fish in order to ensure public health aspects.

5.6.8. Guidelines for measures for preventing / reducing light hazards.

5.6.9. Guidelines for measures for reducing air contaminant emissions.

5.6.10. Guidelines for measures for preventing or reducing noise.

5.6.11. Guidelines for measures for the treatment and removal of cutting discharge and drilling mud.

5.6.12. Guidelines for measures for treatment of various sources of discharge including cooling water, sanitary waste, kitchen waste, concentrate water.

5.6.13. Guidelines for the definition of safety and protection zones and the management of safety against harm to existing infrastructure and sea vessels.

5.6.14. Guidelines for methods of treatment and removal of waste.

5.6.15. Guidelines for preparation of emergency procedures in the event of faults or accidents including submission of an emergency factory plan for the treatment of oil spills at sea, fire.

5.6.16. Guidelines for the actions to be taken when closing and rehabilitating the drilling site.

5.6.17. Guidelines for the setting up of a team to accompany the Application, and the composition thereof.

5.6.18. Guidelines for periodical reporting of faults to the Petroleum Commissioner, and of environmental issues to the Ministry for Environmental Protection.

APPENDIX C

Cross-Reference Table for Compliance with Framework Guidelines

Table C-1. Cross-reference table for compliance with the Framework Guidelines. Yes = included in the EIA; No = not included in the EIA; N/A = not applicable.

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
A	1		**Description of the Current Maritime Environment to which the Application Relates**						
	1.1.		General						
		1.1.1.		The subjects set out in this Chapter shall be used for the examination and description of the environmental impacts expected to develop due to performance of the Application.	Yes	1	--	--	Chapter 1 as a whole addresses this requirement.
		1.1.2.		The Application shall be set out in words, and with maps and graphic descriptions.	Yes	1	--	--	Chapter 1 as a whole addresses this requirement.
		1.1.3.		The current situation of the deep sea area in the exploration sites, as well as biological, ecological, chemical, sedimentological, atmospheric, geological and hydrodynamic aspects of the scientific data and cultural and heritage sites comprise the basis for forecasting the environmental influences that may arise due to the natural gas and oil exploration and production operations in the surrounds of these sites.	Yes	1	--	--	Chapter 1 as a whole addresses this requirement.
		1.1.4.		The background survey set out in Appendix B1 "Framework Guidelines for Preparation of a Background Monitoring Plan for the Marine Environment Accompanying a License for Exploration Purposes – Exploratory (Experimental) Drilling and Offshore Production" shall serve as the basis for the description of the marine environment within the area of the Application.	Yes	1	--	--	Chapter 1 as a whole addresses this requirement. The survey reports stand alone and are referenced in the document.
	1.2.		Boundaries of Application and Area of Influence						
		1.2.1.		The detailed area of the Application (blue line): shall include the maritime area within a radius of up to 2 km around each of the gas and oil exploration sites, in the sea opposite the Israeli coastline, including a salvage drilling site if planned. The maritime area will include the water column, seabed and sub-seabed, and the maritime infrastructure and facilities situated at this site.	Yes	1	1.1.2	Maps and Orthophotos	
		1.2.2.		In the event that the drilling site is situated less than 1 nautical mile from the coastline, the area of the Application shall also include the area of the "coast" as defined in the Preservation of Coastal Environment Law and along a 1 km strip parallel to the drilling site.	N/A	--	--	--	Not applicable. The project sites are more than 1 nautical mile (nmi) from the coastline.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		1.2.3.		The area of impact of the Application shall include the entire marine and coastal area that might be affected environmentally as a result of ongoing operations or a fault in any of the exploration sites, including ecological impacts, acoustic impacts, air quality, appearance from the coast, and hazardous materials. It is clarified that the area of impact varies depending on each of these matters and therefore, the author of the document must consult with the Ministry for Environmental Protection in order to obtain a specific delineation of the various impact boundaries, prior to preparing the document.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
							4.6	Nature and Ecology Impacts	
	1.3.		Maps and Orthophotos						
		1.3.1.		The location of the exploratory drilling shall be described in words and its location noted on the international Lat-Long grid and its coordinates on the New Israel Grid, where possible, and will be marked on all of the maps and sketches in the document.	Yes	3	3.2.1	Well Locations	Table 3-2 in Section 3.2.1 presents a table of the coordinates. The coordinates for the proposed wells are also listed in Table 1-1 in Section 1.1.2. Figure 1-3 illustrates the well locations.
		1.3.2.		The distance between the drilling site and points of note on the coast (Rosh Hacarmel, Hadera, Ashdod) and the perpendicular distance from the coast.	Yes				The lease area is approximately 90 km west of Haifa, as mentioned in the text.
		1.3.3.		An orthophoto will be required where the distance of the exploration drillings is less than 1,000 m from the coastline.	N/A	--	--	--	Not applicable. The project sites are more than 1,000 m from the coastline.
		1.3.4.		A general depth map must be presented at a scale of 1:250,000 of the deep sea off the coast of Israel, with the location of the drilling sites, existing and proposed maritime boundaries and areas and shipping routes being noted on it.	Yes	1	1.1.2	Maps and Orthophotos	Figure 1-5 shows the required map.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		1.3.5.		A series of regional depth maps must be presented at a scale of 1:20,000, at a radius of 2 km from each of the sites, with the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand), fractures, land-slides and above- and underwater infrastructures and facilities found in each region being noted on it. The differences between the depth contours on the maps shall be 5 meters and the mapping data shall be the most up-to-date in existence. If there is information at a radius of more than 2 km, it should be presented too.	Yes	1	1.1.2	Maps and Orthophotos	Pipeline route maps are presented in Section 1.1.2. Figure 1-5 shows the depth contours for the drillsites. Section 1.2.1 presents information on the bottom type at the proposed drillsites.
		1.3.6.		If there is maritime agricultural activity within a field of less than 30km from the exploratory drilling, the location of such activity and the location of the drilling site must be noted on a map at a scale of 1:50,000.	N/A	--	--	--	There is no maritime agricultural activity within 30 km of the proposed drilling sites, although included in Section 1.1.2, Figure 1-4. Also discussed relative to potential shoreline impacts of non-routine events in Section 4.3.
		1.3.7.		Detailed depth maps of the Application area (blue line) are to be set out at a scale of 1:5,000 around each of the sites, and mark on them the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand) and above- and underwater infrastructures and facilities found in each region. The differences between the depth contours on the maps shall be 1 meter and the mapping data shall be updated to the last decade. Likewise, the sedimentological characteristics of the seabed shall be based on a granulometric and mineral survey correctly representing the sediment in the detailed area of the plan	Yes	1	1.1.2	Geological, Seismic, and Sediment Characteristics	The maps are at 5-m contours at an unknown scale but including a radius of 500 m around each proposed well location.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		1.3.8.		In the event of exploratory drilling at a distance of less than 1 nautical mile from the coast, the land zoning and uses in the relevant coastal area must be marked (see section 1.2.2) as well as the physical data including the type of coverage (rock or sand, cliffs), coastal sensitivity to oil pollution, on a coastal water oil pollution sensitivity map (the map is accessible on the internet), existing and proposed marine reserves, maritime infrastructure, culture and heritage sites and antiquities, declared and undeclared bathing beaches, residential areas (existing and planned), public institutions, nature reserves and national parks, roads, engineering facilities and infrastructure lines relating to energy systems (petrol, gas, electricity), desalination plants, drainage and sewage lines, fuel reservoirs, hazardous material reservoirs, communications facilities and lines and other uses.	N/A	--	--	--	Not applicable. The drilling sites are more than 1 nmi from the coastline.
		1.3.9.		Maritime transportation and infrastructure systems, electricity infrastructure and facilities, communications and energy lines, corridors, pipelines and terminals for various infrastructures (gas, petrol, hazmat, RO, etc.) in the Application area must be set out on a maritime map at a scale of 1:20,000 together with a verbal description	Yes	1	1.1.2	Maps and Orthophotos	Shown in Figure 1-4, although scale is not at 1:20,000.
	1.4.		Geological, Seismic and Sedimentological Characteristics An exhaustive and detailed geo-hydrological description of the site, including:						
		1.4.1.		Describe, in words, the general geographical location of the exploration drilling sites, their proximity to seismically active areas and the rock foundations upon which they will be constructed.	Yes	1	1.2.1	Bathymetry, Geological, Seismic, and Sediment Characteristics	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		1.4.2.		A general geological/geomorphological map must be set out at a scale of 1:200,000 of the sea off the coast of Israel, and mark thereupon the location of the exploration drilling sites. On this map, mark geological fractures, with an emphasis on fractures that are active or that are suspected of being active. Fractures described as being "suspected of being active" by the Israel Geological Institute or similar entities shall be deemed to be active unless it is proven that they are not active using the usual methods (conduct of research and geophysical cross-sections, and paleoseismological analysis). Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides and other geological and morphological phenomena which are notable.	Yes	1	1.2.1	Bathymetry, Geological, Seismic, and Sediment Characteristics	A geomorphological map is included. Figures showing the wellsites and nearby faults are included. A separate map showing the locations of historical earthquakes is included.
		1.4.3.		Set out a series of regional geological/geomorphological maps at a scale of 1:20,000, around all of the sites, and mark geological fractures on them, with an emphasis on active (young) fractures or fractures suspected of being active. Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides, active landslides, rocky infrastructure exposed above the ordinary seabed, and other geological and morphological phenomena which are notable.	Yes	1	1.2.1	Geological, Seismic, and Sediment Characteristics	There has only been one recorded earthquake near the Tamar Field so individual site maps showing earthquakes are not provided.
		1.4.4.		If the drilling mud and cutting discharge are to be discharged and/or dumped at sea, set out the area of dispersal of the mud and other cutting discharge on a geophysical survey conducted via side-scan sonar and underwater information, physical changes in the seabed due to the effects of anchoring and excavation, the build-up of waste, etc.	Yes	4	4.6.1.1	Drilling (including the release/discharge of drill muds and cuttings)	These requirements are addressed in the "impact" discussion and are not part of the baseline description. Surveys have been conducted and are discussed in Section 4.15.2.
		1.4.5.		Describe in detail the rock infrastructure at each of the exploration drilling sites. Set out detailed information that might clarify the characteristics of the land (for instance: the speed of shear stress waves, the depth to the bedrock, characteristics that affect non-linear conduct, etc.).	Yes	1	1.2.1	Geological, Seismic, and Sediment Characteristics	
		1.4.6.		Address the possibility of the existence of active geological fractures in the area of the Application and the near environment	Yes	1	1.2.1	Geological, Seismic, and Sediment Characteristics	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	1.5.		Hydrodynamic Regime						
		1.5.1.		Describe the characteristic wave regime within the area of the Application. This description shall be based on wave characteristics measured in the south eastern Mediterranean in general, and off the coast of Israel over the last 20 years in particular.	Yes	1	1.2.2	Physical Oceanography	Presented for July 2005 to February 2008.
		1.5.2.		Set out the statistical breakdown of wave characteristics within the timeframe of one year (significant and maximum height, direction, cycle time at the top of the spectrum, and average cycle time), and within a longer timeframe of 5, 10, 20, 50 and 100 years, statistics of storm durations for various maritime conditions.	Yes	1	1.2.2	Physical Oceanography	Presented for July 2005 to February 2008.
		1.5.3.		Refer to the effect of waves in extreme storms and the possibility of the development of killer waves, including due to a seismic source, on the stability of the marine structures within the area of the Application.	Yes	1	1.2.2	Physical Oceanography	Presented for July 2005 to February 2008.
		1.5.4.		Describe the regime of the currents in the area of the Application, created due to the winds, and other oceanic variables (for instance: astronomic tides, Coriolis force, jet streams along the edge of the continental shelf, seasonal changes of seawater mass, temperature, salinity, etc.). This description shall be based on meteorological-oceanographic information collected since the mid-20th Century, in the Eastern Mediterranean in general and along the coast of Israel in particular.	Yes	1	1.2.2	Physical Oceanography	
		1.5.5.		Set out the statistical division of the wind regime in the Eastern Mediterranean, including the annual frequency of wind directions, wind magnitude (including gusts), seasonal effects, and extreme winds. The minimum resolution shall be 22.5° for wind direction and 2 m/s for speed.	Yes	1	1.2.2	Physical Oceanography	Scale is as presented in the source document
		1.5.6.		Describe the current regime in the Application area or in an adjacent area, including statistic split subject to presentation of the source of the information, to the extent that such information is available.	Yes	1	1.2.2	Physical Oceanography	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	1.6.		Nature and Ecology						
		1.6.1.		The condition of marine mammals, sea turtles, permanent sea birds, migrating birds (based on seasons and hourly distribution), and species of pelagic fish located in the drilling region, must be presented in accordance with information from the most up-to-date professional literature and from field surveys and population sizes must be estimated.	Yes	1	1.2.3	Nature and Ecology	
		1.6.2.		The natural monuments affixed to the seabed (benthic) must be presented. The species within the area of the Application and within the area of its impact (as described in section 1.2.3) must be described including micro and macro algae, seaweeds, seabed dwelling fauna, sedentary or territorial. In addition, describe the coastal natural monuments, as the case may be, situated within the area of the Application and within the area of its impact (as described in section 1.2.3). The information regarding natural phenomena will be in reliance upon a detailed biological survey (Appendix B1) which will be conducted within the area of the Application and the area of impact, and on information, if such exists in this area, from prior surveys. The information included shall be set out in tables, maps, graphs, pictures, video, and shall be accompanied by a detailed verbal description of the findings and with lists of inventory, including scientific names based on taxonomic classification. Note the presence of rare, unique or delicate organisms.	Yes	1	1.2.3	Nature and Ecology	
		1.6.3.		Set out the various habitats that exist in the body of water, and in the various seabed environments including hard surface areas, sponge gardens, deep coral reefs, seaweed carpets. A detailed description must be provided of fauna and flora societies in each of these habitats, including coverage percentages, and taxonomic information regarding the identity of species in the region. A map of the various habitats in the area of the Application must be included.	Yes	1	1.2.3	Nature and Ecology	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
				Pursuant to the above sections, a detailed analysis must be conducted of the information including on the basis of the following issues:	Yes	1	1.2.3	Nature and Ecology	
		1.6.4.		• 1.6.4.1. Identification of the creatures to a species level or to the most detailed taxonomical level possible. • 1.6.4.2. Density of individuals. • 1.6.4.3. Richness of species (in the various taxonomic groups). • 1.6.4.4. Variety, the appropriate index must be chosen from the acceptable variety indexes such as: Shannon-Wiener, Simpson (2004), Magurran, and give reasons for the choice. • 1.6.4.5. Fixed and mobile species. • 1.6.4.6. "Target species": key species, species of commercial value, most common species (breeding season, egg-laying season, area in which drilling operations will be tolerable, heavy metals and organic contaminants in target species). • 1.6.4.7. Classification of species based on origin: Mediterranean-Atlantic, species with broad geographical distribution, invasive species.	Yes	1	1.2.3	Nature and Ecology	
		1.6.5.		Fishing areas within the area of the Application must be set out. Set out trawler fishing routes, fishing (note the kind of fishing - rod fishing, etc.), and show the data on a map at a scale of 1:20,000 and on a GIS layer, and the quantities of fish collected over a monthly and annual cross-section.	Yes	1	1.2.10	Marine Farming	There are no fishing or marine farming areas within the Application Area.
	1.7.		Sea Water and Sediment Quality						
		1.7.1.		Set out the characteristics of the sea water and sediment quality within the area of impact, around each of the sites. The information regarding the quality of the seawater and sediment shall be based on a seawater and sediment quality survey (Appendix B1) which shall be conducted in the area of impact of the Application and on additional relevant information if any in this area, from the monitoring plan and previous surveys. The information included shall be set out in maps, graphs and shall be accompanied by a detailed verbal description of the findings.	Yes	1	1.2.5	Seawater and Sediment Quality	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		1.7.2.		Set out the quantity of floating material in the water column, in a variety of marine climatic conditions (winds, waves, currents). The presentation of this data shall be based on sediment samples in accordance with Appendix B1 and on additional relevant information if such exists in this area. The level of turbidity of the water shall be measured at the surface, in the center of the water column and near to the seabed at each of the sites. Likewise, set out the climatic conditions at the time of taking the samples.	Yes	1	1.2.5	Seawater and Sediment Quality	
		1.7.3.		Set out the levels of chlorophyll in the water column, within the area of the Application. Likewise, an assessment of the dispersion of chlorophyll must be conducted over the entire area of impact, using remote sensing methods.	Yes	1	1.2.3	Nature and Ecology	Chlorophyll is mentioned but was not included in the surveys approved by MoEP.
		1.7.4.		Describe, in detail, the chemical characteristics of the water column (dissolved oxygen, pH, salinity, temperature, fertilizers), within the area of the Application, around each of the sites.	Yes	1	1.2.2	Physical Oceanography	
		1.7.5.		Describe, in detail, the chemical characteristics of the sediment within the above area of the Application. The description shall focus on toxic substances, on chemical derivatives of heavy metals, TOC, PAH, SBF and their derivatives (including the results of decomposition), oxygen concentration in sediments. The sediment sampling system (the number of stations and their location) will be approved prior to performance as is set out in Appendix B1.	Yes	1	1.2.5	Seawater and Sediment Quality	
		1.7.6.		Likewise, describe the characteristics as set out in sections 1.7.5 and 1.7.5B of the fauna on the hard bed (if any) and of the fauna on the soft bed and of the fauna within the bed (in filtering animal tissue such as clams, snails, worms, polychaetes and crabs and fishes). The scope of this sampling will be approved in advance.	Yes	1	1.2.3	Nature and Ecology	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	1.8.		Culture and Heritage Sites						
				The information regarding antiquities and cultural heritage sites shall be based on a detailed archeological survey or as a result of processing following a remote sensing survey (side-scan sonar, multives, ROV movies, etc.) which shall be conducted within the area of the Application and on information that exists regarding the area from prior surveys. The sites known to the Antiquities Authority (both declared and as yet undeclared sites) and other sites containing information about archeological findings or sunken ships from must be included. The total information will be presented on maps at a scale of 1:20,000, and shall include the archeological sites, pictures, videos and shall be accompanied by a detailed verbal description of the findings in the area of the Application and in its close proximity.	Yes	1	1.2.6	Culture and Heritage Sites	
	1.9.		Meteorology and Air Quality						
		1.9.1.		Describe the existing meteorological conditions in the area of the Application and its environs.	Yes	1	1.2.7	Meteorology and Air Quality	
		1.9.2.		Special meteorological conditions that might cause conditions of dispersal that will give rise to high air pollution concentrations in the environment must be noted.					Text states that there are no special meteorological conditions affecting dispersal.
		1.9.3.		For drilling operations planned at a distance of up to 10 km from the coast, up-to-date information must be presented regarding the state of the existing air quality on land, within a range of up to 10 km from the boundaries of the drilling site. Up-to-date monitoring data of contaminants the concentration of which in the air might be affected as a result of the planned operations must be addressed. The following contaminants and other relevant contaminants must be addressed: NO_x, SO_2, PM_{10}, $PM_{2.5}$. The monitoring data will be from the past five years, and will be examined on the basis of the environment and target values (Air Quality Value Regulations, 2011) and if there is no target value, on the basis of the reference value. The availability of the data will not be less than 95% over a period of five years.	N/A	--	--	--	Not applicable. The proposed drilling sites are not within 10 km from the coast.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	1.10.		Noise						
		1.10.1.		Set out the magnitude of the sub-marine noise at a number of representative points at each of the sites (as set out in section 1.6 above)	Yes	1	1.2.8	Noise	There are no data from "representative points at each of the sites." A general description is presented.
	1.11.		Marine Transportation System and Infrastructure						
				On the basis of section 1.3.9, describe, in words, the marine transportation and infrastructure system in the chosen alternative area. Set out the current operations of the system: Traffic volumes, entry and exit directions of vessels in accordance with the various classes of vessel, fuel containers, fishing boats, maritime farming service boats, yachts, tugboats and small operations vessels, etc.	Yes	1	1.2.9	Marine Transportation System and Infrastructure	
	1.12.		Marine Farming						
		1.12.1.		Fishing and marine farming operations must be described, if any, at a distance of up to 30 km from the planned drilling site. The location of marine farming sites in the impact area must be set out, along with the species of fish grown and the quantities of total annual growth.	N/A	--	--	--	There is no maritime agricultural activity within 30 km of the proposed drilling sites, although included in Section 1.1.2, Figure 1-4. Also discussed relative to potential shoreline impacts of non-routine events in Section 4.3.
B			**Reasons for Preference of the Location of the Proposed Plan and Possible Alternatives**						
	2.1		General	In this Chapter, set out all of the reasons that gave rise to choice of the site proposed in the Application for Exploratory Drilling, including the salvage drilling site if planned. In addition, please refer to geological and seismic, environmental, planning, engineering and economic aspects, such as proximity to existing and planned infrastructure, exploitation of additional natural resources, impact on natural monuments, air quality, noise, etc. Data from drilling operations done in the past near to the area of the Application, if any, must also be addressed.	Yes	2	2.2	Location Alternatives	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	2.2.		Location Alternatives	Give details of and explain the various reasons that led to the determination of the proposed site of the exploratory drilling in the Application. Set out the location alternatives examined, the preferred alternative and the reasons that gave rise to the choice of it. The location alternatives will be examined in the exploration zone and for each location alternative, the following criteria, at least, will be examined: Structural analysis issues and the location of the target stratum; marine reserves; regions defined as special regions such as ridges, canyons or deep coral reefs, sponges, clams or other sedentary organisms; proximity to towns and residential areas, visibility and appearance from the coastline; habitats of animals in danger of extinction; shipping lanes; infrastructure, communications and energy lines; current regime; fish reproduction zones and times; fishing lanes; marine farming zones.	Yes	2	2.2	Location Alternatives	
	2.3.		Technological Alternatives	Set out the various technological alternatives examined and the various considerations that gave rise to the decision to use the technology set out in the Application, including the drilling technology (including vertical, angular, horizontal); the type of platform; BOP; drilling mud and liquids – composition, cutting discharge and drilling mud disposal targets. If use is planned to be made of mineral/oil based drilling mud, set out the criteria and limitations for use of one kind as opposed to another.	Yes	2	2.3	Technological Alternatives	
	2.4.		Infrastructure Alternatives	Possible alternative/s for deploying the infrastructures in the future production plan, including possible connection points to the terrestrial transmission system. The alternatives shall be set out in a comparison table, with each topic under examination being ranked, together with the professional reasons for selecting it. A sample table of criteria is attached in Appendix B2.	Yes	2	2.4	Infrastructure Alternatives	No infrastructure alternatives were considered for the Tamar Field Development Project as the work will tie into existing infrastructure that carries the product to the Tamar Platform and then to the Ashdod Onshore Terminal.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
C			**Description of Actions Stemming from Performance of the Application**						
	3.1		General	This Chapter shall set out a drilling plan including the drilling rig, various sea vessels and aircraft, and the plans for them, and the activities that they will perform. The description of the Application shall include reference to all of the works that will be done, including all matters relating to trial drillings, drilling phases, abandonment or announcement of a discovery and transition to production. This Chapter shall also refer to the various stages of construction and operation. Describe all of the details of the Application as will be examined in Chapter D.	Yes	3		Project Description	Chapter 3 as a whole addresses this requirement.
	3.2.		Description of the Application						
		3.2.1	General						
		3.2.1.1.		Describe the purpose of the drilling and the type of drilling (natural gas or oil; exploratory; salvage; verification; development; production).	Yes	3	3.1	General	
		3.2.1.2.		Describe the drilling platform including the type of platform, the name of the platform, ownership, date of manufacture, date of upgrade, region of prior operation and fleet specifications.	Yes	3	3.2.2	Drilling Program	Section 3.2.2.3 discusses the proposed wells.
		3.2.1.3.		Note water depth at the drilling site and depth of drilling below the seabed (below mud line - BML).					Section 3.2.2.3 discusses the proposed wells.
		3.2.1.4.		Describe the sea vessels and aircraft involved in the exploration application.					Section 3.2.2.2 discusses support vessels and aircrafts, and they are referenced in Section 3.2.2.3.
		3.2.2.	Description of Drilling Process						
		3.2.2.1.		Describe, in brief, all of the drilling processes and phases including the actions and materials relating all drilling activities. Note the main operations, depth of drilling under the seabed (BML), under the surface of the water (BWD) and under the platform, for each drilling segment.	Yes	3	3.2.2	Drilling Program	No Gantt Chart is included.
		3.2.2.2.		Attach a schematic sketch showing the depth of the drilling as a function of time, including appropriate reference to the stages of the drilling and drilling data.					
		3.2.2.3.		Set out a Gantt Chart setting out the drilling activities done in series and in parallel.					

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.2.3.	Prevention of Oil Blowout						
				Describe the blowout preventer (BOP) that has proven efficacy and that is designed to prevent oil, gas and/or liquids under the surface such as produced water, saline water from blowing out of the bore into the marine environment. Explain and describe the continuous pressure controls. Set out the standard for periodic testing of all of the means of prevention of blowout or fault.	Yes	3	3.2.4	Safe Drilling Practices	Section 3.2.4 describes the BOP and safe drilling practices. The drilling and completion process testing is discussed in Section 4.2.1 and 4.2.2.
		3.2.4.	Protective Pipeline and Concretization						
				• 3.2.4.1. In accordance with the drilling plan, describe the protective pipeline from the seabed to the target strata. • 3.2.4.2. Describe the concretization of the casement pipelines in the drilling, in order to prevent possible leaks and the transition of liquids from the bore into the seawater. • 3.2.4.3. Describe the method of construction and concretizing of the bore with reference to the timeframes of the principal stages in drilling the bore. • 3.2.4.4. Describe the composition of bore concretization materials. • 3.2.4.5. Set out the manner in which the quality of concretization is ensured during drilling, the method of testing such and the standard used for testing.	Yes	3	3.2.2	Drilling Program	Not included in a separate section.
		3.2.5.	Testing of Drilling Pipelines						
				Describe the references required for ensuring that drilling and protection pipelines are in order and the method of testing such, with all of the components thereof.	Yes	3	3.2.4	Safe Drilling Practices	Section 3.2.3 discusses the pipeline to be installed. Section 3.6.1.7 discusses hydrotesting.
	3.3.		Production Tests						
		3.3.1.		Describe the planned production test method, the phases thereof, the order of activities, the equipment and the possible methods thereof, and set out the reasons for such. Set out the various indexes that will be examined such as maximum production of all production components (gas, oil, water, condensate), pressure, description of oil and/or gas including sulfur, nitrogen, CO_2, etc.	Yes				No production tests are planned. The drilling and completion process testing is discussed in Sections 3.2.4 and 5.2.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.3.2.		In cases where use of chemical substances is planned in the production test, set out the substances that will be used in the production tests, the commercial names of such substances, their quantity, concentration, chemical composition and function including chemical formula, CAS (Chemical Abstract System) Number, and MSDS (Material Safety Data Sheet) and include them in the chemical table in section 3.6.	N/A	--	--	--	No production tests are planned.
	3.4.		Noise Hazards						
				Set out details of the mechanical equipment and the noise levels from the dominant sources characteristic of each form of technology. Set out details of the duration of the drilling, the hours of work each day, the number of sea vessels that will operate at the same time, throughout the hours of the day, and the aircraft involved in the work. Set out details of the frequency and magnitude of the noise that will be generated during the course of work at various distances from the source of the noise. If the drilling is less than one km from the coast, check the existence of noise-sensitive uses that may be exposed to noise levels that rise above what is permissible under the Prevention of Nuisance (Noise Prevention) Regulations, 5753-1992.	Yes	3	3.3	Noise Hazards	
	3.5.		Air Quality						
		3.5.1.		Describe the sources of emissions of contaminants into the air from the planned operations during the drilling and production testing stages, including: Energy facilities, flare/vents, unfocused emissions and other sources.	Yes	3	3.4	Air Quality	
		3.5.2.		For all sources of emissions presented, set out the regime for the activation, the type of fuel, the contaminants emitted and other data necessary for evaluating emission rates. The rates of emissions of contaminants shall be estimated on the basis of manufacturer's data, measurements or calculations on the basis of EPA-AP42 methodologies or on the basis of other methodologies upon prior approval.	Yes	3	3.4	Air Quality	
				Faults that might give rise to increase emissions of air contaminants into the environment, the emission of additional contaminants such as H_2S or the generation of odor hazards to the populace (at sea and on land) must be addressed and the measures for preventing air contamination hazards must be set out for each possible fault.	Yes	3	3.4	Air Quality	Section 5.2.6 discusses mitigation of air emissions.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	3.6.		Hazardous Materials						
				Describe and set out all of the hazardous materials planned to be used, including drilling and production testing liquids. The following details must be noted for each material: Chemical composition, commercial name, CAS identification number, UN number and MSDS - Material Safety Data Sheet. Quantity, purpose of use and method of use, location on the platform (together with a sketch), storage and batching, method of treatment and removal.	Yes	3	3.5	Hazardous Materials	SDSS are referenced in this section and included as Appendix F.
	3.7.		Sources of Discharge into the Sea						
		3.7.1.	General – Ongoing Activities						
		3.7.1.1.		Describe all of the sources of discharge into the sea, and describe, for each source, the processes that give rise to the discharge and a flowchart of the process. The flows that must be presented include: Drilling mud, cutting discharge, cooling water, reverse osmosis concentrate water, organic kitchen waste (where the drilling is located more than 12 nautical miles from the coast), sanitary effluent/waste ("black water"), "gray" rinse waters, washes from the oil separation facility, cement surpluses.	Yes	3	3.6	Discharges	
			The following information will be given for each source of discharge into the sea. For drilling mud and cutting discharge – see also the specific instructions in Section 3.7.2.						
		3.7.1.2.		Describe the processes that create the flow together with a drawing of the processes.	Yes	3	3.6	Discharges	
		3.7.1.3.		Describe the treatment processes, if any, including physical data of stocking units, engineering and operational data for each treatment facility (the area of the facility, the volume of each unit, capacity, duration of presence, etc.); means of monitoring and control of each process/treatment; attach a schematic drawing for each treatment facility.	No	3	3.6	Discharges	Schematics for each treatment facility are not included as they are unique to the drilling unit, which has not yet been selected. *Atwood Advantage* equipment information is included in Section 3.2.2.3.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.7.1.4.		Set out the list of additives in each production and treatment process, the quantity of each additive, its function and the method of addition of it; attach information sheets (MSDS) for each additive, with an emphasis on ecological information for the marine environment, and possible impacts on fish farming and wild fish.	Yes	3	3.6	Discharges	SDSs are provided in Appendix F.
		3.7.1.5.		Describe the flow times including whether the flow is continuous or interrupted, fixed or variable (hourly/daily/other), and what the conditions and/or processes are that determine the quantity and/or times of flow.	Yes	3	3.6	Discharges	
		3.7.1.6.		Describe the method of discharge into the sea of each and every source and whether the discharge is effected separately/separate source or together with other discharges. In describing the source, set out the physical characteristics of the source/source pipe and the depth of the source with respect to the surface of the water/the seabed.	Yes	3	3.6	Discharges	
		3.7.1.7.		Quantities: Set out the quantities of each source, set out the information in accordance with maximum hourly, maximum daily, maximum monthly and total quantity during the course of the drilling. Set out the method of controlling quantities/amounts pumped into the sea (wharf based capacity meters, water meters, other - give details). Quantity data shall be presented in cubic meters.	Yes	3	3.6	Discharges	
		3.7.1.8.		With respect to the discharge of sanitary waste (“black water”) and shower/wash water (“gray water”), set out the quantity in cubic meters/day/person, for each separate source.	Yes	3	3.6	Discharges	
		3.7.1.9.		Quality: Describe the composition of each source. Set out the information on the basis of data from similar facilities, including the conduct of laboratory tests. This information shall include contaminant concentration data, and total contaminant load discharged into the sea (in tons) including the provisions set out in section 3.7.4 (qualities) Note, for each source of pumping, the source of the information regarding the composition of it.	Yes	3	3.6	Discharges	
		3.7.1.10.		Give details as to whether there are land-based alternatives for each pumping source. If not, give reasons and details regarding the way in which this subject was checked.	Yes	3	3.6	Discharges	Sections 3.6.1.6 and 3.6.2.8 discuss alternatives.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
			Cutting discharge, drilling mud and left-over cement (drilling mud relates to any addition of liquids and materials used for drilling purposes).						
		3.7.2.	Cutting Discharge						
		3.7.2.1.		Quantities: Set out the quantity of cutting discharge (tons) and volume (cubic meters) discharged into the sea as follows: In each of the drilling segments, by drilling diameter; in the stage in which the drilling takes place without recycling and the cutting discharge is placed around the wellhead directly on the seabed; in the drilling stage which is done with recycling, when the cutting discharge is brought up to the platform with the drilling mud; total quantity of cutting discharge discharged into the sea.	Yes	3	3.6	Discharges	
		3.7.2.2.		Treatment and removal of cutting discharge – describe the method of treatment and removal of cutting discharge.	Yes	3	3.6	Discharges	Section 3.2.2.3 describes the cuttings treatment process to be used. Section 3.6 discusses the discharges.
		3.7.2.3.		If the cutting discharge removal destination is at sea, describe the piling up of cutting discharge and drilling mud on the seabed. Assess the radius and area affected by this process.	Yes	3	3.6	Discharges	
		3.7.3.	Drilling Mud and Leftover Cement						
		3.7.3.1.		Quantities of drilling mud – set out the total quantity and volume of drilling mud (cubic meters and tons), for the stage of the drilling without recycling when the drilling mud is placed near to the drilling bore on the seabed, and for the stage of drilling done when the recycled drilling mud is brought back up to the platform with the cutting discharge and total quantities of the drilling mud discharged into the sea.	Yes	3	3.6	Discharges	
		3.7.3.2.		Set out the composition of drilling mud in a table, including: The name of the material, the function of each material, the quantity of each material in each segment of drilling and the total quantity of materials in each segment of the drilling, totals of all materials in each segment of the drilling and total quantities of all materials in the entire drilling process. This data shall be presented in cubic meters, transition units (SG) and tons. Note which of the drilling stages the discharge into the sea takes place in, what quantity is being discharged at each stage, and the total. This data shall be presented in cubic meters and tons.	Yes	3	3.6	Discharges	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.7.3.3.		Describe the way in which the various substances are added to the water and to other drilling liquids (creating the drilling mud). In reliance upon the above, please also refer to the quantities of water/other drilling fluid that are added during the course of drilling, due to losses of water/fluids/drilling mud back into the rock strata.	No	--	--	--	This information will be available following the identification of the drilling unit. Fluid loss is included in the information presented in Section 3.6.2.7.
		3.7.3.4.		For each component and material, information sheets (MSDS) must be presented, including ecological information regarding the marine environment (toxicity, biodegradability, bioaccumulation) and concentrations of each component that might be pumped into the sea.	Yes				Section 3.6.4.2 presents CHARM data on the proposed drilling fluid. Appendix F presents the SDSs, which contain the required information.
		3.7.3.5.		Chemicals/additives: Set out in a concentrated table data on chemicals, based on source of use (drilling mud, cement, etc.), based on information sheets, including: the name of the chemical, its CAS number, the composition of the chemical (in the event of a compound, set out each substance and composition, and the percentage of it in the compound), ecological information including the results of toxicity tests, biodegradability, bioaccumulation and the level of its impact/toxicity on the marine environment. Wherever there is no information, write “no information”; and note the level of environmental risk according to OSPAR/the Norwegian Method (green, yellow, red, black).	Yes	3	3.6	Discharges	
		3.7.3.6.		Describe the method and frequency of the various tests conducted in mud and drilling liquids, including materials pumped into the drilling mud preparation system and the standards under which the tests are conducted.	No	--	--	--	This information will be available following the identification of the drilling unit.
		3.7.3.7.		Biological toxicity test – set out the tests conducted for testing biological toxicity in drilling mud/surpluses from the treatment facility pumped into the sea and set out where such tests are performed and the source of the data; examine and present the extent to which the existing toxicity tests accord with the deep sea conditions in the Eastern Mediterranean Deep Sea Basin. Attach an expert opinion regarding the extent to which the tests comply, and his recommendations regarding the conducting of compatibility tests for the deep sea conditions in our region.	Yes	3	3.6	Discharges	Data from previous uses of the drilling fluid have been presented. No expert opinion is included.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.7.3.8.		Drilling mud treatment – describe the areas and methods of organization and the facility for the treatment of drilling mud, separation of the cutting discharge from it, testing the composition of it and details of the additives planned for the treatment facility, including the list of additives, the function of each substance, the method of placement of it, etc. Losses of drilling mud must be addressed, and estimates given as to the percentage lost, quantities (in tons) and volume (in cubic meters).	Yes	3	3.6	Discharges	The areas and facilities are not presented as the drilling unit has not yet been identified. Fluid loss is included in the information presented in Section 3.6.2.7.
		3.7.3.9.		Attach sketches, including notation of physical data of units of production/processes/treatment and return of drilling mud, including work areas, volumes of treatment facilities, durations, etc.	Yes	3	3.6	Discharges	The drilling unit has not yet been selected, so some of this information is not available.
		3.7.3.10.		Describe the stages of drilling in which use is made of cement, and the processes in respect of which left-over cement is discharged into the sea.	Yes	3	3.6	Discharges	Cementing is discussed in Section 3.6.2.9.
		3.7.3.11.		Cement quantities: Set out the total quantity of cement in each of the stages of drilling and the total quantity in use (tons). Estimate and set out the quantities of cement that are to be discharged into the sea.	Yes	3	3.6	Discharges	
		3.7.4.	Information on quality of discharges into the sea: Set out the information on the quality of discharges into the sea so as to include information on chemical composition as follows. This information will be based on tests from similar facilities and processes from the past five years, subject to the existence of such, and details of the source of the information.						
		3.7.4.1.		Discharges originating in the drilling mud: Set out the chemical composition of the water, including: An extended metal scan (ICP, mercury in AA); GCMS scan for organic materials with probability percentages, half-quantity concentrations and summary; detailed VOC scan (head space) with probability percentages, including half-quantity concentrations and summary; TOC; TSS; BOD; mineral oil (FTIR); PAH; turbidity; free chlorine; phenol; cresol; pH; AOX; DOX; species of nitrogen (nitrate - NO3; nitrite - NO2; ammoniac nitrogen NH4-N; Kjeldahl nitrogen TKN; total nitrogen - calculated); phosphorus - P; sulfide; TDS; chlorides; the information shall be presented as concentration (mg/L) and as load (weight per unit of time).	Yes	3	3.6.3	Quality of Discharges	
		3.7.4.2.		Discharges originating in the cutting discharge: Set out metal composition: Ag, As, Cd, Cu, Cr, Hg, Ni, Pb, Zn; organic matter (TOC); radioactive materials Pb 210, Th 228, Ra 226, Ra 228.	Yes	3	3.6.3	Quality of Discharges	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		3.7.4.3.		Discharges from the wash treatment facility: Set out the chemical composition of the water, including: An extended metal scan (ICP, mercury in AA); GCMS scan for organic materials with probability percentages, half-quantity concentrations and summary; detailed VOC scan (head space) with probability percentages, including half-quantity concentrations and summary; TOC; TSS; BOD; DOC; turbidity; phenol; cresol; pH; AOX; DOX; mineral oil (FTIR); species of nitrogen (nitrate - NO3; nitrite - NO2; ammoniac nitrogen NH4-N; Kjeldahl nitrogen TKN; total nitrogen - calculated); phosphorus - P; sulfide; TDS; chlorides; the information shall be presented as concentration (mg/L) and as load (weight per unit of time).	Yes	3	3.6.3	Quality of Discharges	
		3.7.4.4.		Discharges from sanitary effluent treatment facility: Set out the chemical composition of the water, including: BOD; TSS; TOC; turbidity, free chlorine, oils and lipids (FTIR), mineral oil (FTIR), species of nitrogen; sulphide; detergents (MBAS); pH; fecal coli per 100 mL, streptococcus per 100 mL, extended survey of metals (ICP), TDS; the information shall be presented as concentrate (ML) and load (mass per unit of time - mass/month or mass/year).	Yes	3	3.6.3	Quality of Discharges	
		3.7.5.		Describe the measures and structure of the platform for the purpose of separating clean upper water, in the event of rain, from oily lower water intended for treatment prior to release into the sea or removal to land.	No	--	--	--	The drilling unit has not yet been selected, so this information is not available.
	3.8.		Waste						
				Describe the quantity of the waste expected to be created, including kitchen waste, dry waste, other waste created as a result of the drilling process, except for waste set out in the section regarding sources of discharge into the sea as set out in section 3.7 above	Yes	3	3.7	Waste	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	3.9.		Closure/Abandonment of Drilling Site						
				Describe the details of the actions required for closure of the drilling site and the order of performance thereof, including permanent abandonment or temporary abandonment. Describe the measures for closing the wellhead, the target strata, and other conducting strata for two alternatives, abandonment and restoration of the previous condition; declaration of a discovery and transition to production. In the event of closure of the wellhead, the standard under which the closure means are installed must be set out. Set out the list of chemicals planned for use in closing the well and include these in the table of chemicals in Section 3.6 together with information sheets. Attach a schematic drawing of a cross-section of the drilling prior to closure of the drilling and after closure (temporary/permanent).	Yes	3	3.8	Abandonment/ Closure	No diagram is included, as the closure design has not been determined. The wells are for production.
D			**Evaluation of the Environmental Impacts Expected to Develop due to Performance of the Application and the Measures to be Taken to Prevent/Minimize Such**						
				In this Chapter, the various topics expected to have an environmental impact shall be set out graphically and verbally, including impact on moving or stationary species within the areas of the Application and its close and remote environs, in accordance with the provisions of section 1.2.3. The description of the environmental impacts and the sources of these shall be both qualitative and quantitative. The variety of activities expected to take place at the drilling site must be set out. With respect to each subject, an explanation shall be given as to whether it is necessary to prevent or reduce the negative environmental impacts and what means must be employed in order to prevent or reduce such, if any. In the event that during the course of preparation of the Application, influences or other findings are found that are not mentioned in this document, these must be addressed and means must be proposed for reducing the impact in the document.	Yes	4			The chapter as a whole addresses this requirement.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	4.1.		Assessment of Potential Impact on Marine Environment						
		4.1.1.		Assess the maximum scope of the impact of the drilling rig, including anchors, on the seawater, the seabed, and the coast, as the case may be, and set out the basis for the information and the method of effecting the assessment.	Yes	4			The drilling unit is expected to be dynamically positioned and will have no anchors. Other seafloor impacts from the physical presence of the rig are discussed in Chapter 4.
		4.1.2.		In the event that the discharge target for the cutting discharge and drilling mud is at sea, assess the extent of impact on the environment in accordance with an evaluation of the radius and the area affected by the process, as set out in section 3.7.2.3 and set out the tests, actions and frequency thereof in order to minimize harm to the marine environment.	Yes	4			
		4.1.3.		In the event of proximity to natural monuments identified in accordance with section 1.6, existing and proposed nature reserves, culture and heritage sites and marine farming facilities, the methods of action to remove the cutting discharge and the drilling mud to an alternative marine site and/or to a site on dry land are to be examined and presented.	Yes	4			No cultural sites, nature preserves, or marine farming occurs near the project site. Impacts from non-routine events are discussed in Section 4.3.
		4.1.4.		Examine and present the possibility of reducing and minimizing the placement of discharge and drilling mud directly onto the seabed during the course of drilling from the drilling segment prior to installation of the riser, such as by using an RMR SYSTEM.	No	--	--	--	The drilling mud system has been selected based on previous experience offshore Israel.
		4.1.5.		Assess the maximum scope of the impact of the drilling liquids at the time of effecting the production tests on the seawater in the area of the Application.	No	--	--	--	No production testing will be performed. The impact of drilling discharges is discussed in Chapter 4.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.1.6.		Simulation (a digital three-dimensional hydrodynamic contaminant dispersion model) for drilling mud of the dispersion zone of the drilling mud and other mining liquids – each case must be considered on its merits on the basis of environmental data and location relative to the coast, the quantity of mud and discharge and the duration of time of the drilling or discharge into the sea. This matter will be coordinated and approved in advance and in writing. If simulation is required, the model must be approved and is to be presented in a preliminary document which shall contain a description of the type of model, calibration characteristics, commencement conditions, language conditions, the grid of the model and other parameters required in order to activate the model. After approval of the conditions and calibration of the model, the scenarios for modeling the dispersion of contaminants from a hydrodynamic point of view will be set, in various climatic conditions.	Yes	4	4.6.1	Sediments and Sediment Quality	
	4.2.		Production Tests						
				Describe all of the means for ensuring that under no circumstances will there be any connection (transfer of liquids or gases) from the area where the production tests are taking place and the water-carrying strata and expansion of the fuel composition (liquid and gas) underground or in the marine environment.	Yes	4			No completion testing will be performed. The drilling and completion process testing is discussed in Sections 3.2.2.2, 3.2.4, and 5.2.
	4.3.		Environmental Impacts of Sea Pollution Event by Oil Based on Extreme Scenarios						
		4.3.1.		Please describe the current field and the movement of the oil stain along the Israeli coastline from the drilling bore in detail and in stages. This description should rely, inter alia, on the results of activation of a three-dimensional hydrodynamic model, which has been fed with wind data and the other necessary hydrodynamic characteristics. The hydrodynamic model must set out, precisely, the field of currents in accordance with the layout of the local seabed up to the Israeli coastline.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.3.2.		If the oil slick will, based on the findings of the hydrodynamic model, penetrate the shallow portion of the continental shelf off the coast of Israel, describe via the appropriate hydrodynamic model for simulating the hydrodynamic processes in the coastal environment the current regime in the area affected mainly by local winds and waves, and analyze the impact of such currents on dispersal of the oil slick on the coastal environment.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
		4.3.3.		In running the model and in all of the calculations stemming from it, please take into account the worst-case scenario of 30 continuous days of discharge into the marine environment, at a maximum daily capacity in accordance with the drilling data. The type of oil in the model must be the most resilient oil expected in the reservoir and/or in accordance with the worst-case scenario data.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
		4.3.4.		Please run each of the four most common sea conditions on Israeli beaches for a period of 30 days: • 4.3.4.1. Extreme winter wave storm: 9.12.2010 - 08.01.2011 • 4.3.4.2. Winter wave storm: 26.01.2008 - 14.02.2008 • 4.3.4.3. Summer swell: 17.07.2008 - 16.08.2008 • 4.3.4.4. Strong North-Easterly wind (Spring and Autumn): 25.09.2007 - 25.10.2007	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
		4.3.5.		Please explain in clear detail all of the data and estimates for the maximum daily quantity of oil set out in the document, and the general quantity during the course of the current scenario, without 30 day control, including formulas and calculations. Please clarify the objective difficulties in evaluating the expected quantities and the possible areas of imprecision. Please address the relevance of the modeling method performed and expand, in the explanation, on the relationship between the results of the model and the actual anticipated assessment based on international knowledge and experience from past oil pollution incidents. Explain the nature of the oil spill over the water, including the thickness and expected spread of it, and the environmental significance of the thickness and spread of the spill.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	Estimates are presented in the text. The modeling effort was carried out using accepted modeling methodology and the results should be considered to be relevant to potential events. No in-depth discussion of the difficulties in modeling nor the relevance of the modeling is provided.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.3.6.		Please analyze, on the basis of the findings of the model, the results of the spread of the oil stain from the drilling bore and give a detailed explanation of the environmental significance of the results of the model. Please refer to the marine environment in general and to the coastal area and the various sites therein in particular. Give details and explain the environmental and other implications that might arise from an oil spill incident at sea under the various scenarios, vis-à-vis the various environments. Including a description of sensitive areas that might be affected by a pollution incident (based on a map of sensitivity of beaches to sea pollution by oil. The map is accessible on the internet and a copy may be obtained from the Marine and Coastal Division as a GIS layer). Address the various significances, including:	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
		4.3.6.1.		The impact on the ecosystem in general, and on the various species in particular.	Yes	4	4.3		
		4.3.6.2.		The impact of the various uses including an assessment of the measures required to remedy the damage and to restore the previous condition, an assessment of the length of time during which uses might be harmed and a general assessment of the costs of restoring the previous condition, all in accordance with open reports of international experiences.	Yes	4	4.3		Measures are primarily presented in Noble Energy's Oil Spill Contingency Plan (OSCP). An estimate of the costs is included in Section 4.3.3.
		4.3.6.3.		Please address the following environments: The open sea environment, including a distinction between deep water and the critical transition zone, the seabed, beaches used for swimming and leisure, rocky beaches and/or sandy beaches that are rich in biota, marinas, moorings, marine anchorages and ports, power station cooling water suction plant and coal terminal, reverse osmosis plants and fish farm cages.	Yes	4	4.3	Yes	
		4.3.7.		Set out an oil spill spread model (name of model, name of manufacturer and representative calibration data), and output data, for the prior approval of the Ministry for Environmental Protection (Marine and Coastal Division), prior to running the model. For the purpose of approval of the calibration stage, please set out a document describing, in detail, the boundary conditions and the starting conditions of the model, and the various variables and non-variables chosen for the purpose of running the model. The following are the details, variables and conditions that are required for the approval:	Yes	4	4.3	Yes	Additional details on the modeling are found in the referenced modeling report.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.3.7.1	General						
				• 4.3.7.1.1. The name of the model. • 4.3.7.1.2. A brief description of the model. • 4.3.7.1.3. Reasons for adapting the proposed Eastern Mediterranean Sea (oil) spill simulation model. • 4.3.7.1.4. Examples from around the world for use in the proposed spill simulation model.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	Examples from around the world are not included.
		4.3.7.2.	Meteorological-Physical Conditions and Variables						
				• 4.3.7.2.1. Conditions of edge of model (boundaries and surface) • 4.3.7.2.2. Conditions of commencement of model. • 4.3.7.2.3. Resolution of model, both horizontal and vertical. • 4.3.7.2.4. Characteristics of starting data for model: winds, currents, sea level, temperature, salinity, etc. • 4.3.7.2.5. Bathymetry.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	Bathymetry is provided in Chapter 1.
		4.3.7.3.	Chemical Variables						
				• 4.3.7.3.1. Type of oil. • 4.3.7.3.2. Quantity of oil emitted per unit of time.	Yes	4	4.3	Environmental Impacts of Non-Routine Events	
		4.3.7.4.	Calibration and Verification of Model						
				• 4.3.7.4.1. Methodological description and explanation of the proposed method of calibration. • 4.3.7.4.2. Presentation of the variables required for calibration for the purpose of achieving the requisite model performances. • 4.3.7.4.3. Presentation of calibration findings (in figures, tables, and a verbal explanation). • 4.3.7.4.4. Methodological description and explanation of the proposed method of verification. • 4.3.7.4.5. Presentation of verification findings (in figures, tables, and a verbal explanation).	No	--	--	--	These details were not provided in the modeling report.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.3.7.5.	Scenarios for Examination						
				• 4.3.7.5.1. Analysis of the usual and extreme hydrodynamic characteristics in the area and environs of the drilling bore.	Yes	4	4.3	Yes	Background conditions are discussed in Chapter 1.
	4.4.		Light Hazards						
				The effect of lighting and the planned production tests required for performance of the Application on the environment must be examined and measures proposed for reducing expected light hazards	Yes	4	4.4	Light Hazards	
	4.5.		Noise						
				Assess the expected impact of noise on animals in the environs of the drilling. Give details of the local species that might be harmed by such noises (with an emphasis on pelagic animals such as fish, whether wild or caged, marine mammals, turtles), and measures for reducing damage.	Yes	4	4.5	Noise Impacts	
	4.6.		Nature and Ecology						
		4.6.1		Assess the level of sensitivity of the animals and the possible impacts of construction of the rig on habitats as described on the habitat map in section 1.6.	Yes	4	4.6	Nature and Ecology Impacts	
		4.6.2.		Describe rehabilitation at the end of drilling work and abandonment or commencement of the operational period.					Rehabilitation is mentioned where information was available.
	4.7.		Culture and Heritage Sites						
		4.7		Check the impact of performance of the plan on declared sites and on sites that may be discovered and exposed during the performance of the Application.	Yes	4	4.7	Culture and Heritage Sites	
	4.8.		Air Quality						
		4.8.1.		Set out a table that concentrates the rates of emission of air contaminants set out in section 3.5 from any source, and the method of calculation/evaluation of them.	Yes	4	4.8	Air Quality	Section 3.4 discusses air emissions from the drilling activities. Section 4.8 reviews potential impacts from the air emissions.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.8.2.		Set out the measures and actions planned to be taken to reduce emissions from all sources set out in section 3.5, and the efficacy thereof, and address the best available technology (BAT) for complying with international requirements. For facilities/operations in respect of which there are requirements in TA-Luft 2002, address compliance with such requirements. Describe the ongoing maintenance of these facilities. In particular, address the treatment of problems relating to H_2S emissions into the air, in routine operations or in the event of faults.	Yes	4	4.8	Air Quality	Section 5.2.6 discusses measures to reduce the discharge of H_2S. A description of the technology to be used and facility maintenance is not possible until a drilling unit is identified. BAT is not addressed.
		4.8.3.		Assess what faults might be expected to cause harmful material emissions into the air causing danger to elements of the population or to shipping. The following sections (4.8.4-4.8.10) will be added for applications for drilling at a distance of less than 10 km from the coast.	Yes	4	4.8	Air Quality	
		4.8.4.		Assess the impact of emissions of the following contaminants: SO2, NOx, PM25, PM10, on the quality of the air in the environs of the bore, by running an acceptable dispersion model such as AERMOD or another model. The author of the document must obtain the prior approval of the model chosen before running it. Set out all of the input data taken for the purpose of running the model (emission rates, temperature, stack diameter, meteorological data, etc.), including the reasons for any presumptions, if any. Meteorological data for running the model shall be taken from the meteorological station near to the coast, upon coordination with the Ministry for Environmental Protection.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.
		4.8.5.		The results of running the model shall be examined in a defined area up to the rate in which concentrations of 10% of the environmental standard are obtained. Within this range, if additional emissions sources exist, another model must be run that includes the existing and approved emissions sources, including roads, power stations and factories.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.
		4.8.6.		The model shall be run on a Cartesian grid, and individual receptors must be shown in areas where existing and approved sensitive land uses are in existence.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.8.7.		The results of running the model shall be examined with respect to environmental values and goals (Air Quality Value Regulations, 2011). If there is no target value in the Regulations, the results must be examined with respect to the reference values. The results shall be presented in tables and graphically via isoplates, on a background map. The percentage contribution of each source to the emission of each contaminant must be set out.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.
		4.8.8.		Calculate dispersal of the contaminants in scenarios of faults for severe weather conditions.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.
		4.8.9.		Set out the measures and actions planned to be taken to reduce emissions from all sources set out in section 3.5, and the efficacy thereof, and address the best available technology (BAT) for complying with international requirements. For facilities/operations in respect of which there are requirements in TA-Luft 2002, address compliance with such requirements. Describe the ongoing maintenance of these facilities. In particular, address the treatment of problems relating to H2S emissions into the air, in routine operations or in the event of faults.	N/A	--	--	--	Air modeling was not performed for this EIA due to the distance from the coast.
	??	??	Waste	Describe the methods of treatment and removal of waste, as set out in section 3.8 above.	Yes	4	4.9		
	4.9.		Hazardous Materials						
		4.9.1.		Set out the measures for reducing risks from hazardous materials in accordance with the details in section 3.6 above.	Yes	3	3.5	Hazardous Materials	SDSs are provided in Appendix F and present measures for reducing risk from hazardous materials.
		4.9.2.		Describe and set the measures for treatment in the event that hazardous materials are discovered during the course of the drilling, including H2S.	Yes	3	3.5	Hazardous Materials	SDSs are provided in Appendix F and present measures for treatment. H_2S precautions are presented in Section 5.2.6.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.9.3.		Set out the method of treatment in emergencies (hazardous material event) and the means for minimizing risks, including passive and active measures such as batches detectors.	Yes	3	3.5	Hazardous Materials	SDSs are provided in Appendix F and present measures for reducing risk from hazardous materials.
	4.10.		Preparations for Earthquakes						
				Prepare emergency procedures or a chapter of existing emergency procedures for the handling of earthquakes. These procedures must address all exceptional situations, including: failure of communications and contact, inability to reach emergency forces, partial emergency team, etc.	No	--	--	--	Emergency procedures are presented in the Noble Energy OSCP.
	4.11.		Fishing and Marine Farming						
		4.11.1.		Describe the impacts of the exploratory drilling on fishing activity and the ways of reducing such impacts, in the event of harm to fishing and marine farming.	Yes	4	4.12	Fishing and Marine Farming	
		4.11.2.		Describe a veterinary monitoring plan to examine the impact of the drilling on questions of fish health and public health in the event of intensive marine farming, or alternatively set out coordination with growers regarding implementation of a monitoring plan and risk assessment approved by the veterinary services.	No	--	--	--	No veterinary monitoring plan was developed due to the distance of the project form marine farming activities.
	4.12		Safety and Protection						
				Assess the safety range required around the bore against harm to existing infrastructure and sea vessels.	Yes	4	4.13	Safety and Protection – Safety Zone	
	4.13		Monitoring and Control Programs						
		4.13.1.		Describe the monitoring and control methods for each source discharged into the sea. Note, inter alia, what tests are planned to be done continuously, which are done visually and which are done in laboratories on the platform, which are done at external laboratories, and at what frequency.	Yes	4	4.14	Monitoring and Control Program	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		4.13.2.		Describe the method of taking samples in order to obtain representative samples, for continuous/visual/laboratory sampling.	No	--	--	--	These methods will be described in Noble Energy's Discharge Plan, which will be created after identifying the drilling unit to be used.
		4.13.3.		Describe the calibration and maintenance actions on monitoring and control instruments.	No	--	--	--	These methods will be described in Noble Energy's Discharge Plan, which will be created after identifying the drilling unit to be used.
		4.13.4.		A background monitoring report of the marine environment must be submitted in accordance with Appendix B1.	Yes	4	4.14.2		Background monitoring has been done for the Tamar projects. The reports have been submitted and are referenced in the EIA.
	4.14		Closure of Drilling Site	Examine the impact of closure of the drilling site on the environment and the means required to prevent such impacts, including the removal of materials, equipment and waste	No	4	4.15	Closure and Abandonment	Impacts cannot be defined at this time as the closure will be done under regulations existing at the time of closure.
E			**Proposal for Application Guidelines**						
	5.1		General	This Chapter shall set out all of the proposals for setting the guidelines of the Application, at the level set out as being required for detailing the possible impacts set out in the chapters of this document, and the measures that are to be taken in order to prevent or reduce such.	Yes	5	5	Proposal for Application Guidelines (Mitigation)	This chapter addresses this issue.
	5.2.			The guidelines shall refer to the actions that must be taken or not taken in the entire area of the Plan, during the course of drilling and throughout the various phases of performance thereof, and following completion thereof.	Yes	5	5	Proposal for Application Guidelines (Mitigation)	This chapter addresses this issue.
	5.3.			The guidelines shall be for the grant of a drilling permit.	Yes	5	5	Proposal for Application Guidelines (Mitigation)	This chapter addresses this issue.

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
	5.4.			The guidelines shall relate to the installation and operation of systems to track and monitor the effects that flow or that may flow from this Application.	Yes	5	5	Proposal for Application Guidelines (Mitigation)	This chapter addresses this issue.
	5.5.			The guidelines shall relate to the actions that must be done throughout the area of the Application, upon the making of a decision to perform drilling and up to closure of the drilling site within the area of the Application.	Yes	5	5	Proposal for Application Guidelines (Mitigation)	This chapter addresses this issue.
	5.6.			The guidelines shall include the following topics, *inter alia*:					
		5.6.1.		Guidelines for the phases of performance of drilling and production tests.	Yes	5	5.2		
		5.6.2.		Guideline for the handling of hazardous materials.	Yes	5	5.2.1	Handling of Hazardous Materials	
		5.6.3.		Guidelines for the reduction and prevention of harm to land and to seawater and the coastline, and including harm to the marine ecology, fishing and marine farming.	Yes	5	5.2.2	Reduction and Prevention of Harm – Land, Seawater and Coastline Including Marine Ecology	
		5.6.4.		Guidelines for preservation of fauna and flora in the area of the Application including instructions for the prevention of harm to pelagic species whose presence around the drilling rig might be increased, such as sharks, marine mammals and birds.	Yes	5	5.2.3	Preservation of Fauna and Flora	
		5.6.5.		Guidelines regarding the collection of data for the purpose of monitoring and tracking the quality of seawater, sediment, currents, fauna and flora and marine farming in the environs of the bore.	Yes	5	5.2.4	Monitoring Procedures	
		5.6.6.		Guidelines for the construction of various monitoring systems (air, water, waste, mud and cutting discharge, etc.), to operate during the construction and performance of the Application.					

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		5.6.7.		Guidelines for performance of a veterinary monitoring plan for marine farming fish in order to ensure public health aspects.	Yes	5			A veterinary monitoring plan was not developed for this project due to the distance from marine farming and the coast.
		5.6.8.		Guidelines for measures for preventing/reducing light hazards.	Yes	5	5.2.5	Preventing/ Reducing Light Hazards	
		5.6.9.		Guidelines for measures for reducing air contaminant emissions.	Yes	5	5.2.6	Measures for Reducing Air Emissions	
		5.6.10.		Guidelines for measures for preventing or reducing noise.	Yes	5	5.2.7	Measures for Preventing or Reducing Noise	
		5.6.11.		Guidelines for measures for the treatment and removal of cutting discharge and drilling mud.	Yes	5	5.2.9	Measures for Reducing the Impacts of Discharges and Wastes	
		5.6.12.		Guidelines for measures for treatment of various sources of discharge including cooling water, sanitary waste, kitchen waste, concentrate water.					
		5.6.13.		Guidelines for the definition of safety and protection zones and the management of safety against harm to existing infrastructure and sea vessels.	Yes	5	5.2.10	Measures to Manage the Safety of Vessels and Infrastructure	
		5.6.14.		Guidelines for methods of treatment and removal of waste.	Yes	5	5.2.9	Measures for Reducing the Impacts of Discharges and Wastes	
		5.6.15.		Guidelines for preparation of emergency procedures in the event of faults or accidents including submission of an emergency factory plan for the treatment of oil spills at sea, fire.	Yes	5	5.2.8	Accidental Spills and Emergency Procedures	

Table C-1. (Continued).

Framework Guidelines for the Preparation of Environmental Documents					Addressed in Tamar Field Development EIA				
Chapter	Section	Subsection	Heading	Clause/Requirement	Yes, No, or N/A	Chapter	Section Number	Section Name	Comments
		5.6.16.		Guidelines for the actions to be taken when closing and rehabilitating the drilling site.	Yes	5	5.2.11	Wellsite Abandonment and Rehabilitation	
		5.6.17.		Guidelines for the setting up of a team to accompany the Application, and the composition thereof.					
		5.6.18.		Guidelines for periodical reporting of faults to the Petroleum Commissioner, and of environmental issues to the Ministry for Environmental Protection.	No	--	--	--	

APPENDIX D

Side-Scan Sonar Targets

Easting	Northing	Length(m)	Width(m)	Height(m)	Tag-Number	Tag-Name
595350.7	3660593.69	3.40	1.00	0.00	TS_01	Unidentified
591708.8	3653558.31	4.20	1.20	0.00	TS_02	Unidentified
592142.6	3654186.17	2.70	0.50	0.00	TS_03	Unidentified
594339.0	3657840.24	3.40	2.00	0.10	TS_04	Unidentified
593182.9	3655189.97	2.20	0.70	0.00	TS_05	Unidentified
595673.5	3660377.22	3.00	0.50	0.00	TS_06	Unidentified
593682.4	3655614.26	5.60	0.70	0.00	TS_07	Unidentified
595652.9	3660563.56	2.70	1.00	0.00	TS_08	Unidentified
592968.1	3653306.56	2.20	0.80	0.00	TS_09	Unidentified
592975.8	3653324.95	3.90	0.50	0.00	TS_10	Unidentified
592953.3	3653321.42	5.10	1.20	0.00	TS_11	Unidentified
593688.3	3655452.03	2.80	1.10	0.10	TS_12	Unidentified
592374.2	3651472.46	3.20	1.30	0.00	TS_13	Unidentified
592748.9	3652345.98	5.60	8.90	1.90	TS_14	Unidentified
592901.0	3652968.92	4.70	3.20	1.20	TS_15	Unidentified
592612.2	3651866.41	3.70	1.50	0.00	TS_16	Unidentified
592267.8	3650681.48	5.90	2.20	0.00	TS_17	Unidentified
592270.4	3650729.09	5.40	2.20	0.00	TS_18	Unidentified
592286.0	3650792.19	3.70	2.30	0.00	TS_19	Unidentified
592858.2	3652651.41	10.50	6.80	0.90	TS_20	Unidentified
595762.5	3657891.59	5.00	1.30	0.00	TS_21	Unidentified
592719.6	3652177.15	10.40	1.30	0.00	TS_22	Unidentified
592661.8	3652056.96	5.30	1.50	0.00	TS_23	Unidentified
592673.0	3652048.32	5.20	1.50	0.00	TS_24	Unidentified
592419.5	3651543.31	7.70	2.10	0.00	TS_25	Unidentified
592391.8	3651419.71	6.20	0.70	0.00	TS_26	Unidentified
592350.0	3651393.81	6.40	2.30	0.00	TS_27	Unidentified
592376.8	3651227.30	4.50	1.60	0.00	TS_28	Unidentified
592258.6	3650921.91	5.10	1.90	0.00	TS_29	Unidentified
591844.7	3649298.24	6.90	1.70	0.00	TS_30	Unidentified

Easting	Northing	Length(m)	Width(m)	Height(m)	Tag-Number	Tag-Name
591892.87	3649315.19	4.80	2.00	0.00	TS_31	Unidentified
591964.10	3649565.91	5.80	1.90	0.00	TS_32	Unidentified
591986.94	3649573.74	2.90	1.80	0.00	TS_33	Unidentified
592047.63	3650381.76	7.30	3.50	0.00	TS_34	Unidentified
592781.91	3652005.71	5.60	1.20	0.20	TS_35	Unidentified
593490.62	3653295.00	7.10	1.00	0.00	TS_36	Unidentified
591835.58	3649405.02	4.20	4.00	0.00	TS_37	Unidentified
591889.51	3649462.63	8.40	2.20	0.00	TS_38	Unidentified
591956.64	3649573.83	6.30	1.40	0.00	TS_39	Unidentified
591944.95	3649646.78	3.90	2.00	0.00	TS_40	Unidentified
592302.66	3649868.30	1.90	1.70	0.00	TS_41	Unidentified
591927.85	3649236.38	5.20	1.80	0.00	TS_42	Unidentified
591876.85	3649248.34	4.90	1.50	0.00	TS_43	Unidentified
593995.96	3653475.41	6.40	0.30	0.00	TS_44	Unidentified
593386.96	3651899.74	5.50	3.80	0.10	TS_45	Unidentified
594248.17	3653416.23	5.90	1.80	0.10	TS_46	Unidentified
592186.04	3649002.11	5.40	0.80	0.00	TS_47	Unidentified
594380.39	3653424.03	4.60	1.10	0.00	TS_48	Unidentified
594389.40	3653440.09	6.50	1.00	0.00	TS_49	Unidentified
594517.76	3653405.05	5.10	1.10	0.00	TS_50	Unidentified
594810.39	3653195.29	3.60	1.60	0.00	TS_51	Unidentified
595089.20	3653263.22	3.40	1.00	0.00	TS_52	Unidentified
594112.01	3649694.72	2.50	0.70	0.00	TS_53	Unidentified
593851.34	3649852.95	3.10	0.80	0.00	TS_54	Unidentified
596576.52	3655767.61	4.70	1.40	0.00	TS_55	Unidentified
597746.20	3658188.35	3.60	0.50	0.00	TS_56	Unidentified
595440.65	3651927.18	3.40	1.00	0.00	TS_57	Unidentified
596283.82	3654123.54	3.80	0.50	0.00	TS_58	Unidentified
596173.71	3653108.32	5.80	0.80	0.00	TS_59	Unidentified
598241.63	3658144.35	3.00	1.20	0.00	TS_60	Unidentified
599434.54	3660554.15	5.10	1.00	0.00	TS_61	Unidentified
600753.69	3655496.36	4.80	1.70	0.10	TS_62	Well
597959.85	3651444.23	3.80	0.50	0.00	TS_63	Unidentified
598207.27	3655135.17	9.70	11.70	0.00	TS_64	Unidentified

Easting	Northing	Length(m)	Width(m)	Height(m)	Tag-Number	Tag-Name
598202.8	3655142.6	9.30	2.20	2.20	TS_65	Unidentified
594692.1	3647649.2	4.70	0.90	0.00	TS_66	Unidentified
598915.9	3657784.6	4.80	0.80	0.00	TS_67	Unidentified
596477.6	3652055.9	4.70	2.20	0.00	TS_68	Well
596412.3	3652933.5	2.80	1.20	0.10	TS_69	Unidentified
598929.5	3658597.8	2.00	0.40	0.00	TS_70	Unidentified
596171.2	3652688.2	4.00	1.20	0.00	TS_71	Unidentified
598420.5	3658116.5	4.30	0.70	0.00	TS_72	Unidentified
595443.2	3650978.9	4.60	0.30	0.00	TS_73	Unidentified
598459.3	3647349.7	4.20	2.80	0.10	TS_74	Unidentified
598551.1	3648606.9	1.10	0.60	0.10	TS_75	Unidentified
599687.3	3652466.4	3.50	1.00	0.00	TS_76	Unidentified
599746.2	3647948.5	5.60	1.80	0.00	TS_77	Unidentified
598559.0	3647330.3	1.60	1.10	0.20	TS_78	Unidentified
603765.1	3653838.1	2.30	1.00	0.00	TS_79	Unidentified
602574.8	3652571.7	13.60	16.00	1.10	TS_80	Possible Anchor Location
601892.0	3651669.8	3.90	1.40	0.00	TS_81	Unidentified
603360.8	3655551.9	11.00	17.00	0.30	TS_82	Possible Anchor Location
603255.9	3656974.2	11.10	17.40	0.40	TS_83	Possible Anchor Location
600706.5	3658320.3	18.00	8.20	0.00	TS_84	Possible Anchor Location
599312.5	3657952.6	7.20	19.00	0.00	TS_85	Possible Anchor Location
597883.6	3655464.8	9.40	9.20	0.00	TS_86	Possible Anchor Location
598300.8	3654073.6	12.50	9.50	0.00	TS_87	Possible Anchor Location
600786.7	3652570.6	20.00	25.00	0.30	TS_88	Possible Anchor Location
598890.3	3652907.3	12.30	13.60	0.00	TS_89	Possible Anchor Location
598212.0	3654104.6	20.00	9.00	0.00	TS_90	Possible Anchor Location
594458.2	3653785.8	12.00	7.50	0.20	TS_91	Possible Anchor Location
593881.2	3651097.0	12.40	8.50	0.00	TS_92	Possible Anchor Location
594760.6	3650060.0	17.80	5.30	0.00	TS_93	Possible Anchor Location
597356.4	3649551.6	13.70	13.10	0.10	TS_94	Possible Anchor Location
598499.6	3650328.9	24.00	16.90	0.20	TS_95	Possible Anchor Location

APPENDIX E

ESCAID 110 Fluid Specifications

MATERIAL SAFETY DATA SHEET

(SOLAS regulation VI/5-1 format)

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: ESCAID 110 FLUID
Product Description: Dearomatised Hydrocarbons

Intended Use: Drilling muds, oil-based
MARPOL Annex I Category: Naphthas, and condensates
See Section 14 for transportation information related to the Bill of Lading, other shipping documents

COMPANY IDENTIFICATION

Supplier: **EXXONMOBIL CHEMICAL COMPANY**
P.O. BOX 3272
HOUSTON, TX. 77253-3272 USA

Transportation Emergency Phone	(800) 424-9300 or (703) 527-3887 CHEMTREC
Product Technical Information	(281) 870-6000/Health & Medical (281) 870-6884
Supplier General Contact	(281) 870-6000

This (M)SDS is a document with no country specific information included.

SECTION 2 HAZARDS IDENTIFICATION

This material is hazardous according to UN GHS Criteria. Classification includes all GHS hazard classes. For hazard categories with two cut-off/concentration limits, classification was based on the higher limit.

GHS CLASSIFICATION:

Flammable liquid: Category 4.
Aspiration toxicant: Category 1.

GHS Label Elements:
Pictogram:

Signal Word: Danger

Hazard Statements:

Physical: H227: Combustible liquid.

Health: H304: May be fatal if swallowed and enters airways.

Precautionary Statements:

Prevention: P210: Keep away from flames and hot surfaces. -- No smoking. P280: Wear protective gloves and eye / face protection.
Response: P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. P331: Do NOT induce vomiting. P370 + P378: In case of fire: Use water fog, foam, dry chemical or carbon dioxide (CO2) for extinction.
Storage: P403 + P235: Store in a well-ventilated place. Keep cool. P405: Store locked up.
Disposal: P501: Dispose of contents and container in accordance with local regulations.

Contains: DISTILLATES (PETROLEUM), HYDROTREATED LIGHT

Other hazard information:

PHYSICAL / CHEMICAL HAZARDS
Material can accumulate static charges which may cause an ignition. Material can release vapours that readily form flammable mixtures. Vapour accumulation could flash and/or explode if ignited. Combustible.

HEALTH HAZARDS
May be irritating to the eyes, nose, throat, and lungs. Repeated exposure may cause skin dryness or cracking.

ENVIRONMENTAL HAZARDS
No significant hazards.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

This material is defined as a complex substance.

Hazardous Substance(s) or Complex Substance(s) required for disclosure

Name	CAS#	Concentration*	GHS Hazard Codes
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	100 %	H227, H304

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 4 FIRST AID MEASURES

INHALATION
Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

Seek immediate medical attention. Do not induce vomiting.

ACUTE AND DELAYED SYMPTOMS/EFFECTS

See Toxicological Section

NOTE TO PHYSICIAN

If ingested, material may be aspirated into the lungs and cause chemical pneumonitis. Treat appropriately.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Combustible. Hazardous material. Firefighters should consider protective equipment indicated in Section 8.

Hazardous Combustion Products: Smoke, Fume, Incomplete combustion products, Oxides of carbon

FLAMMABILITY PROPERTIES

Flash Point [Method]: >77C (171F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: 0.6 UEL: 5.1
Autoignition Temperature: 225°C (437°F)

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required, due to toxicity or flammability of the material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be

necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders. For emergency responders: Respiratory protection: half-face or full-face respirator with filter(s) for organic vapor and, when applicable, H2S, or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to aromatic hydrocarbons are recommended. Note: gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

SPILL MANAGEMENT

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Prevent entry into waterways, sewer, basements or confined areas. A vapour-suppressing foam may be used to reduce vapour. Use clean non-sparking tools to collect absorbed material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Large Spills: Water spray may reduce vapour, but may not prevent ignition in enclosed spaces. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Avoid contact with skin. Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Loading/Unloading Temperature: [Ambient]

Transport Temperature: [Ambient]
Transport Pressure: [Ambient]

Static Accumulator: This material is a static accumulator. A liquid is typically considered a nonconductive, static accumulator if its conductivity is below 100 pS/m (100x10E-12 Siemens per meter) and is considered a semiconductive, static accumulator if its conductivity is below 10,000 pS/m. Whether a liquid is nonconductive

or semiconductive, the precautions are the same. A number of factors, for example liquid temperature, presence of contaminants, anti-static additives and filtration can greatly influence the conductivity of a liquid.

STORAGE

The container choice, for example storage vessel, may effect static accumulation and dissipation. Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Storage containers should be earthed and bonded. Fixed storage containers, transfer containers and associated equipment should be earthed and bonded to prevent accumulation of static charge.

Storage Temperature: [Ambient]
Storage Pressure: [Ambient]

Suitable Containers/Packing: Barges; Drums; Tank Cars; Tank Trucks
Suitable Materials and Coatings (Chemical Compatibility): Carbon Steel; Stainless Steel; Polyethylene; Polypropylene; Teflon
Unsuitable Materials and Coatings: Natural Rubber; Butyl Rubber; Ethylene-proplyene-diene monomer (EPDM); Polystyrene

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Substance Name	Form	Limit/Standard			Note	Source	Year
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	Vapour.	RCP - TWA	1200 mg/m3	165 ppm	Total Hydrocarbons	ExxonMobil	2009

Biological limits

No biological limits allocated.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

Adequate ventilation should be provided so that exposure limits are not exceeded. Use explosion-proof ventilation equipment.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a

level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Half-face filter respirator Type A filter material

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Chemical resistant gloves are recommended. Nitrile

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

Chemical/oil resistant clothing is recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Liquid
Form: Clear
Colour: Colourless
Odour: Mild Petroleum/Solvent
Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15.6 C): 0.798
Density: 798 kg/m3 (6.66 lbs/gal, 0.8 kg/dm3)
Flammability (Solid, Gas): N/A
Flash Point [Method]: >77C (171F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: 0.6 UEL: 5.1
Autoignition Temperature: 225°C (437°F)
Boiling Point / Range: 200C (392F) - 248C (478F)

Decomposition Temperature: N/D
Vapour Density (Air = 1): 6.2 at 101 kPa
Vapour Pressure: 0.023 kPa (0.17 mm Hg) at 20°C
Evaporation Rate (n-butyl acetate = 1): 0.1
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: 1.68 cSt (1.68 mm2/sec) at 40°C | 2.16 cSt (2.16 mm2/sec) at 25C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION
Freezing Point: N/D
Melting Point: N/D
Pour Point: -39°C (-39°F)
Molecular Weight: 175 [Calculated]
Hygroscopic: No
Coefficient of Thermal Expansion: 0.00074 V/V/DEG C

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Avoid heat, sparks, open flames and other ignition sources.

MATERIALS TO AVOID: Strong oxidisers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Route of Exposure	Conclusion / Remarks
Inhalation	
Toxicity: Data available.	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: Data available.	Negligible hazard at ambient/normal handling temperatures. Based on test data for structurally similar materials.
Ingestion	
Toxicity: LD50 > 15000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity: LD50 > 3160 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: Data available.	May dry the skin leading to discomfort and dermatitis. Based on test data for structurally similar materials.
Eye	

Irritation: Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

OTHER HEALTH EFFECTS FROM SHORT AND LONG TERM EXPOSURE
Anticipated health effects from sub-chronic, chronic, respiratory or skin sensitization, mutagenicity, reproductive toxicity, carcinogenicity, target organ toxicity (single exposure or repeated exposure), aspiration toxicity and other effects based on human experience and/or experimental data.

For the product itself:
Vapour/aerosol concentrations above recommended exposure levels are irritating to the eyes and respiratory tract, may cause headaches, dizziness, anaesthesia, drowsiness, unconsciousness and other central nervous system effects including death. Prolonged and/or repeated skin contact with low viscosity materials may defat the skin resulting in possible irritation and dermatitis. Small amounts of liquid aspirated into the lungs during ingestion or from vomiting may cause chemical pneumonitis or pulmonary edema.

Additional information is available by request.

IARC Classification:
The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--
1 = IARC 1 2 = IARC 2A 3 = IARC 2B

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY
Material -- Not expected to be harmful to aquatic organisms.
Material -- Not expected to demonstrate chronic toxicity to aquatic organisms

PERSISTENCE AND DEGRADABILITY
Biodegradation:
Material -- Expected to be readily biodegradable.
Hydrolysis:
Material -- Transformation due to hydrolysis not expected to be significant.
Photolysis:
Material -- Transformation due to photolysis not expected to be significant.
Atmospheric Oxidation:
Material -- Expected to degrade rapidly in air

OTHER ECOLOGICAL INFORMATION
VOC: Yes

INTERNATIONAL OIL POLLUTION COMPENSATION (IOPC)

Material is considered a non-persistent oil.

SECTION 13 DISPOSAL CONSIDERATIONS

DISPOSAL METHODS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

MARPOL - see International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) which provides technical aspects at controlling pollutions from ships.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

Note - this material is being carried under the scope of MARPOL Annex I

SECTION 15 REGULATORY INFORMATION

REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS

Complies with the following national/regional chemical inventory requirements: IECSC, PICCS, TSCA, DSL, AICS, KECI, ENCS

SECTION 16 OTHER INFORMATION

N/D = Not determined, N/A = Not applicable
KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):
H227: Combustible liquid; Flammable Liquid, Cat 4
H304: May be fatal if swallowed and enters airways; Aspiration, Cat 1

THIS MATERIAL SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:
Revision Changes:
Section 09: Phys/Chem Properties Note was modified.

Section 15: National Chemical Inventory Listing was modified.
Composition: Component Table was modified.
Revision Date: 06 Sep 2011

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DGN: 4400260IUS (1019199)

APPENDIX F

Material Safety Data Sheets

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **ADAPTA™**

Revision Date: 03-Jan-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: ADAPTA™
Synonyms: None
Chemical Family: Polymer
Application: Additive

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Methylstyrene/Acrylate copolymer		60 - 100%	Not applicable	Not applicable
Silica gel	112926-00-8	1 - 5%	10 mg/m^3	80 mg/m^3 / %SiO2

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Rinse mouth with water many times.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Avoid dust accumulations. Ground and bond containers when transferring from one container to another.

Storage Information Store away from oxidizers. Keep away from friction, impact, and heat. Store in a well ventilated area. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Trace amounts of monomers may be released during use of this material.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Dust/mist respirator. (95%)

Hand Protection Neoprene gloves. Rubber gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Off white
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.03
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	33
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	If not contaminated, reuse product. Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **AQUAGEL® GOLD SEAL**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: AQUAGEL® GOLD SEAL
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	0.1 mg/m^3	Not applicable	0,075 mg/m^3	Not applicable
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Bentonite	1302-78-9	60 - 100%	215-108-5	10 mg/m^3	Not applicable	Not applicable	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 24 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Tan
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARA-DEFOAM® W300**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARA-DEFOAM® W300
Synonyms: None
Chemical Family: Blend
Application: Defoamer

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed. Combustible.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrotreated light petroleum distillate	64742-47-8	30 - 60%	265-149-8	5 mg/m^3	Not applicable	Not applicable	Xn; R65

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases. Runoff to sewer may cause fire or explosion hazard.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 6 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear amber
Odor:	Mineral oil
pH:	5 - 8.5
Specific Gravity @ 20 C (Water=1):	0.872
Density @ 20 C (kg/l):	0.88
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	< -17.8
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	>77
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.6
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	5.0
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide. Hydrocarbons.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin defatting with prolonged exposure. May cause skin irritation.
Eye Contact	May cause eye irritation.

Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xn - Harmful.
R65 Harmful: may cause lung damage if swallowed.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARACARB**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARACARB
Synonyms: None
Chemical Family: Mineral
Application: Bridging Agent

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye, skin, and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, quartz	14808-60-7	0 - 1%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Limestone	1317-65-3	60 - 100%	215-279-6	10 mg/m^3	Not applicable	10 mg/m^3	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Store away from acids. Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to tan
Odor:	Odorless
pH:	8-9
Specific Gravity @ 20 C (Water=1):	2.7
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide. Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.
Risk Phrases	None
Safety Phrases	S22 Do not breathe dust.
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARACOR™ 95**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARACOR™ 95
Synonyms: None
Chemical Family: Amine
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R34 Causes burns.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.

Hazard Overview
May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed. Repeated overexposure may cause liver and kidney effects.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Monoethanolamine	141-43-5	60 - 100%	205-483-3	3 ppm	2 ppm	1 ppm	Xn; C; R20/21/22-34

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases. Do not allow runoff to enter waterways.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from acids. Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	In high concentrations, supplied air respirator or a self-contained breathing apparatus.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron. Rubber boots.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Colorless
Odor:	Amine
pH:	12
Specific Gravity @ 20 C (Water=1):	1.02
Density @ 20 C (kg/l):	1.02
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	130
Freezing Point/Range (C):	-13
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	96
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	0.2
Vapor Density (Air=1):	2.1
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	0.1
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	23
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	-1.9 (OECD117)
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Carbon monoxide and carbon dioxide. Hydrocarbons.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause Central Nervous System effects.
Skin Contact	Causes severe skin irritation. May cause skin burns.
Eye Contact	Causes severe eye irritation May cause eye burns.

Ingestion	May be harmful if swallowed. Causes burns of the mouth, throat and stomach. May cause stomach discomfort. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions. May cause liver and kidney damage.
Aggravated Medical Conditions	Skin disorders. Lung disorders. Liver and kidney disorders.
Chronic Effects/Carcinogenicity	Prolonged or repeated exposure may cause central nervous system and brain effects. Prolonged or repeated exposure may cause liver, kidney and lung effects.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 1720 mg/kg (Rat)
Dermal Toxicity:	LD50: 2000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 57% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	EC50: 1247 mg/l (Corophium volutator)
Acute Crustaceans Toxicity:	TLM48: 163.2 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 60.5 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
UN2491,Ethanolamine Solution, 8, III

Air Transportation

ICAO/IATA
UN2491,Ethanolamine Solution, 8, III

Sea Transportation

IMDG
UN2491,Ethanolamine Solution, 8, III
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification
Xn - Harmful.
C - Corrosive.

Risk Phrases
R34 Causes burns.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.

Safety Phrases
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification
C - Corrosive.
Xn - Harmful.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R34 Causes burns.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARAZAN® D**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARAZAN® D
Synonyms: None
Chemical Family: Polysaccharide
Application: Viscosifier

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Xanthan gum	11138-66-2	60 - 100%	234-394-2	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Slippery when wet. Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 6 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	White to yellow
Odor:	Slight
pH:	5.5-8.5

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	510
Flash Point Method:	Not Determined
Autoignition Temperature (C):	204
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	1,000,000
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May impede respiration.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(5 Day): 200 mg/g COD: 1600 mg/g
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 320-560 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	TLM96: > 75000 ppm (Mysidopsis bahia)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended. *OEL in Section 2 is for dust.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

BARITE

Revision Date: 27-Mar-2012 **Revision Number:** 17

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name BARITE

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Weight Additive
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Carcinogenicity - (H350)	Category 1A
Specific Target Organ Toxicity - (Repeated Exposure) - (H372)	Category 1

2. HAZARDS IDENTIFICATION

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H350i - May cause cancer by inhalation
H372 - Causes damage to organs through prolonged or repeated exposure

Contains

Substances	CAS Number
Barium sulfate	7727-43-7
Crystalline silica, quartz	14808-60-7

Precautionary Statements - EU (§28, 1272/2008)
P201 - Obtain special instructions before use
P308 + P313 - IF exposed or concerned: Get medical advice/attention

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Barium sulfate	231-784-4	7727-43-7	60 - 100%	Not applicable	Not applicable	No data available
Crystalline silica, quartz	238-878-4	14808-60-7	1 - 5%	Not applicable	Carc. 1A (H350i) STOT RE 1 (H372)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

4. FIRST AID MEASURES

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

Specific End Use(s)

Exposure Scenario	No information available
Other Guidelines	No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Barium sulfate	Not applicable	10 mg/m^3	4 mg/m^3	Not applicable	8 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Barium sulfate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Personal protective equipment
Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.
Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State: Solid **Color:** Pink to tan to gray
Odor: Odorless **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	4.23
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	233.4
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity

10. STABILITY AND REACTIVITY

Not applicable

Chemical Stability

Stable

Possibility of Hazardous Reactions

Will Not Occur

Conditions to Avoid

None anticipated

Incompatible Materials

None known.

Hazardous Decomposition Products

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects

Acute Toxicity

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause mild eye irritation.

Skin Contact None known.

Ingestion May produce nervous system effects such as feeling of weakness, unsteady walk, and dilation of blood vessels. May affect the heart and cardiovascular system.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Prolonged inhalation of fine barium sulfate dusts form harmless nodular granules in lung, an affliction called baritosis. Baritosis produces no symptoms of bronchitis or emphysema, and lung functioning is not affected although dyspnea, upon exertion, may occur. The nodulation disappears if exposure is stopped.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation

11. TOXICOLOGICAL INFORMATION

Barium sulfate	No data available	No data available	No data available
Crystalline silica, quartz	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Barium sulfate	No information available	TLM96: 7500 ppm (Oncorhynchus mykiss)	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)
Crystalline silica, quartz	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

14. TRANSPORT INFORMATION

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	27-Mar-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE® COARSE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE® COARSE
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9
Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity:	TLM48: 1875 mg/l (Daphnia magna)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE® SUPERFINE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE® SUPERFINE
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended. *OEL in Section 2 is for dust.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE®**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE®
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9 (1%)
Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity:	TLM48: 1875 mg/l (Daphnia magna)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BDF-467**

Revision Date: 30-Aug-2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BDF-467
Synonyms: None
Chemical Family: Anionic Polymer
Application: Flocculent

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Do NOT spread spilled product with water. Scoop up and remove. Flush area with water.

7. HANDLING AND STORAGE

Handling Precautions Slippery when wet. Avoid creating or inhaling dust.

Storage Information Store away from oxidizers. Store in a dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Store at temperatures between 40 and 90 F (5 and 35 C). Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Rubber gloves.

Skin Protection Rubber apron.

Eye Protection Wear safety glasses or goggles to protect against exposure. Do NOT wear contact lenses.

Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Off white
Odor:	Odorless
pH:	4-9 (5g/l)
Specific Gravity @ 20 C (Water=1):	Not Determined
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	Prolonged or repeated contact may cause slight skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: LD50: > 5000 mg/kg (Rat)

Dermal Toxicity: LD50: > 10000 mg/kg (Rabbit)

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not readily biodegradable.

Bio-accumulation Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity: LC50:(96 hour) >100 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity: EC50: (48 hour) >100 mg/l (Daphnia magna)

Acute Algae Toxicity: IC50 (72 hour): > 100 mg/l (Clorella vulgaris)

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BENTONITE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Weight Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Bentonite	1302-78-9	60 - 100%	215-108-5	10 mg/m^3	Not applicable	Not applicable	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	0.1 mg/m^3	Not applicable	0,075 mg/m^3	Not applicable
Crystalline silica, quartz	14808-60-7	< 3	238-878-4	0.3 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable

Restrictive exposure limits **More restrictive exposure limits may be enforced by some states, agencies, or other authorities.**

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	9.9
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

	BJ SERVICES COMPANY **MATERIAL SAFETY DATA SHEET**	Region: Europe-Africa English

SECTION I - PRODUCT INFORMATION

Product Name: **C-250**
Product Use: Corrosion inhibitor.
Chemical Family: Mixture.
Contact Address:

BJ Services Company (UK) Limited
Badentoy Avenue, Badentoy Park
Porthlethen, Aberdeen, Scotland AB12 4YB
Phone: +44 (0) 1224 401 401 Fax: +44 (0) 1224 401 501

IN CASE OF EMERGENCY CALL: +44 (0) 1224 401 401 (24 HRS)

SECTION II - HAZARDOUS INGREDIENTS

Ingredient CAS #	%	Risk Phrases	Safety Phrases	Hazard Symbol
Substituted amine derivative	10-30	36/38	26 36/37/39	Xi

SECTION III - HAZARDS IDENTIFICATION

No specific hazards in conjunction with appropriate handling and precautionary measures.

SECTION IV - FIRST AID MEASURES

INHALATION:
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

INGESTION:
Rinse mouth out with water. Drink plenty of water. Seek medical advice.

EYES:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

SKIN:
Flush skin with water. Remove contaminated clothing and launder before reuse. Get medical attention if irritation persists.

SECTION V - FIRE AND EXPLOSION DATA

NFPA-FLAMMABILITY CODE:	0
FLASHPOINT (METHOD):	None
LOWER EXPLOSION LIMIT (% v/v):	Not applicable
UPPER EXPLOSION LIMIT (% v/v):	Not applicable
AUTO-IGNITION TEMPERATURE:	Not applicable

SPECIAL HAZARDS:
None.

EXTINGUISHING MEDIA:
Use appropriate media for surrounding fire.

SPECIAL FIREFIGHTING PROCEDURES:
None required; however, when fighting chemical fires, self-contained breathing apparatus and protective clothing is recommended.

HAZARDOUS COMBUSTION PRODUCTS:
See Hazardous Thermal Decomposition Products.

SECTION VI - ACCIDENTAL RELEASE MEASURES

Wear specified protective equipment. Small spills - Cover spill with absorbent material. Scoop absorbed material into a suitable container for disposal. Large spills - Dike to contain. Prevent from entering sewers or waterways. Recover product to suitable containers or vessel for reuse, if possible, or for disposal.

SECTION VII - HANDLING AND STORAGE

HANDLING:
Wear specified protective equipment. Use only in a well ventilated area.

STORAGE REQUIREMENTS:
Keep container tightly closed, in a cool, well ventilated place.

SECTION VIII - EXPOSURE CONTROLS AND PERSONAL PROTECTION

SPECIFIC ENGINEERING CONTROLS:
Use only in well ventilated area.

PERSONAL PROTECTIVE EQUIPMENT: Chemical resistant goggles. Rubber gloves. Coveralls.

EXPOSURE GUIDELINES: Not specified.

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:	Liquid
COLOR:	Brown
ODOR:	Amine
ODOR THRESHOLD:	Not available
SPECIFIC GRAVITY:	1.06 @ 15°C
VAPOR PRESSURE:	Not available
VAPOR DENSITY (air=1):	Not available

EVAPORATION RATE:	Not available
BOILING POINT:	> 100°C
FREEZING POINT:	Not available
pH:	6-9
SOLUBILITY IN WATER:	Soluble.

SECTION X - STABILITY AND REACTIVITY

STABILITY: Stable under normal conditions of use.

INCOMPATIBILITY/CONDITIONS OF REACTIVITY:
Strong acids.

HAZARDOUS THERMAL DECOMPOSITION PRODUCTS:
Oxides of carbon and nitrogen.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION XI - TOXICOLOGICAL PROPERTIES

PRIMARY ROUTES OF EXPOSURE: Eye contact. Skin contact.

ACUTE OVEREXPOSURE EFFECTS:

INHALATION: Not a likely exposure route.

INGESTION: Not a likely exposure route.

EYE CONTACT: May cause mild eye irritation.

SKIN CONTACT: Prolonged contact may cause drying of skin.

CHRONIC EFFECTS:
None known.

SENSITIZATION: Not known.
CARCINOGENICITY: None of the components of this product have been listed as carcinogenic by IARC, NTP or OSHA.
IARC- International Agency for Research on Cancer
NTP - National Toxicology Program
OSHA - Occupational Safety & Health Administration (US)
This product is not classified as a carcinogen in accordance with COSHH Regulations.- Control of Substances Hazardous to Health
MUTAGENICITY: Not known.
REPRODUCTIVE TOXICITY: Not known.

SECTION XII - ECOLOGICAL INFORMATION

AQUATIC TOXICITY:
No specific information available.

SECTION XIII - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL:
Disposal should be made in accordance with EC, national and local regulations.

SECTION XIV - SHIPPING INFORMATION

SHIPPING NAME:
NOT RESTRICTED

AIR-ICAO/IATA
NA

SEA-IMO/IMDG
NA

ADR/RID-ADNR
NA

SECTION XV - REGULATORY INFORMATION

NAME(S) ON LABEL:
NOT REGULATED
CLASSIFICATION/SYMBOL: NA
RISK PHRASES:
NA
SAFETY PHRASES:
NA

SECTION XVI - OTHER INFORMATION

ISSUE DATE: 18/07/2003
REVISIONS:
Not applicable (first issue).
PREPARED BY: Chemical Technology Centre

REFERENCES:
Suppliers' Literature.
CCINFOdisc (Core Collection), Canadian Centre for Occupational Health and Safety, 2001.
Restructured ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road, United Nations, New York and Geneva, 2001. Vols. I, II.
International Marine Dangerous Goods Code, 2000 Edition, International Maritime Organisation, 2000.
Dangerous Goods Regulations, 43rd ed., International Air Transport Association, 2002.
The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002, Statutory Instruments 2002 No. 1689, UK.

"Information contained herein has been provided in good faith and reasonable efforts have been made to

ensure its reliability, however BJ Services Company accepts no liability for damage arising from the use of this information."

Revision: 1 **Status: Approved & Released MSDS**

Revision History:

Revision:	Sec/Para Changed	Change Made:	Date
1	N/A	Initial Issue of Document	18/07/03

HALLIBURTON

SAFETY DATA SHEET

CALCIUM CHLORIDE (52620)

Revision Date: 04-Jan-2011 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name CALCIUM CHLORIDE (52620)

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Reagent

Uses Advised Against No information available

Details of the supplier of the safety data sheet

FANN Instruments Company
Halliburton House, Howe Moss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Acute Oral Toxicity	Category 4

- H302

Serious Eye Damage / Eye Irritation	Category 2

- (H319)

2. HAZARDS IDENTIFICATION

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Label Elements

Signal Word **Warning**

Hazard Statements
H319 - Causes serious eye irritation
H302 - Harmful if swallowed

Precautionary Statements - EU (§28, 1272/2008)
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P280 - Wear eye protection/face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P301+ P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P330 - Rinse mouth

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Calcium chloride	Listed	Proprietary	60 - 100%	Xi; R36	Eye Irrit. 2 (H319) Acute Tox. 4 (H302)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists. Remove contaminated clothing and launder before reuse.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

4. FIRST AID MEASURES

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Calcium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Calcium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.

Predicted No Effect Concentration (PNEC)	No information available.

Exposure controls

Engineering Controls	Use in a well ventilated area.
Personal protective equipment	
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls	No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State: Solid **Color:** White
Odor: Odorless

Property Remarks/ Method	Values
pH:	10
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.83
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	147.02
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation.

11. TOXICOLOGICAL INFORMATION

Eye Contact May cause severe eye irritation. May cause corneal injury.
Skin Contact Causes severe skin irritation. May cause skin burns on prolonged contact.
Ingestion Causes burns of the mouth, throat and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Calcium chloride	1000 mg/kg	LD50: > 5000 mg/kg	No data available

Test species: Rat

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Calcium chloride	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted

14. TRANSPORT INFORMATION

Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory This product, and all its components, complies with EINECS
US TSCA Inventory All components listed on inventory or are exempt.
Canadian DSL Inventory All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
R36 Irritating to eyes.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 04-Jan-2011
Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CAUSTIC SODA**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CAUSTIC SODA
Synonyms: None
Chemical Family: Hydroxide
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R35 Causes severe burns.

Hazard Overview May cause eye, skin, and respiratory burns. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium hydroxide	1310-73-2	60 - 100%	215-185-5	2 mg/m^3	2 mg/m^3	Not applicable	C; R35

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse. Destroy or properly dispose of contaminated shoes.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	May form explosive mixtures with strong acids. Reaction with steel and certain other metals generates flammable hydrogen gas.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Neutralize to pH of 6-8. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Localized ventilation should be used to control dust levels.
Respiratory Protection	HEPA Respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Full protective chemical resistant clothing. Rubber boots.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	14

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	2.13
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	1390
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Soluble in alcohols
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	40
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Contact with acids. Peroxides. Halogenated compounds. Prolonged contact with aluminum, lead, or zinc may liberate flammable hydrogen.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Causes severe respiratory burns. May cause chemical pneumonia.
Skin Contact	Causes severe burns.
Eye Contact	May cause eye burns.
Ingestion	Causes burns of the mouth, throat and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure may cause erosion of the teeth.
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	LD50: 140-340 mg/kg (Rat)
Dermal Toxicity:	LD50: 1350 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 730 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	This bag may contain residue of a hazardous material. Some authorities may regulate such containers as hazardous waste. Dispose of container according to national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
UN1823,Sodium Hydroxide, Solid, 8, II

Air Transportation

ICAO/IATA
UN1823,Sodium Hydroxide, Solid, 8, II

Sea Transportation

IMDG
UN1823,Sodium Hydroxide, Solid, 8, II
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification C - Corrosive.

Risk Phrases R35 Causes severe burns.

Safety Phrases S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S1/2 Keep locked up and out of reach of children.
S37/39 Wear suitable gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification C - Corrosive.
R35 Causes severe burns.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

CEMENT - CLASS G

Revision Date: 08-May-2012 **Revision Number:** 13

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name CEMENT - CLASS G

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Cement

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Skin Corrosion / irritation - (H315)	Category 2
Serious Eye Damage / Eye Irritation - (H318)	Category 1
Skin Sensitization - (H317)	Category 1
Carcinogenicity	Category 1A

2. HAZARDS IDENTIFICATION

- (H350)	
Specific Target Organ Toxicity - (Single Exposure)	Category 3
- (H335)	
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1
- (H372)	

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xi - Irritant.

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H318 - Causes serious eye damage
H315 - Causes skin irritation
H317 - May cause an allergic skin reaction
H335 - May cause respiratory irritation
H372 - Causes damage to organs through prolonged or repeated exposure
H350i - May cause cancer by inhalation

Contains

Substances	CAS Number
Portland cement	65997-15-1
Crystalline silica, quartz	14808-60-7

Precautionary Statements - EU (§28, 1272/2008)
P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
P201 - Obtain special instructions before use
P280 - Wear eye protection/face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor/physician
P308 + P313 - IF exposed or concerned: Get medical advice/attention

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Portland cement	266-043-4	65997-15-1	60 - 100%	Xi; R37/38-41 R43	Eye Dam. 1 (H318) Skin Irrit. 2 (H315) Skin Sens. 1 (H317) STOT SE 3 (H335)	No data available
Crystalline silica, quartz	238-878-4	14808-60-7	<3	Not applicable	Carc. 1A (H350i) STOT RE 1 (H372)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed

May cause eye and skin irritation.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó

Suitable Extinguishing Media

None - does not burn.

Extinguishing media which must not be used for safety reasons

None known.

Special hazards arising from the substance of mixture

Special Exposure Hazards

Not applicable.

Advice for firefighters

Special Protective Equipment for Fire-Fighters

Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions

None known.

Methods and material for containment and cleaning up

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

Reference to other sections

See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Product has a shelf life of 24 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Portland cement	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	5 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Portland cement	Not applicable	6.0 mg/m^3	10 mg/m^3	10.0 mg/m^3	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Personal protective equipment
Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.
Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Gray
Odor: Odorless **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	12.4
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Density	No data available
Specific Gravity	3.15
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
Keep away from any contact with water.
Incompatible Materials
Hydrofluoric acid.

Hazardous Decomposition Products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Eye Contact	May cause severe eye irritation.
Skin Contact	Can dry skin. May cause an allergic skin reaction. May cause alkali burns with confined contact.
Ingestion	None known

11. TOXICOLOGICAL INFORMATION

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Portland cement	No data available	No data available	No data available
Crystalline silica, quartz	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Portland cement	No information available	No information available	No information available	No information available
Crystalline silica, quartz	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
Does not bioaccumulate

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.

16. OTHER INFORMATION

R37/38 Irritating to respiratory system and skin.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	08-May-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CITRIC ACID (BAROID)**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CITRIC ACID (BAROID)
Synonyms: None
Chemical Family: Organic acid
Application: Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Citric acid	77-92-9	60 - 100%	201-069-1	10 mg/m^3	Not applicable	Not applicable	Xi: R36

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water.

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Get immediate medical attention.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	2.2
Specific Gravity @ 20 C (Water=1):	1.66
Density @ 20 C (kg/l):	1.66
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	1000
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	8
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	65
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	192.12
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases

S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CITRIC ACID (BAROID)**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CITRIC ACID (BAROID)
Synonyms: None
Chemical Family: Organic acid
Application: Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Citric acid	77-92-9	60 - 100%	201-069-1	10 mg/m^3	Not applicable	Not applicable	Xi: R36

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water.

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Get immediate medical attention.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	2.2
Specific Gravity @ 20 C (Water=1):	1.66
Density @ 20 C (kg/l):	1.66
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	1000
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	8
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	65
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	192.12
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases

S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **Clay Sync II**

Revision Date: 05-Jan-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: Clay Sync II
Synonyms: None
Chemical Family: Polymer
Application: Shale stabilizer

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 0, Reactivity 0
HMIS Ratings: Health 1, Flammability 0, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Wash hands after use. Slippery when wet.

Storage Information Store away from oxidizers. Store in a dry location. Store between 40.5 F (4.7 C) and 120.5 F (49 C). Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Granules
Color:	Off white
Odor:	Odorless
pH:	6.5-7.5 (1%)
Specific Gravity @ 20 C (Water=1):	1.04
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	500,000-750,000

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 10000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: >1000 mg/l (Pimephales promelas)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	EC50: > 500 mg/l (Selenastrum capricornutum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CLAYSEAL PLUS**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CLAYSEAL PLUS
Synonyms: None
Chemical Family: Ethoxylated polyamine
Application: Shale stabilizer

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrochloric acid	7647-01-0	1 - 5%	231-595-7	1 ppm	8 mg/m^3	5 ppm	C; R34-37
Propylene glycol	57-55-6	10 - 30%	200-338-0	150 ppm	10 mg/m^3	Not applicable	Not applicable
Polyalkeneamine		10 - 30%	Not Listed	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

4. FIRST AID MEASURES

Inhalation	If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store in a cool well ventilated area. Keep container closed when not in use. Store away from oxidizers. Store away from alkalis. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Organic vapor/acid gas respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear light yellow
Odor:	Amine
pH:	6-8
Specific Gravity @ 20 C (Water=1):	1.04-1.07
Density @ 20 C (kg/l):	1.04-1.07
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	-9
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 93**Min:** > 93
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	2-15
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers. Strong alkalis.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause severe skin irritation.

Eye Contact	May cause severe eye irritation.
Ingestion	May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.
Aggravated Medical Conditions	Skin disorders. Eye ailments.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases

S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/39 Wear suitable protective clothing and eye/face protection.

EINECS Inventory This product does not comply with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

C - Corrosive.
R34 Causes burns.
R37 Irritating to respiratory system.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

D-AIR 3000L

Revision Date: 09-Jun-2011 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name D-AIR 3000L

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Defoamer

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

Risk Phrases None

2. HAZARDS IDENTIFICATION

Label Elements
Not classified

Signal Word **Not Hazardous**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Alkenes	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available
Silica, amorphous precipitated	Not applicable	67762-90-7	10 - 30%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation. May cause lung damage if swallowed.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 24 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Alkenes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Silica, amorphous precipitated	Not applicable	6 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Alkenes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Silica, amorphous precipitated	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Impervious rubber gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid **Color:** Opaque
Odor: Hydrocarbon

Property Remarks/ Method	Values
pH:	5.5-7.9
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.92
Water Solubility	Insoluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Eye Contact May cause mild eye irritation.
Skin Contact May cause mild skin irritation.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation

11. TOXICOLOGICAL INFORMATION

Alkenes	No data available	No data available	No data available
Silica, amorphous precipitated	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Alkenes	No information available	No information available	No information available	No information available
Silica, amorphous precipitated	No information available	No information available	No information available	No information available

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

14. TRANSPORT INFORMATION

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) Not determined.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	09-Jun-2011
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

DEXTRID® E

Revision Date: 18-Nov-2010 **Revision Number:** 7

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name DEXTRID® E

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
Dust can form an explosive mixture in air

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Complex carbohydrate	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential. Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

6. ACCIDENTAL RELEASE MEASURES

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust. Avoid dust accumulations.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Complex carbohydrate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Complex carbohydrate	Not applicable	Not applicable	Not applicable	4.0 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Powder **Color:** White to Off white

Odor: Starch

Property	Values
Remarks/ Method	
pH:	7.1
Melting Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.5
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
Keep away from heat, sparks and flame.
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause allergic respiratory reaction.
Eye Contact	None known.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Complex carbohydrate	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

12. ECOLOGICAL INFORMATION

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Complex carbohydrate	No information available	No information available	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

15. REGULATORY INFORMATION

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	18-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

DEXTRID® E

Revision Date: 18-Nov-2010 **Revision Number:** 7

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name DEXTRID® E

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
Dust can form an explosive mixture in air

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Complex carbohydrate	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential. Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

6. ACCIDENTAL RELEASE MEASURES

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust. Avoid dust accumulations.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Complex carbohydrate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Complex carbohydrate	Not applicable	Not applicable	Not applicable	4.0 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Powder **Color:** White to Off white

Odor: Starch

Property	Values
Remarks/ Method	
pH:	7.1
Melting Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.5
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
Keep away from heat, sparks and flame.
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause allergic respiratory reaction.
Eye Contact	None known.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Complex carbohydrate	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

12. ECOLOGICAL INFORMATION

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Complex carbohydrate	No information available	No information available	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

15. REGULATORY INFORMATION

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	18-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **DIAMOND SEAL**

Revision Date: 04-Jan-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: DIAMOND SEAL
Synonyms: None
Chemical Family: Polymer
Application: Additive

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Carbon Dioxide, Dry Chemicals, Foam.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust. Slippery when wet.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Wash hands after use. Slippery when wet.

Storage Information Store away from oxidizers. Store in a dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	4-11
Specific Gravity @ 20 C (Water=1):	0.65- 0.85
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	40-50
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Ammonia. Hydrocarbons. Carbon monoxide and carbon dioxide. In the event of oxygen depletion, hydrocyanic acid can be formed.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 2000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **ECONOLITE LIQUID**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: ECONOLITE LIQUID
Synonyms: None
Chemical Family: Silicate
Application: Light Weight Cement Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Sodium silicate	1344-09-8	35-49	215-687-4	Xi; R36/37/38

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Neutralize to pH of 6-8. Scoop up and remove. Do NOT spread spilled product with water.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from acids. Store in a cool well ventilated area. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Full protective chemical resistant clothing.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Sodium silicate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Sodium silicate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear to hazy
Odor:	Slightly soapy
pH:	11.2
Specific Gravity @ 20 C (Water=1):	1.4
Density @ 20 C (kg/l):	1.4
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	101
Freezing Point/Range (C):	-1
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.
Hazardous Decomposition Products	Toxic fumes.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Causes severe respiratory irritation.

Skin Contact	May cause skin burns.
Eye Contact	May cause eye burns.
Ingestion	Causes burns of the mouth, throat and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 2000-3000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases
R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36 Wear suitable protective clothing.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36/37/38 Irritating to eyes, respiratory system and skin.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **ELASTICEM CEMENT BLEND**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: ELASTICEM CEMENT BLEND
Synonyms: None
Chemical Family: Cement
Application: Cement

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

2. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye, skin, and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Aluminum oxide	1344-28-1	5 - 10%	215-691-6	Not applicable
Crystalline silica, quartz	14808-60-7	<3	238-878-4	Not applicable
Portland cement	65997-15-1	30 - 60%	266-043-4	Xi; R37/38-41

Restrictive exposure limits

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation

If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin

Wash with soap and water. Get medical attention if irritation persists.

Eyes

In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion

Under normal conditions, first aid procedures are not required.

Notes to Physician

Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media

None - does not burn.

Extinguishing media which must not be used for safety reasons

None known.

Special Exposure Hazards

Not applicable.

Special Protective Equipment for Fire-Fighters

Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures

Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures

None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Product has a shelf life of 24 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Aluminum oxide	Not applicable	10 mg/m^3	10 mg/m^3	10 mg/m^3	6 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3
Portland cement	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	5 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Aluminum oxide	Not applicable	2.5 mg/m^3	6 mg/m^3	0.1 mg/m^3	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable
Portland cement	Not applicable	6.0 mg/m^3	10 mg/m^3	10.0 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Solid
Color: Gray
Odor: Odorless
pH: 12.4
Specific Gravity @ 20 C (Water=1): 2.58
Density @ 20 C (kg/l): Not Determined
Bulk Density @ 20 C (kg/m^3): Not Determined
Boiling Point/Range (C): Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	0
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Not Determined
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from any contact with water.
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	Can dry skin. May cause an allergic skin reaction. May cause alkali burns with confined contact.
Eye Contact	May cause severe eye irritation.
Ingestion	None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not applicable

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

Safety Phrases
S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S37 Wear suitable gloves.
S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

Xi - Irritant.
R37/38 Irritating to respiratory system and skin.
R41 Risk of serious damage to eyes.

Disclaimer Statement

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*****END OF MSDS*****

Imperial Oil

Esso CHEMICAL

HYDROCARBON FLUIDS

Sales Specification
Rev. 15 (12/ 2010)

ESCAID™ 110 Fluid

Properties	Test Methods	Sales Specifications
Aniline Point, °C	ASTM D 611	65.6 min
Appearance	Visual	Pass
Aromatics Content, wt. %	AM-S 140.31	0.5 max
Color, Saybolt Units	ASTM D 156 or ASTM D 6045	30 min
Distillation	ASTM D 86	
IBP, °C		192 min
DP, °C		250 max
Flash Point, °C	ASTM D 93	70 min
Pour Point, °C	ASTM D 97	-35 max
Specific Gravity @ 15.6/15.6°C	ASTM D 4052	0.790 – 0.810
Viscosity @ 40°C, cSt	ASTM D 445	1.50 – 1.75

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For more information, to request samples and/or to place orders, call: 1 (800) 663-4109

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PERFORMANCE FLUIDS

SALES SPECIFICATION

Effective: as from June 01, 2013

Escaid™ 110

Hydrocarbon Fluid

Property	Units	Method	Specification
Appearance	-	EC-A-A01	Bright & Clear
Aromatic content	wt%	UV1	<0.50
Colour, Saybolt	-	ASTM D 6045 / ASTM D 156	+30 min
Distillation range	°C	ASTM D 86	
Initial Boiling Point			192 min
Dry Point			250 max
Flash point	°C	ASTM D 93	74 min
Viscosity at 40°C	mm^2/s	ASTM D 445	1.50 – 1.75

Values may be determined by one or more ExxonMobil test methods equivalent to industry standard test methods. Applicable sampling and testing methods are subject to change without notice and are available for review on request.

The values indicated in this document may deviate from the test method requirements by the number of significant figures shown.

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HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **EZ SPOT®**

Revision Date: 02-Jul-2009

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: EZ SPOT®
Synonyms: None
Chemical Family: Blend
Application: Pipe Release Agent

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Hydrotreated light petroleum distillate	64742-47-8	30 - 60%	200 mg/m^3	Not applicable
Isobutanol	78-83-1	10 - 30%	50 ppm	100 ppm

3. HAZARDS IDENTIFICATION

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed. Flammable.

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Eyes
In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion
Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Notes to Physician
Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	92
Flash Point/Range (C):	33
Flash Point Method:	PMCC
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards May be ignited by heat, sparks or flames. Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 2, Flammability 2, Reactivity 0
HMIS Ratings: Health 2, Flammability 2, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Remove ignition sources and work with non-sparking tools. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

Storage Information Store away from oxidizers. Keep from heat, sparks, and open flames. Keep container closed when not in use. Product separates with storage and requires mixing before use. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Respiratory Protection Organic vapor respirator with a dust/mist filter. In high concentrations, supplied air respirator or a self-contained breathing apparatus.

Hand Protection Impervious rubber gloves.

Skin Protection Rubber apron.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Semi-Solid
Color:	Brown Green
Odor:	Alcohol
pH:	5-8
Specific Gravity @ 20 C (Water=1):	0.977
Density @ 20 C (lbs./gallon):	8.2
Bulk Density @ 20 C (lbs/ft3):	61
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	14
Freezing Point/Range (C):	-10
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Slightly soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.

Aggravated Medical Conditions	Lung disorders.
Chronic Effects/Carcinogenicity	Repeated overexposure may cause liver and kidney effects.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: > 100 mg/l (Golden orfe)
Acute Crustaceans Toxicity:	LC50: 8.77 mg/l (Daphnia magna)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT

UN1212,Isobutanol Solution, 3, III, (33.3 C)
NAERG 129

Canadian TDG
Isobutanol Solution, 3, UN1212, III, (33.3 C)

ADR

UN1212,Isobutanol Solution, 3, III

Air Transportation

ICAO/IATA

UN1212,Isobutanol Solution, 3, III

Sea Transportation

IMDG

UN1212,Isobutanol Solution, 3, III, (33.3 C)
EmS F-E, S-D

Other Shipping Information

Labels:	Flammable Liquid

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Fire Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does meet the criteria of a hazardous waste as defined by the US EPA, because of: Ignitability D001
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.

WHMIS Hazard Class	B2 Flammable Liquids D2B Toxic Materials

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **EZ-MUD®**

Revision Date: 01-Apr-2009

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: EZ-MUD®
Synonyms: None
Chemical Family: Blend
Application: Shale Inhibitor

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrotreated light petroleum distillate	64742-47-8	10 - 30%	265-149-8	5 mg/m^3	Not applicable	Not applicable	Xn; R65

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated shoes and discard.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Use water spray to cool fire exposed surfaces.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Organic vapor respirator with a dust/mist filter. In high concentrations, supplied air respirator or a self-contained breathing apparatus.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	White to gray
Odor:	Mild hydrocarbon
pH:	6-8
Specific Gravity @ 20 C (Water=1):	1.0
Density @ 20 C (kg/l):	1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	175
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	PMCC
Autoignition Temperature (C):	> 200
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	0.002
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	70
Evaporation Rate (Butyl Acetate=1):	< 1
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.

Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.
Aggravated Medical Conditions	Lung disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 40% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: >1000 mg/l (Pimephales promelas)
Acute Crustaceans Toxicity:	TLM48: 98 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 16.70 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases
S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 2: Hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xn - Harmful.
R65 Harmful: may cause lung damage if swallowed.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

SAFETY DATA SHEET
Fluorodye UC

1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

PRODUCT NAME	Fluorodye UC
APPLICATION	INDUSTRIAL DYE
SUPPLIER	Champion Technologies Minto Avenue Altens Industrial Estate Aberdeen, AB12 3JZ 00 44 1224 879022 00 44 1224 876022 eh.productstewardship@champ-tech. com
EMERGENCY TELEPHONE	[24Hr] 00 44 (0)1224 879022 OUT OF OFFICE HOURS ASK FOR HEALTH AND SAFETY

2 HAZARDS IDENTIFICATION

CLASSIFICATION (1999/45) Xi;R36/38.

CLASSIFICATION (EC 1272/2008)

Physical	Not classified.
Health	Skin Irrit. 2 - H315;Eye Irrit. 2 - H319
Environmental	Not classified.

LABEL IN ACCORDANCE WITH (EC) NO. 1272/2008

SIGNAL WORD Warning

HAZARD STATEMENTS

H315	Causes skin irritation.
H319	Causes serious eye irritation.

PRECAUTIONARY STATEMENTS

P280	Wear protective gloves/protective clothing/eye protection/face protection.
P305/351/338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P313	Get medical advice/attention.

3 COMPOSITION/INFORMATION ON INGREDIENTS

ETHANEDIOL **10-30%**

CAS-No.: 107-21-1 **EC No.: 203-473-3**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Acute Tox. 4 - H302	Xn;R22

ACETIC ACID **10-30%**

CAS-No.: 64-19-7 **EC No.: 200-580-7**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Flam. Liq. 3 - H226	R10
Skin Corr. 1A - H314	C;R35

9-(2-carboxyphenyl)-3,6-bis(diethylamino)xanthylium chloride **10-30%**

CAS-No.: 81-88-9 **EC No.: 201-383-9**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Eye Irrit. 2 - H319	Xi;R36.

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16

4 FIRST-AID MEASURES

INHALATION

Provide rest, warmth and fresh air. Get medical attention if any discomfort continues.

INGESTION

Immediately rinse mouth and drink plenty of water (200-300 ml).

SKIN CONTACT

Wash skin thoroughly with soap and water. Immediately remove contaminated clothing. Get medical attention if irritation persists after washing.

EYE CONTACT

Make sure to remove any contact lenses from the eyes before rinsing. Promptly wash eyes with plenty of water while lifting the eye lids. To hospital or eye specialist.

5 FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA

Use fire-extinguishing media appropriate for surrounding materials.

SPECIAL FIRE FIGHTING PROCEDURES

Cool containers exposed to flames with water until well after the fire is out. If risk of water pollution occurs, notify appropriate authorities.

UNUSUAL FIRE & EXPLOSION HAZARDS

No unusual fire or explosion hazards noted.

SPECIFIC HAZARDS

Oxides of: Carbon. Nitrogen. Sulphur.

PROTECTIVE MEASURES IN FIRE

Use air-supplied respirator during fire fighting. Wear full protective clothing.

6 ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS

Wear protective clothing as described in Section 8 of this safety data sheet. Avoid contact with skin and eyes.

ENVIRONMENTAL PRECAUTIONS

Do not discharge into drains, water courses or onto the ground. Contain spillages with sand, earth or any suitable adsorbent material.

SPILL CLEAN UP METHODS

Stop leak if possible without risk. Provide ventilation and confine spill. Do not allow runoff to sewer. Absorb in vermiculite, dry sand or earth and place into containers. Containers with collected spillage must be properly labelled with correct contents and hazard symbol.

7 HANDLING AND STORAGE

USAGE PRECAUTIONS

Avoid spilling, skin and eye contact. Provide good ventilation. Observe good chemical hygiene practices.

STORAGE PRECAUTIONS

Store in tightly closed original container in a dry, cool and well-ventilated place. Store above freezing.

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Fluorodye UC

Name	Std	TWA - 8 hrs		STEL - 15 min		Notes
ETHANEDIOL	WEL		10 mg/m3		104 mg/m3	Sk

WEL = Workplace Exposure Limit.
Sk = Can be absorbed through skin.

INGREDIENT COMMENTS

WEL = Workplace Exposure Limits

PROTECTIVE EQUIPMENT

ENGINEERING MEASURES

Provide adequate general and local exhaust ventilation.

RESPIRATORY EQUIPMENT

Respiratory protection not required.

HAND PROTECTION

Rubber or plastic. The most suitable glove must be chosen in consultation with the gloves supplier, who can inform about the breakthrough time of the glove material. Be aware that the liquid may penetrate the gloves. Frequent change is advisable.

EYE PROTECTION

Use approved safety goggles or face shield.

OTHER PROTECTION

Wear appropriate clothing to prevent any possibility of skin contact.

HYGIENE MEASURES

When using do not eat, drink or smoke. DO NOT SMOKE IN WORK AREA! Wash at the end of each work shift and before eating, smoking and using the toilet.

9 PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE	Liquid		
COLOUR	Dark Purple		
ODOUR	Acrid. Acetic acid		
SOLUBILITY	Miscible with water		
BOILING POINT (°C)	~ 100	**RELATIVE DENSITY**	1.052-1.082 @ 20C
VAPOUR PRESSURE	~ 15.7 mbar @ 20C	**pH-VALUE, DILUTED SOLUTION**	2.18-4.18
DECOMPOSITION TEMPERATURE (°C)	>200		

10 STABILITY AND REACTIVITY

STABILITY

Stable under normal temperature conditions and recommended use.

CONDITIONS TO AVOID

Avoid heat.

MATERIALS TO AVOID

Strong oxidising substances. Strong alkalis.

HAZARDOUS DECOMPOSITION PRODUCTS

Oxides of: Carbon. Nitrogen. Sulphur.

11 TOXICOLOGICAL INFORMATION

GENERAL INFORMATION

Prolonged and repeated contact with solvents over a long period may lead to permanent health problems.

INHALATION

Not relevant at normal room temperatures. When heated, toxic vapours may be formed.

INGESTION

May cause discomfort if swallowed.

SKIN CONTACT

Liquid may irritate skin.

EYE CONTACT

Spray and vapour in the eyes may cause irritation and smarting.

12 ECOLOGICAL INFORMATION

ECOTOXICITY

The product is not expected to be hazardous to the environment.

MOBILITY

The product is miscible with water. May spread in water systems.

BIOACCUMULATION

The product does not contain any substances expected to be bioaccumulating.

DEGRADABILITY

The product is biodegradable.

ACUTE FISH TOXICITY

Not considered toxic to fish.

13 DISPOSAL CONSIDERATIONS

GENERAL INFORMATION

Recover and reclaim or recycle, if practical.

DISPOSAL METHODS

Absorb in vermiculite or dry sand and dispose of at a licenced hazardous waste collection point. Dispose of waste and residues in accordance with local authority requirements.

WASTE CLASS

For this product, in accordance with the European Waste Catalogue (EWC), a catalogue number cannot be given because the customer has to lay down the purpose first. The catalogue number has to be given according to the local waste removal processes.

14 TRANSPORT INFORMATION

GENERAL	The product is not covered by international regulation on the transport of dangerous goods (IMDG, IATA, ADR/RID).

15 REGULATORY INFORMATION

UK REGULATORY REFERENCES

Approved Supply List.

EU DIRECTIVES

Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 with amendments.

STATUTORY INSTRUMENTS

The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 (S.I 2009 No. 716).

APPROVED CODE OF PRACTICE

Safety Data Sheets for Substances and Preparations.

GUIDANCE NOTES

Classification and Labelling of Substances and Preparations Dangerous for Supply.

16 OTHER INFORMATION

REVISION COMMENTS

NOTE: Lines within the margin indicate significant changes from the previous revision.

ISSUED BY

CES

REVISION DATE	22/11/2010
REV. NO./REPL. SDS GENERATED	8

RISK PHRASES IN FULL

R35	Causes severe burns.
R10	Flammable.
R22	Harmful if swallowed.
R36	Irritating to eyes.

HAZARD STATEMENTS IN FULL

H226	Flammable liquid and vapour.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage.
H319	Causes serious eye irritation.

DISCLAIMER

The information provided in this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process unless specified in the text.

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **GEM GP**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: GEM GP
Synonyms: None
Chemical Family: Glycol Ether
Application: Shale stabilizer

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Polyalkylene glycol		60 - 100%	Not Listed	Not applicable	Not applicable	Not applicable	Xi; R36

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Store away from acids. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Yellow to brown

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Mild
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.012
Density @ 20 C (kg/l):	1.012
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	126
Freezing Point/Range (C):	< -12**Max.** < -12
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	166
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	7.3
Partition Coefficient/n-Octanol/Water:	0.436
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers. Mineral acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

Aggravated Medical Conditions	Lung disorders. Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 66% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	EC50: 475 ppm (Abra alba)
Acute Crustaceans Toxicity:	TLM48: 310 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 391 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases
S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S46 If swallowed, seek medical advice immediately and show this container or label.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification
Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **GEM GP**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: GEM GP
Synonyms: None
Chemical Family: Glycol Ether
Application: Shale stabilizer

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Polyalkylene glycol		60 - 100%	Not Listed	Not applicable	Not applicable	Not applicable	Xi; R36

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Store away from acids. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Yellow to brown

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Mild
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.012
Density @ 20 C (kg/l):	1.012
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	126
Freezing Point/Range (C):	< -12**Max.** < -12
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	166
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	7.3
Partition Coefficient/n-Octanol/Water:	0.436
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers. Mineral acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

Aggravated Medical Conditions	Lung disorders. Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 66% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	EC50: 475 ppm (Abra alba)
Acute Crustaceans Toxicity:	TLM48: 310 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 391 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S46 If swallowed, seek medical advice immediately and show this container or label.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

Gravel Pack Fluid MSDS Baker

SAFETY DATA SHEET

BAKER CLEAN™ 6

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : BAKER CLEAN™ 6

Product code : 2709DF

Product type : Liquid. [Clear.]

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Cleaning agent

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720000
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : C; R35

Human health hazards : Causes severe burns.

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Skin Corr. 1A, H314

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

GHS05

Signal word : Danger

Hazard statements : Causes severe skin burns and eye damage.

Precautionary statements

Prevention : Wear protective gloves. Wear eye or face protection. Wear protective clothing.

SECTION 2: Hazards identification

Response : IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Immediately call a POISON CENTER or physician. IF IN EYES: Immediately call a POISON CENTER or physician.

Storage : Store locked up.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazardous ingredients : sodium hydroxide

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII Not applicable.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : Causes digestive tract burns.

SECTION 3: Composition/information on ingredients

3.1 / 3.2 Substance/mixture : Mixture

Product/ingredient name	Identifiers	%	Classification 67/548/EEC	Classification Regulation (EC) No. 1272/2008 [CLP]	Type
citric acid	EC: 201-069-1 CAS: 77-92-9	10 - 30	Xi; R36	Eye Irrit. 2, H319	[1]
sodium hydroxide	EC: 215-185-5 CAS: 1310-73-2 Index: 011-002-00-6	5 - 10	C; R35	Met. Corr. 1, H290 Skin Corr. 1A, H314	[1] [2]
			See Section 16 for the full text of the R-phrases declared above.	**See Section 16 for the full text of the H statements declared above.**	

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician.

Inhalation : Get medical attention immediately. Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Skin contact : Get medical attention immediately. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.

Skin contact : Causes severe burns.

Ingestion : May cause burns to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not ingest. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

7.2 Conditions for safe storage, including any incompatibilities

SECTION 7: Handling and storage

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Cleaning agent

Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
sodium hydroxide	**EH40/2005 WELs (United Kingdom (UK), 12/2011).** STEL: 2 mg/m³ 15 minutes.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Liquid. [Clear.]
Colour	:	Not available.
Odour	:	Odourless.
Odour threshold	:	Not available.
pH	:	7 to 9
Boiling point	:	>100°C (>212°F)
Melting point/freezing point	:	Not available.
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Closed cup: >100°C (>212°F)
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	1.1
Solubility	:	Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/water	:	Not available.
Viscosity	:	Kinematic (38°C):
Vapour density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	-10°C (14°F)

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Conditions of reactivity	:	Slightly flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.
Ingestion	:	May cause burns to mouth, throat and stomach.
Skin contact	:	Causes severe burns.
Eye contact	:	Causes serious eye damage.

SECTION 11: Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
citric acid	LD50 Oral	Rat	3 g/kg	-

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : No specific data.

Ingestion : Adverse symptoms may include the following:
stomach pains

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
citric acid	Acute LC50 160000 µg/l Marine water	Crustaceans - Carcinus maenas - Adult	48 hours
sodium hydroxide	Acute EC50 40.38 mg/l Fresh water	Crustaceans - Ceriodaphnia dubia - Neonate	48 hours
	Acute LC50 125 ppm Fresh water	Fish - Gambusia affinis - Adult	96 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
citric acid	-1.8	-	low

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : The classification of the product may meet the criteria for a hazardous waste.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	UN1824	SODIUM HYDROXIDE SOLUTION	8	II	
ADN Class	UN1824	SODIUM HYDROXIDE SOLUTION	8	II	
IMDG Class	UN1824	SODIUM HYDROXIDE SOLUTION	8	II	
IATA Class	UN1824	SODIUM HYDROXIDE SOLUTION	8	II	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	**UK Hazchem:** 2R
ADN Class	No.	-	-

SECTION 14: Transport information

IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Skin Corr. 1A, H314

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Skin Corr. 1A, H314	Calculation method

16.5 Full text of abbreviated H statements :

H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H319	Causes serious eye irritation.

SECTION 16: Other information

Full text of classifications [CLP/GHS]	: Eye Irrit. 2, H319	SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2
	Met. Corr. 1, H290	CORROSIVE TO METALS - Category 1
	Skin Corr. 1A, H314	SKIN CORROSION/IRRITATION - Category 1A
16.5 Full text of abbreviated R phrases	: R35- Causes severe burns.	
	R36- Irritating to eyes.	
Full text of classifications [DSD/DPD]	: C - Corrosive	
	Xi - Irritant	
16.6 Training advice	: Not available.	
16.7 Further information		
Date of issue/ Date of revision	: 23 July 2014	
Version	: 4	

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

SAFETY DATA SHEET

BIO-PAQ™

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : BIO-PAQ™
EC number :
CAS number : 9063-38-1
Product code : 1156DF
Product type : Powder.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Filtration Control Agent

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.
Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients : BIO-PAQ™

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : Fine dust clouds may form explosive mixtures with air. Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
Starch, carboxymethyl ether, sodium salt	CAS: 9063-38-1	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

SECTION 4: First aid measures

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use dry chemical powder.

Not suitable : Do not use water jet.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : Fine dust clouds may form explosive mixtures with air.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

warge spill : Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Avoid creating dusty conditions and prevent wind dispersal. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

SECTION 6: Accidental release measures

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : ***TO BE TRANSLATED***

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Recommended: No personal respiratory protective equipment normally required.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: nitrile or neoprene

SECTION [: Exposure controls/personal protection

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If operating conditions cause high dust concentrations to be produced, use dust goggles.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Solid. [Powder.]

Colour : Off-white.

Odour : Slight

Odour threshold : Not available.

pH : 9 to 10.5 [Conc. (% w/w): 4% - (H2O)]

Boiling point : Not available.

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Not available.

Explosive properties : Not available.

Explosion limits : Not available.

Oxidising properties : Not available.

Vapour pressure : Not available.

Density : 1.64 g/cm³

Relative density : Not available.

Solubility : Easily soluble in the following materials: cold water.

Partition coefficient: n-octanol/8 ater : Not available.

Viscosity : Not available.

Vapour density : Not available.

Evaporation rate (butyl acetate V 1) : Not available.

Decomposition temperature : Not available.

Auto-ignition temperature : Not available.

9.2 Other information

Pour point : Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

SECTION 10: Stability and reactivity

10.4 Conditions to avoid : Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Prevent dust accumulation.

10.5 Incompatible materials : Reactive or incompatible with the following materials: oxidizing materials.

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Ingestion : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Acute toxicity

General : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Ingestion : No specific data.

Skin contact : No specific data.

Eye contact : Adverse symptoms may include the following:
irritation
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.	NOT REGULATED	-	-	
IATA Class	Not regulated.	NOT REGULATED	-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

SECTION 14: Transport information

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : Not determined.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

SECTION 16: Other information

Date of issue/ Date of revision : 17 March 2014

Version : 2.01

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the company's kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

SAFETY DATA SHEET

Caustic Soda

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product name	:	Caustic Soda
EC number	:	215-185-5
CAS number	:	1310-73-2
Product code	:	6062DF
Product description	:	pH control
Product type	:	Solid.
Other means of identification	:	Not available.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Not available.

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Science & Technology Park,
Balgownie Road, Bridge of Don,
Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0203 318 0470
CHEMTREC Emergency Telephone outside UK: +44 203 318 0470

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Skin Corr. 1A, H314

Classification according to Directive 67/548/EEC [DSD]

C; R35

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

GHS05

Signal word : Danger

SECTION 2: Hazards identification

Hazard statements : Causes severe skin burns and eye damage.

Precautionary statements

Prevention : Wear protective gloves. Wear eye or face protection. Wear protective clothing.

Response : IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Immediately call a POISON CENTER or physician. IF IN EYES: Immediately call a POISON CENTER or physician.

Storage : Store locked up.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : No.
P: Not available. B: Not available. T: No.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : Not available.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/548/EEC	Regulation (EC) No. 1272/2008 [CLP]	
SODIUM HYDROXIDE	EC: 215-185-5 CAS: 1310-73-2 Index: 011-002-00-6	60 - 100	C; R35 **See Section 16 for the full text of the R-phrases declared above.**	Skin Corr. 1A, H314 **See Section 16 for the full text of the H statements declared above.**	[A]

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Type

[A] Constituent
[B] Impurity
[C] Stabilizing additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician.

Inhalation : Get medical attention immediately. Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Skin contact : Get medical attention immediately. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.

Skin contact : Causes severe burns.

Ingestion : May cause burns to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
metal oxide/oxides

5.3 Advice for firefighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not get in eyes or on skin or clothing. Do not ingest. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : pH control

SECTION 7: Handling and storage

Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
sodium hydroxide	**EH40/2005 WELs (United Kingdom (UK), 8/2007).** STEL: 2 mg/m³ 15 minute(s).

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Solid.

Color : White.

Odor : Odorless.

Odor threshold : Not available.

pH : 14 [Conc. (% w/w): 10% - (H2O)]

Boiling point : 1390°C (2534°F)

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

SECTION 9: Physical and chemical properties

Flash point	:	Closed cup: Not applicable.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidizing properties	:	Not available.
Vapor pressure	:	Not available.
Density	:	Not available.
Relative density	:	2.13 (20°C)
Solubility	:	Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/water	:	Not available.
Viscosity	:	Not available.
Vapor density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	Extremely reactive or incompatible with the following materials: acids.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.
Ingestion	:	May cause burns to mouth, throat and stomach.
Skin contact	:	Causes severe burns.
Eye contact	:	Causes serious eye damage.

Acute toxicity

General	:	No known significant effects or critical hazards.
Carcinogenicity	:	No known significant effects or critical hazards.
Mutagenicity	:	No known significant effects or critical hazards.
Teratogenicity	:	No known significant effects or critical hazards.
Developmental effects	:	No known significant effects or critical hazards.
Fertility effects	:	No known significant effects or critical hazards.
Inhalation	:	No specific data.
Ingestion	:	Adverse symptoms may include the following: stomach pains

SECTION 11: Toxicological information

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
sodium hydroxide	Acute EC50 40.38 mg/L Fresh water	Daphnia - Ceriodaphnia dubia - Neonate - <24 hours	48 hours
	Acute LC50 33000 to 100000 ug/L Marine water	Crustaceans - Crangon crangon - Adult	48 hours
	Acute LC50 125000 ug/L Fresh water	Fish - Gambusia affinis - Adult	96 hours
	Chronic NOEC 56 mg/L Marine water	Fish - Poecilia reticulata - Young - 3 to 4 weeks	96 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : No.
P: Not available. B: Not available. T: No.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : The classification of the product may meet the criteria for a hazardous waste.

Packaging

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

SECTION 13: Disposal considerations

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	UN 1823	Sodium hydroxide, solid	8	II	
ADN/ADNR Class	UN 1823	Sodium hydroxide, solid	8	II	
IMDG Class	UN 1823	Sodium hydroxide, solid	8	II	
IATA Class	UN 1823	Sodium hydroxide, solid	8	II	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	**UK Hazchem:** 2W
ADN/ADNR Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorization

Substances of very high concern

None of the components are listed.

SECTION 15: Regulatory information

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

◤ Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Skin Corr. 1A, H314

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Skin Corr. 1A, H314	Calculation method

16.5 Full text of abbreviated H statements : H314 Causes severe skin burns and eye damage.

Full text of classifications [CLP/GHS] : Skin Corr. 1A, H314 SKIN CORROSION/IRRITATION - Category 1A

16.5 Full text of abbreviated R phrases : R35- Causes severe burns.

Full text of classifications [DSD/DPD] : C - Corrosive

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 9 February 2012

Version : 1

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

SAFETY DATA SHEET

CI-27

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : CI-27

Product code : 488220-EH

Product type : Liquid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Acid corrosion inhibitor

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Badentoy Avenue, Badentoy Park
Portlethen, Aberdeen
Scotland, UK
AB12 4YB

Tel: +44 (0)1224-720000
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : MSDSPPcontacts@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : F; R11
T; R23/24/25, R39/23/24/25
Xi; R41, R38
R52/53

Physical/chemical hazards : Highly flammable.

Human health hazards : Toxic by inhalation, in contact with skin and if swallowed. Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed. Risk of serious damage to eyes. Irritating to skin.

Environmental hazards : Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Classification according to Regulation (EC) No. 1272/200L [CwP/8 HS]

Flam. Liq. 2, H225
Acute Tox. 3, H301
Acute Tox. 3, H311
Acute Tox. 3, H331
Skin Corr. 1B, H314
STOT SE 1, H370
Aquatic Acute 1, H400
Aquatic Chronic 3, H412

See Section 16 for the full text of the R phrases or H statements declared above.

SECTION 2: Hazards identification

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200L [CwP]

Hazard pictograms :

GHS02 GHS06 GHS05 GHS08 GHS09

Signal Gord : Danger

Hazard statements : Highly flammable liquid and vapour.
Toxic if swallowed, in contact with skin or if inhaled.
Causes severe skin burns and eye damage.
Causes damage to organs.
Very toxic to aquatic life.
Harmful to aquatic life with long lasting effects.

Precautionary statements

Prevention : Wear protective gloves: > 8 hours (breakthrough time): Nitrile gloves.. Wear eye or face protection: Recommended: Chemical splash goggles.. Wear protective clothing. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Avoid release to the environment. Do not breathe vapour.

Response : IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or physician. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Immediately call a POISON CENTER or physician. IF IN EYES: Immediately call a POISON CENTER or physician.

Storage : Keep cool.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazardous ingredients : methanol
Alcohols, C14-15, ethoxylated
prop-2-yn-1-ol

Supplemental label elements : Contains formaldehyde. May produce an allergic reaction.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII

Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII

Not applicable.
vP: Not available. vB: Not available.

Other hazards Ghich do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

Product/ingredient name	Identifiers	%	Classification: 67/54L/EEC	Classification: Regulation (EC) No. 1272/200L [CwP]	Type
methanol	REACH #: 01-2119433307-44 EC: 200-659-6 CAS: 67-56-1 Index: 603-001-00-X	30 - 60	F; R11 T; R23/24/25, R39/23/24/25	Flam. Liq. 2, H225 Acute Tox. 3, H301 Acute Tox. 3, H311 Acute Tox. 3, H331 STOT SE 1, H370	[1] [2]
Alcohols, C14-15, ethoxylated	CAS: 68951-67-7	10 - 30	Xn; R22 Xi; R41 N; R50	Acute Tox. 4, H302 Eye Dam. 1, H318 Aquatic Acute 1, H400	[1]
Thiourea, polymer with formaldehyde and 1-phenylethanone	CAS: 68527-49-1	10 - 30	Xn; R22 Xi; R41 N; R51/53	Acute Tox. 4, H302 Eye Dam. 1, H318 Aquatic Chronic 2, H411	[1]
prop-2-yn-1-ol	REACH #: 01-2119489016-35 EC: 203-471-2 CAS: 107-19-7 Index: 603-078-00-X	5 - 10	R10 T; R23/24/25 C; R34 N; R51/53	Flam. Liq. 3, H226 Acute Tox. 3, H301 Acute Tox. 2, H310 Acute Tox. 2, H330 Skin Corr. 1B, H314 Aquatic Chronic 2, H411	[1] [2]
hexadec-1-ene	REACH #: 01-2119474686-23 EC: 211-105-8 CAS: 629-73-2	1 - 5	Xn; R65 R66	Asp. Tox. 1, H304	[1]
			See Section 16 for the full text of the R-phrases declared above.	**See Section 16 for the full text of the H statements declared above.**	

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician.

SECTION 4: First aid measures

Inhalation : Get medical attention immediately. Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Get medical attention immediately. Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : Toxic if inhaled. May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Causes severe burns. Toxic in contact with skin.

Ingestion : Toxic if swallowed. May cause burns to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use dry chemical, CO_2, water spray (fog) or foam.

Not suitable : Do not use water jet.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : Highly flammable liquid. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Runoff to sewer may create fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides
sulfur oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

warge spill : Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use

SECTION 7: Handling and storage

away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s)

: Acid corrosion inhibitor

Not available.

SECTION L: Exposure controls/personal protection

L.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
methanol	**EH40/2005 WEws (United Kingdom (UK), 12/2011). Absorbed through skin.** STEL: 333 mg/m³ 15 minutes. STEL: 250 ppm 15 minutes. TWA: 266 mg/m³ 8 hours. TWA: 200 ppm 8 hours.
prop-2-yn-1-ol	**EH40/2005 WEws (United Kingdom (UK), 12/2011). Absorbed through skin.** STEL: 7 mg/m³ 15 minutes. STEL: 3 ppm 15 minutes. TWA: 2.3 mg/m³ 8 hours. TWA: 1 ppm 8 hours.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

L.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

SECTION L: Exposure controls/personal protection

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: half-face mask and organic vapour filter (Type A)

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: Nitrile gloves.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. Recommended: Chemical splash goggles.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

DNEws

Ingredient name	Exposure	DNEws	Population	Effects
methanol	Long term Inhalation	260 mg/m³	Workers	Systemic
	Short term Inhalation	260 mg/m³	Workers	Local
	Long term Inhalation	260 mg/m³	Workers	Local
	Short term Inhalation	260 mg/m³	Workers	Systemic
	Long term Dermal	40 mg/kg bw/day	Workers	Systemic
	Short term Dermal	40 mg/kg bw/day	Workers	Systemic
prop-2-yn-1-ol	Short term Dermal	3.3 mg/kg bw/day	Workers	Systemic
	Long term Dermal	0.83 mg/kg bw/day	Workers	Systemic
	Long term Inhalation	4.7 mg/m³	Workers	Local
	Short term Inhalation	9.4 mg/m³	Workers	Local
	Short term Inhalation	9.4 mg/m³	Workers	Systemic
	Long term Inhalation	4.7 mg/m³	Workers	Systemic

DEw Summary : Not available.

PNECs

Ingredient name	Compartment Detail	PNECs	Method Detail
methanol	Fresh water	154 mg/l	Assessment Factors
	Marine	15.4 mg/l	Assessment Factors
	Sewage Treatment Plant	100 mg/l	Assessment Factors
	Fresh water sediment	570.4 mg/kg	-
	Soil	23.5 mg/kg	-
prop-2-yn-1-ol	Fresh water	0.00153 mg/l	-
	Marine	0.000153 mg/l	-
	Fresh water sediment	0.00323 mg/l	-
	Marine water sediment	0.000323 mg/l	-
hexadec-1-ene	Fresh water	0.001 mg/l	-
	Marine	0.001 mg/l	-

SECTION L: Exposure controls/personal protection

Fresh water sediment	426.58 mg/kg	-
Marine water sediment	426.58 mg/kg	-
Soil	85.3 mg/kg	-

PEC Summary : Not available.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Liquid.

Colour : Amber.

Odour : Alcohol-like.

Odour threshold : Not available.

pH : 3.1

Boiling point : >=65°C (>=149°F)

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Closed cup: >9°C (>48.2°F)

Explosive properties : Not available.

Explosion limits : Not available.

Oxidising properties : Not available.

Vapour pressure : Not available.

Density : Not available.

Relative density : 0.93 (16°C)

Solubility : Not available.
Dispersible in water

Partition coefficient: n-octanol/Gater : Not available.

Viscosity : Not available.

Vapour density : Not available.

Evaporation rate (butyl acetate = 1) : Not available.

Decomposition temperature : Not available.

Auto-ignition temperature : Not available.

9.2 Other information

Pour point : Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

10.4 Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurise, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Avoid release to the environment.

10.5 Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : Toxic if inhaled. May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Ingestion : Toxic if swallowed. May cause burns to mouth, throat and stomach.

Skin contact : Causes severe burns. Toxic in contact with skin.

Eye contact : Causes serious eye damage.

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
methanol	LC50 Inhalation Vapour	Rat	128.2 mg/l	4 hours
	LD50 Dermal	Rabbit	17100 mg/kg	-
	LD50 Oral	Rat	>=2528 mg/kg	-
prop-2-yn-1-ol	LC50 Inhalation Gas.	Rat	1040 ppm	1 hours
	LD50 Dermal	Rabbit	88 mg/kg	-
	LD50 Oral	Rat	55 mg/kg	-
hexadec-1-ene	LC50 Inhalation Dusts and mists	Rat	>8.5 mg/l	1 hours
	LD50 Dermal	Rabbit	>2020 mg/kg	-
	LD50 Oral	Rat	10 g/kg	-

8 eneral : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : No specific data.

Ingestion : Adverse symptoms may include the following:
stomach pains

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

SECTION 12: Ecological information

12.1 Toxicity : Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
methanol	Acute EC50 10000 ppm Fresh water	Algae - Prorocentrum minimum	96 hours
	Acute EC50 >10000 mg/l Fresh water	Daphnia	48 hours
	Acute EC50 10000000 µg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 15400 mg/l Fresh water	Fish	96 hours
	Acute LC50 100 mg/l Fresh water	Fish - Pimephales promelas - Juvenile (Fledgling, Hatchling, Weanling)	96 hours
Alcohols, C14-15, ethoxylated	Acute EC50 0.22 mg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 1400 to 1700 µg/l Fresh water	Crustaceans - Gammarus sp.	48 hours
	Acute LC50 700 µg/l Fresh water	Fish - Pimephales promelas - Fry	96 hours
	Chronic NOEC 77 µg/l Fresh water	Daphnia - Daphnia magna - Neonate	21 days

SECTION 12: Ecological information

	Chronic NOEC 160 µg/l Fresh water	Fish - Pimephales promelas - Adult	30 days
hexadec-1-ene	Acute EC50 >1000 mg/l Fresh water	Algae	72 hours
	Acute EC50 >1000 mg/l Fresh water	Daphnia	48 hours
	Acute LC50 >1000 mg/l Fresh water	Fish	96 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
hexadec-1-ene	-	-	Not readily

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{oG}$	BCF	Potential
methanol	-0.77	<10	low
prop-2-yn-1-ol	-0.35	-	low
hexadec-1-ene	8.06	4.37	low

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.

P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.

vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous Gaste : The classification of the product may meet the criteria for a hazardous waste.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 P8 *	wabel
ADR/RID Class	UN3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S. (contains methanol & propargyl alcohol)	3 (6.1, 8)	II	
ADN Class	UN3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S. (contains methanol & propargyl alcohol)	3 (6.1, 8)	II	
IMD8 Class	UN3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S. (contains methanol & propargyl alcohol)	3 (6.1, 8)	II	
IATA Class	UN3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S. (contains methanol & propargyl alcohol)	3 (6.1, 8)	II	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	**Tunnel code** (D/E)	**UK Hazchem:** 3WE
ADN Class	No.	-	-
IMD8 Class	No.	-	-

SECTION 14: Transport information

IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7L and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : Not determined.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200L [CwP/8 HS]

Flam. Liq. 2, H225
Acute Tox. 3, H301
Acute Tox. 3, H311
Acute Tox. 3, H331
Skin Corr. 1B, H314
STOT SE 1, H370
Aquatic Acute 1, H400
Aquatic Chronic 3, H412

Procedure used to derive the classification according to Regulation (EC) No. 1272/200L [CwP/8 HS]

SECTION 16: Other information

Classification	Justification
Flam. Liq. 2, H225	On basis of test data
Acute Tox. 3, H301	Calculation method
Acute Tox. 3, H311	Calculation method
Acute Tox. 3, H331	Calculation method
Skin Corr. 1B, H314	Calculation method
STOT SE 1, H370	Calculation method
Aquatic Acute 1, H400	Calculation method
Aquatic Chronic 3, H412	Calculation method

16.5 Full text of abbreviated H statements :

H225 Highly flammable liquid and vapour.
H226 Flammable liquid and vapour.
H301 Toxic if swallowed.
H302 Harmful if swallowed.
H304 May be fatal if swallowed and enters airways.
H310 Fatal in contact with skin.
H311 Toxic in contact with skin.
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H330 Fatal if inhaled.
H331 Toxic if inhaled.
H370 Causes damage to organs.
H400 Very toxic to aquatic life.
H411 Toxic to aquatic life with long lasting effects.
H412 Harmful to aquatic life with long lasting effects.

Full text of classifications [CwP/8 HS] :

Acute Tox. 2, H310	ACUTE TOXICITY: SKIN - Category 2
Acute Tox. 2, H330	ACUTE TOXICITY: INHALATION - Category 2
Acute Tox. 3, H301	ACUTE TOXICITY: ORAL - Category 3
Acute Tox. 3, H311	ACUTE TOXICITY: SKIN - Category 3
Acute Tox. 3, H331	ACUTE TOXICITY: INHALATION - Category 3
Acute Tox. 4, H302	ACUTE TOXICITY: ORAL - Category 4
Aquatic Acute 1, H400	ACUTE AQUATIC HAZARD - Category 1
Aquatic Chronic 2, H411	LONG-TERM AQUATIC HAZARD - Category 2
Aquatic Chronic 3, H412	LONG-TERM AQUATIC HAZARD - Category 3
Asp. Tox. 1, H304	ASPIRATION HAZARD - Category 1
Eye Dam. 1, H318	SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1
Flam. Liq. 2, H225	FLAMMABLE LIQUIDS - Category 2
Flam. Liq. 3, H226	FLAMMABLE LIQUIDS - Category 3
Skin Corr. 1B, H314	SKIN CORROSION/IRRITATION - Category 1B
STOT SE 1, H370	SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) - Category 1

16.5 Full text of abbreviated R phrases :

R11- Highly flammable.
R10- Flammable.
R23/24/25- Toxic by inhalation, in contact with skin and if swallowed.
R39/23/24/25- Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.
R22- Harmful if swallowed.
R65- Harmful: may cause lung damage if swallowed.
R34- Causes burns.
R41- Risk of serious damage to eyes.
R38- Irritating to skin.
R66- Repeated exposure may cause skin dryness or cracking.
R50- Very toxic to aquatic organisms.
R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R52/53- Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

SECTION 16: Other information

Full text of classifications [DSD/DPD] : F - Highly flammable
T - Toxic
C - Corrosive
Xn - Harmful
Xi - Irritant
N - Dangerous for the environment

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 14 May 2014

Version : 3

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination Gith any other materials or in any process. Such information is, to the best of the company's knoGledge and belief, accurate and reliable as of the date indicated. HoGever, no Garranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his oGn particular use.

SAFETY DATA SHEET

GLACIAL ACETIC ACID

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of the substance or preparation

Product name : GLACIAL ACETIC ACID

Code : 10253088

Product type : Liquid.

Product description :

Use of the substance/preparation

Industrial
Professional

Company/undertaking identification

Supplier : Baker Petrolite,
Tofts Farm Industrial Estate,
Brenda Road,
Hartlepool,
Cleveland

Tel: +44 01429 279 831
Fax: +44 01429 861 634

e-mail address of person responsible for this SDS : paul.chapman2@bakerhughes.com

Emergency telephone number (with hours of operation) : UK Office:- +44 01429 279 831
CHEMTREC International:- +1 703 527 3887

2. HAZARDS IDENTIFICATION

The product is classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification according to Regulation (EC) 1907/2006 (REACH)

Classification : R10
C; R35

Physical/chemical hazards : Flammable.

Human health hazards : Causes severe burns.

Classification according to Regulation (EC) 1272/2008 (CLP)

Classification : FLAMMABLE LIQUIDS - Category 3
SKIN CORROSION/IRRITATION - Category 1A
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1

See section 11 for more detailed information on health effects and symptoms.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/preparation : Mono-constituent substance

Ingredient name	CAS number	%	Number	Classification
acetic acid ...% **See section 16 for the full text of the R-phrases declared above**	64-19-7	60 - 100	200-580-7	R10 [1] [2] C; R35

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

[1] Substance classified with a health or environmental hazard

[2] Substance with a workplace exposure limit

3. COMPOSITION/INFORMATION ON INGREDIENTS

[3] PBT-substance

[4] vPvB-substance

Occupational exposure limits, if available, are listed in section 8.

4. FIRST AID MEASURES

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Ingestion : Get medical attention immediately. Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Skin contact : Get medical attention immediately. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Chemical burns must be treated promptly by a physician.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

Notes to physician : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

See section 11 for more detailed information on health effects and symptoms.

5. FIRE-FIGHTING MEASURES

Suitable : Use dry chemical, CO_2, water spray (fog) or foam.

Not suitable : Do not use water jet.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe vapour or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see section 8).

Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

6. ACCIDENTAL RELEASE MEASURES

Large spill : Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7. HANDLING AND STORAGE

Handling : Put on appropriate personal protective equipment (see section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Packaging materials

Recommended : Use original container.

Specific uses :

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ingredient name	Occupational exposure limits
acetic acid ...%	**EU OEL (Europe, 4/2006). Notes: Indicative** Limit value: 10 ppm 8 hour(s). Limit value: 25 mg/m³ 8 hour(s).

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

Occupational exposure controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation.

9. PHYSICAL AND CHEMICAL PROPERTIES

General information

Appearance

Physical state : Liquid.

Colour : Colourless.

Odour : Acidic.

Important health, safety and environmental information

pH : <3

Flash point : Closed cup: 39°C (102.2°F) [Pensky-Martens.]

Relative density : 1.014 to 1.084 (20°C)

Solubility : Easily soluble in the following materials: cold water.

Viscosity : Kinematic (40°C): 1 cSt

10. STABILITY AND REACTIVITY

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurise, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Materials to avoid : Reactive or incompatible with the following materials:
oxidizing materials

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11. TOXICOLOGICAL INFORMATION

Toxicokinetics

Absorption : Not available.

Distribution : Contains material which may cause damage to the following organs: upper respiratory tract, skin, eye, lens or cornea, teeth.

Metabolism : Not available.

Elimination : Not available.

Potential acute health effects

Inhalation : May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system.

Ingestion : May cause burns to mouth, throat and stomach.

Skin contact : Severely corrosive to the skin. Causes severe burns.

Eye contact : Severely corrosive to the eyes. Causes severe burns.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
acetic acid ...%	LD50 Oral	Rat	3310 mg/kg	-

Conclusion/Summary : Not available.

Potential chronic health effects

Chronic toxicity

Conclusion/Summary : Not available.

Irritation/Corrosion

Conclusion/Summary : Not available.

Sensitiser

Conclusion/Summary : Not available.

Carcinogenicity

Conclusion/Summary : Not available.

Mutagenicity

Conclusion/Summary : Not available.

Teratogenicity

Conclusion/Summary : Not available.

Reproductive toxicity

Conclusion/Summary : Not available.

Chronic effects : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : No specific data.

Ingestion : Adverse symptoms may include the following: stomach pains Irritation to digestive system

Skin : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Eyes : Adverse symptoms may include the following:
pain
watering
redness

12. ECOLOGICAL INFORMATION

Ecotoxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
acetic acid ...%	Acute EC50 65000 ug/L Fresh water	Daphnia - Daphnia magna - Neonate - <24 hours	48 hours
	Acute LC50 50.1 ul/L Marine water	Crustaceans - Artemia sp.	48 hours
	Acute LC50 75000 ug/L Fresh water	Fish - Lepomis macrochirus - 5.3 to 7.2 cm - 3.5 to 3.9 g	96 hours

Conclusion/Summary : Not available.

Persistence/degradability

Conclusion/Summary : Not available.

Other adverse effects : No known significant effects or critical hazards.

PBT : No.
P: Not available. B: Not available. T: No.

12. ECOLOGICAL INFORMATION

vPvB : Not available.

13. DISPOSAL CONSIDERATIONS

Methods of disposal : Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : The classification of the product may meet the criteria for a hazardous waste.

14. TRANSPORT INFORMATION

International transport regulations

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
ADR/RID Class	UN2789	ACETIC ACID, GLACIAL	3 (8)	II		-
ADN/ADNR Class	UN2789	ACETIC ACID, GLACIAL	3 (8)	II		-
IMDG Class	UN2789	ACETIC ACID, GLACIAL	3 (8)	II		-
IATA Class	UN2789	ACETIC ACID, GLACIAL	3 (8)	II		-

PG* : Packing group

15. REGULATORY INFORMATION

Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

EU regulations

Classification and labeling have been determined according to EU Directives 67/548/EEC and 1999/45/EC (including amendments) and take into account the intended product use.

15. REGULATORY INFORMATION

Hazard symbol or symbols :

Corrosive

Risk phrases : R10- Flammable.
R35- Causes severe burns.

Safety phrases : S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/37/39- Wear suitable protective clothing, gloves and eye/face protection.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

Contains : acetic acid

Classification and labeling according to Regulation (EC) 1272/2008 (CLP)

Classification and labeling have been determined according to Regulation (EC) 1272/2008 (including amendments) and take into account the intended product use.

Signal word : Danger

Hazard statements : Flammable liquid and vapour.
Causes severe skin burns and eye damage.

Precautionary statements

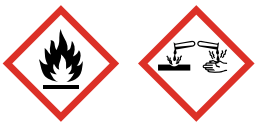
Prevention : Wear protective gloves. Wear eye/face protection. Wear protective clothing. Keep away from ignition sources such as heat/sparks/open flame. - No smoking. Use explosion-proof electrical/ventilating/lighting/material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Wash thoroughly after handling.

Response : Immediately call a POISON CENTER or doctor/physician. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.

Storage : Store locked up. Store in cool/well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazard symbol or symbols :



Product use : Industrial applications, Professional applications.

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

16. OTHER INFORMATION

Full text of R-phrases referred to in sections 2 and 3 - United Kingdom (UK) : R10- Flammable.
R35- Causes severe burns.

Full text of classifications referred to in sections 2 and 3 - United Kingdom (UK) : C - Corrosive

Restrictions on use

None identified.

History

Date of issue/Date of revision : 6/8/2010.

16. OTHER INFORMATION

Date of printing	:	6/8/2010.
Date of issue/ Date of revision	:	6/8/2010.
Date of previous issue	:	No previous validation.
Version	:	1

Indicates information that has changed from previously issued version.

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

Annex

SAFETY DATA SHEET

Magnesium Oxide

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Magnesium Oxide
EC number : 215-171-9
CAS number : 1309-48-4
Product code : 1080DF
Product type : Solid. [Crystalline solid.]

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : pH control

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.
Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients : Magnesium Oxide

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
magnesium oxide	EC: 215-171-9 CAS: 1309-48-4	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type

[A] Constituent
[B] Impurity
[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

SECTION 4: First aid measures

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor.

warge spill : Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : pH control

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
magnesium oxide	**EH40/2005 WEws (United Kingdom (UK), 12/2011).** TWA: 10 mg/m³, (as Mg) 8 hours. Form: inhalable dust TWA: 4 mg/m³, (as Mg) 8 hours. Form: respirable dust and fume

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

SECTION [: Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Solid. [Crystalline solid.]

Colour : White.

Odour : Odourless.

Odour threshold : Not available.

pH : 10 [Conc. (% w/w): 10% - (H2O)]

Boiling point : 360°C (680°F)

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Not available.

Explosive properties : Not available.

Explosion limits : Not available.

Oxidising properties : Not available.

Vapour pressure : Not available.

Density : 3.58 g/cm³ [20°C]

Relative density : Not available.

Solubility : Soluble in the following materials: cold water.

Partition coefficient: n-octanol/8 ater : Not available.

Viscosity : Not available.

Vapour density : Not available.

Evaporation rate (butyl acetate = 1) : Not available.

Decomposition temperature : Not available.

Auto-ignition temperature : Not available.

9.2 Other information

Pour point : Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

10.4 Conditions to avoid : No specific data.

10.5 Incompatible materials : No specific data.

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Eye contact : No known significant effects or critical hazards.

Acute toxicity

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.
Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

SECTION 13: Disposal considerations

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

SECTION 15: Regulatory information

Europe inventory : All components are listed or exempted.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	' ustification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 4 April 2014

Version : 2

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the companyJs kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the userJs responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

SAFETY DATA SHEET

MAX-GUARD™

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : MAX-GUARD™

Product code : 1737DF

Product type : Liquid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Shale Control Addtive

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : Xi; R36/37/38

Human health hazards : Irritating to eyes, respiratory system and skin.

Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Skin Irrit. 2, H315
Eye Irrit. 2, H319
STOT SE 3, H335

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Dangerous Preparations Directive [1999/45/EC]

Hazard symbol or symbols :

Indication of danger : Irritant

Risk phrases : R36/37/38- Irritating to eyes, respiratory system and skin.

Safety phrases : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients :

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII Not applicable.
vP: Not available. vB: Not available.

Other hazards Ghich do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

Product/ingredient name	Identifiers	%	Classification: 67/54wEEC	Classification: Regulation (EC) No. 1272/200w[CLP]	Type
N-(2-hydroxyethyl) ethylenediaminetriacetic acid	EC: 205-759-3 CAS: 150-39-0	5 - 10	Xi; R36/37/38	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	[1]
3,6,9,12-tetrakis (carboxymethyl)-3,6,9, 12-tetraazatetradecanedioic acid	EC: 212-790-6 CAS: 869-52-3	5 - 10	Not classified.	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	[1]
N-carboxymethyliminobis (ethylenenitrilo)tetra (acetic acid)	EC: 200-652-8 CAS: 67-43-6	1 - 5	Xi; R36/37/38	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	[1]
hexamethylenediaminetetraacetic acid	EC: 216-642-1 CAS: 1633-00-7	1 - 5	Xi; R36/37/38	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	[1]
			See Section 16 for the full text of the R-phrases declared above.	**See Section 16 for the full text of the H statements declared above.**	

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Continue to rinse for at least 15 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Irritating to eyes.

Inhalation : Irritating to respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Irritating to skin.

Ingestion : Irritating to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

SECTION 5: Firefighting measures

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also Section 8 for additional information on hygiene measures.

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapour or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Shale Control Addtive
Not available.

SECTION w: Exposure controls/personal protection

w.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

w.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: organic vapour filter (Type A)

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: nitrile or neoprene

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Liquid.
Colour	:	Amber. [Dark]
Odour	:	Mild.
Odour threshold	:	Not available.
pH	:	6.8 to 7.2 [Conc. (% w/w): 2% - (H2O)]
Boiling point	:	Not available.
Melting point/freezing point	:	Not available.
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Closed cup: >93°C (>199.4°F) [PMCC]
Explosive properties	:	Not available.
Explosion limits	:	Not available.

SECTION 9: Physical and chemical properties

Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	1.07 to 1.09
Solubility	:	Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/Gater	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate V 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	Irritating to respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
Ingestion	:	Irritating to mouth, throat and stomach.
Skin contact	:	Irritating to skin.
Eye contact	:	Irritating to eyes.

Acute toxicity

8 eneral	:	No known significant effects or critical hazards.
Carcinogenicity	:	No known significant effects or critical hazards.
Mutagenicity	:	No known significant effects or critical hazards.
Teratogenicity	:	No known significant effects or critical hazards.
Developmental effects	:	No known significant effects or critical hazards.
Fertility effects	:	No known significant effects or critical hazards.
Inhalation	:	Adverse symptoms may include the following: respiratory tract irritation coughing
Ingestion	:	No specific data.
Skin contact	:	Adverse symptoms may include the following: irritation redness

SECTION 11: Toxicological information

Eye contact : Adverse symptoms may include the following:
irritation
watering
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
N-(2-hydroxyethyl) ethylenediaminetriacetic acid	Acute LC50 808000 µg/l Fresh water	Fish - Lepomis macrochirus	96 hours
N-carboxymethyliminobis (ethylenenitrilo)tetra(acetic acid)	Acute LC50 245000 µg/l Fresh water	Daphnia - Daphnia carinata - Neonate	48 hours
	Chronic NOEC 10000 µg/l Fresh water	Fish - Melanotaenia fluviatilis - Adult	28 days

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{oG}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous Gaste : The classification of the product may meet the criteria for a hazardous waste.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

SECTION 13: Disposal considerations

Special precautions : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 P8 *	Label
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMD8 Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMD8 Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/7wand the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : Not determined.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

SECTION 15: Regulatory information

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Skin Irrit. 2, H315
Eye Irrit. 2, H319
STOT SE 3, H335

Procedure used to derive the classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Classification	' ustification
Skin Irrit. 2, H315	Expert judgment
Eye Irrit. 2, H319	Expert judgment
STOT SE 3, H335	Expert judgment

16.5 Full text of abbreviated H statements :
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.

Full text of classifications [CLP/8 HS] :
Eye Irrit. 2, H319 SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2
Skin Irrit. 2, H315 SKIN CORROSION/IRRITATION - Category 2
STOT SE 3, H335 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) [Respiratory tract irritation] - Category 3

16.5 Full text of abbreviated R phrases : R36/37/38- Irritating to eyes, respiratory system and skin.

Full text of classifications [DSD/DPD] : Xi - Irritant

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 27 January 2014

Version : 3

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination Gith any other materials or in any process. Such information is, to the best of the companyJs knoGledge and belief, accurate and reliable as of the date indicated. HoGever, no Garranty guarantee or representation is made to its accuracy, reliability or completeness. It is the userJs responsibility to satisfy himself as to the suitability of such information for his oGn particular use.

SAFETY DATA SHEET

Mudzyme S/X

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Mudzyme S/X

Product code : 398291

Product type : Liquid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Specialty treatment

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Badentoy Avenue, Badentoy Park
Portlethen, Aberdeen
Scotland, UK
AB12 4YB

e-mail address of person responsible for this SDS : MSDSPPcontacts@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : Not classified.

Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Dangerous Preparations Directive [1999/45/EC]

Hazard symbol or symbols :

Indication of danger :

Risk phrases : This product is not classified according to EU legislation.

Safety phrases : Not applicable.

Hazardous ingredients :

Supplemental label elements : Contains cellulase, amylase, α-. May produce an allergic reaction. Safety data sheet available for professional user on request.

2.3 Other hazards

SECTION 2: Hazards identification

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII — Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII — Not applicable.
vP: Not available. vB: Not available.

Other hazards Ghich do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

Product/ingredient name	Identifiers	%	Classification 67/54wEEC	Classification Regulation (EC) No. 1272/200w[CLP]	Type
cellulase	EC: 232-734-4 CAS: 9012-54-8 Index: 647-002-00-3	5 - 10	R42	Resp. Sens. 1, H334	[1]
amylase, α-	EC: 232-565-6 CAS: 9000-90-2 Index: 647-015-00-4	0.1 - 1	R42	Resp. Sens. 1, H334	[1]
			See Section 16 for the full text of the R-phrases declared above.	**See Section 16 for the full text of the H statements declared above.**	

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

SECTION 4: First aid measures

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
halogenated compounds
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also Section 8 for additional information on hygiene measures.

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Specialty treatment

Not available.

SECTION w. Exposure controls/personal protection

w.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

w.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: No personal respiratory protective equipment normally required.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: Rubber gloves.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

SECTION w: Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Liquid.

Colour : Brown.

Odour : Unpleasant. Pungent.

Odour threshold : Not available.

pH : 4 to 5

Boiling point : 100°C (212°F)

Melting point/freezing point : 0°C (32°F)

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Not available.

Explosive properties : Not available.

Explosion limits : Not available.

Oxidising properties : Not available.

Vapour pressure : Not available.

Density : Not available.

Relative density : 1.01

Solubility : Partially soluble in the following materials: cold water and hot water.

Partition coefficient: n-octanol/Gater : Not available.

Viscosity : Not available.

Vapour density : Not available.

Evaporation rate (butyl acetate V 1) : Not available.

Decomposition temperature : Not available.

Auto-ignition temperature : Not available.

9.2 Other information

Pour point : Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

10.4 Conditions to avoid : No specific data.

10.5 Incompatible materials : No specific data.

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Eye contact : No known significant effects or critical hazards.

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
amylase, α-	LD50 Oral	Rat	>7500 mg/kg	-

8 eneral : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
cellulase	Acute EC50 793.28 mg/l Fresh water	Crustaceans - Ceriodaphnia dubia - Neonate	48 hours
amylase, α-	Acute EC50 3865 mg/l Fresh water	Crustaceans - Ceriodaphnia dubia - Neonate	48 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{oG}$	BCF	Potential

Not available.

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

SECTION 13: Disposal considerations

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous Gaste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 P8 *	Label
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMD8 Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMD8 Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/7wand the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Full text of classifications [CLP/8 HS] : Resp. Sens. 1, H334 RESPIRATORY SENSITIZATION - Category 1

16.5 Full text of abbreviated R phrases : R42- May cause sensitisation by inhalation.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 19 August 2013

Version : 1.01

Notice to reader

SECTION 16: Other information

This information relates only to the specific material designated and may not be valid for such material used in combination Gith any other materials or in any process. Such information is, to the best of the company's knoGledge and belief, accurate and reliable as of the date indicated. HoGever, no Garranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his oGn particular use.

SAFETY DATA SHEET

MUL-FREE™ RS

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : MUL-FREE™ RS

Product code : 2027DF

Product type : Liquid. [Clear.]

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Non-Emulsifier

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720000
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : Not classified.

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

Hazard pictograms not applicable

Signal word : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.

Response : Not applicable.

Storage : Not applicable.

Disposal : Not applicable.

Hazardous ingredients :

SECTION 2: Hazards identification

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 4: First aid measures

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : No specific data.

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Non-Emulsifier

SECTION 7: Handling and storage

Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Recommended: No personal respiratory protective equipment normally required.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: nitrile or neoprene

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Liquid. [Clear.]

Colour : Amber.

Odour : Not available.

Odour threshold : Not available.

pH : Not available.

Boiling point : Not available.

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Closed cup: >230°C (>446°F) [Tagliabue.]

SECTION 9: Physical and chemical properties

Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	1.073 (20°C)
Solubility	:	Insoluble in the following materials: cold water.
Partition coefficient: n-octanol/water	:	Not available.
Viscosity	:	Kinematic (40°C): 700 to 900 cSt
Vapour density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	-21°C (-5.8°F)

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	No known significant effects or critical hazards.
Ingestion	:	No known significant effects or critical hazards.
Skin contact	:	No known significant effects or critical hazards.
Eye contact	:	No known significant effects or critical hazards.

Acute toxicity

General	:	No known significant effects or critical hazards.
Carcinogenicity	:	No known significant effects or critical hazards.
Mutagenicity	:	No known significant effects or critical hazards.
Teratogenicity	:	No known significant effects or critical hazards.
Developmental effects	:	No known significant effects or critical hazards.
Fertility effects	:	No known significant effects or critical hazards.
Inhalation	:	No specific data.
Ingestion	:	No specific data.
Skin contact	:	No specific data.
Eye contact	:	No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	

SECTION 14: Transport information

IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

SECTION 16: Other information

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications [CLP/GHS] : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 23 April 2014

Version : 2

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

SAFETY DATA SHEET

Sodium Acetate

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Sodium Acetate
EC number : 204-823-8
CAS number : 127-09-3
Product code : 100130
Product type : Solid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Buffer

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Badentoy Avenue, Badentoy Park
Portlethen, Aberdeen
Scotland, UK
AB12 4YB

e-mail address of person responsible for this SDS : MSDSPPcontacts@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients : Sodium Acetate

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
sodium acetate	EC: 204-823-8 CAS: 127-09-3	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type

[A] Constituent
[B] Impurity
[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

SECTION 4: First aid measures

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor.

warge spill : Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Buffer

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Chemical-resistant gloves: plastic or Rubber gloves.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

SECTION [: Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Solid. [Crystals.]
Colour	:	White.
Odour	:	Odourless.
Odour threshold	:	Not available.
pH	:	7.5 to 9.2
Boiling point	:	Not available.
Melting point/freezing point	:	324°C (615.2°F)
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Not available.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	Not available.
Solubility	:	Not available.
Partition coefficient: n-octanol/8 ater	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate V 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Conditions of reactivity	:	Non-flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	Reactive or incompatible with the following materials: oxidizing materials.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Eye contact : No known significant effects or critical hazards.

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
sodium acetate	LD50 Oral	Rat	3530 mg/kg	-

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
sodium acetate	Acute LC50 >1000 mg/l Fresh water	Fish - Lepomis macrochirus	96 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential
sodium acetate	-3.72	-	low

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

SECTION 13: Disposal considerations

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.	-	-	-	
ADN Class	Not regulated.	-	-	-	
IMDG Class	Not regulated.	-	-	-	
IATA Class	Not regulated.	-	-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 3 March 2014

Wersion : 1

Notice to reader

SECTION 16: Other information

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the company's kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

SAFETY DATA SHEET

Sodium Bromide

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Sodium Bromide
EC number : 231-599-9
CAS number : 7647-15-6
Product code : 5049DF
Product type : Solid. [Crystalline powder.]

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Brine component

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients : Sodium Bromide

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : Fine dust clouds may form explosive mixtures with air. Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
sodium bromide	EC: 231-599-9 CAS: 7647-15-6	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type
[A] Constituent
[B] Impurity
[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

SECTION 4: First aid measures

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use dry chemical powder.

Not suitable : Do not use water jet.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : Fine dust clouds may form explosive mixtures with air.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
halogenated compounds
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

SECTION 6: Accidental release measures

warge spill : Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Avoid creating dusty conditions and prevent wind dispersal. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Brine component

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Use explosion-proof ventilation equipment.

SECTION [: Exposure controls/personal protection

Hygiene measures	:	Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Respiratory protection	:	Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
Hand protection	:	Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
Eye protection	:	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If operating conditions cause high dust concentrations to be produced, use dust goggles.
Skin protection	:	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Environmental exposure controls	:	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Solid. [Crystalline powder.]
Colour	:	White.
Odour	:	Odourless.
Odour threshold	:	Not available.
pH	:	5 to 8.8 [Conc. (% w/w): 5% - (H2O)]
Boiling point	:	1390°C (2534°F)
Melting point/freezing point	:	755°C (1391°F)
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Not available.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	3.2 (20°C)
Solubility	:	Soluble in the following materials: cold water.
Partition coefficient: n-octanol/8 ater	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate V 1)	:	Not available.
Decomposition temperature	:	800°C (1472°F)
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 9: Physical and chemical properties

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

10.4 Conditions to avoid : Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Prevent dust accumulation.

10.5 Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Ingestion : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
sodium bromide	LD50 Oral	Rat	2500 mg/kg	-

General : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Ingestion : No specific data.

Skin contact : No specific data.

Eye contact : Adverse symptoms may include the following:
irritation
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential

SECTION 12: Ecological information

Not available.

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.

P: Not available. B: Not available. T: Not available.

vPvB : Not available.

vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

SECTION 14: Transport information

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

SECTION 16: Other information

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	' ustification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 8 April 2014

Version : 1

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the companyJs kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the userJs responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

SAFETY DATA SHEET

Sodium Chloride

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Sodium Chloride
EC number : 231-598-3
CAS number : 7647-14-5
Product code : 777699
Product type : Solid. [Crystals. Powder.]

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Multipurpose

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Badentoy Avenue, Badentoy Park
Portlethen, Aberdeen
Scotland, UK
AB12 4YB

Tel: +44 (0)1224-720000
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : MSDSPPcontacts@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.

Response : Not applicable.

Storage : Not applicable.

SECTION 2: Hazards identification

Disposal : Not applicable.

Hazardous ingredients : Sodium Chloride

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
sodium chloride	EC: 231-598-3 CAS: 7647-14-5	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type

[A] Constituent
[B] Impurity
[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

SECTION 4: First aid measures

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
halogenated compounds
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Dispose of via a licensed waste disposal contractor.

SECTION 6: Accidental release measures

warge spill : Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Avoid creating dusty conditions and prevent wind dispersal. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Avoid breathing dust.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Multipurpose

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

SECTION [: Exposure controls/personal protection

Eye protection	:	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If operating conditions cause high dust concentrations to be produced, use dust goggles.
Skin protection	:	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Environmental exposure controls	:	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Solid. [Crystals. Powder.]
Colour	:	White.
Odour	:	Odourless.
Odour threshold	:	Not available.
pH	:	6.7 to 7.3 [Conc. (% w/w): 1% - (H2O)]
Boiling point	:	Not available.
Melting point/freezing point	:	Not available.
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Not available.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	2.15 to 2.2 (20°C)
Solubility	:	Soluble in the following materials: cold water.
Partition coefficient: n-octanol/8 ater	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate V 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.

SECTION 10: Stability and reactivity

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Ingestion : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Acute toxicity

General : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Ingestion : No specific data.

Skin contact : No specific data.

Eye contact : Adverse symptoms may include the following:
irritation
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.	-	-	-	
ADN Class	Not regulated.	-	-	-	
IMDG Class	Not regulated.	-	-	-	
IATA Class	Not regulated.	-	-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

SECTION 14: Transport information

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

SECTION 16: Other information

Date of issue/ Date of revision : 26 June 2014

Version : 2

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the company's kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

SAFETY DATA SHEET

Sodium Chloride - Sodium Bromide Brine

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : Sodium Chloride - Sodium Bromide Brine

Product code : 7125DF

Product type : Liquid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Workover and Completion Brine

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : Not classified.

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

Hazard pictograms not applicable

Signal word : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.

Response : Not applicable.

Storage : Not applicable.

Disposal : Not applicable.

Hazardous ingredients :

SECTION 2: Hazards identification

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not applicable.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

SECTION 4: First aid measures

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
halogenated compounds
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

SECTION 7: Handling and storage

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Workover and Completion Brine

Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Liquid.
Colour	:	Clear. Colourless.
Odour	:	Odourless.
Odour threshold	:	Not available.
pH	:	5.5 to 8.5 [Conc. (% w/w): 5% - (H2O)]
Boiling point	:	Not available.
Melting point/freezing point	:	Not available.
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Not available.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	1.01 to 1.53 (20°C)
Solubility	:	Not available.
Partition coefficient: n-octanol/water	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	No known significant effects or critical hazards.
Ingestion	:	No known significant effects or critical hazards.
Skin contact	:	No known significant effects or critical hazards.
Eye contact	:	No known significant effects or critical hazards.

Acute toxicity

General	:	No known significant effects or critical hazards.

SECTION 11: Toxicological information

Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.
Conclusion/Summary : Not available.

12.2 Persistence and degradability
Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment
PBT : Not applicable.
P: Not available. B: Not available. T: Not available.
vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 13: Disposal considerations

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.
Ship type : Not available.
Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.
Black List Chemicals : Not listed
Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 15: Regulatory information

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications [CLP/GHS] : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 8 April 2014

Version : 4

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

SAFETY DATA SHEET

SUPER-SWEEP

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product name : SUPER-SWEEP
EC number :
CAS number : 9003-07-0
Product code : 1368DF
Product description : Lost Circulation Material
Product type : Solid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Not available.

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Science & Technology Park,
Balgownie Road, Bridge of Don,
Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0203 318 0470
CHEMTREC Emergency Telephone outside UK: +44 203 318 0470

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Classification according to Directive 67/548/EEC [DSD]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

Signal word : No signal word.
Hazard statements : No known significant effects or critical hazards.
Precautionary statements
Prevention : Not applicable.
Response : Not applicable.

SECTION 2: Hazards identification

Storage : Not applicable.

Disposal : Not applicable.

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1207/2006, Annex XIII Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1207/2006, Annex XIII Not available.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : Not available.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/548/EEC	Regulation (EC) No. 1272/2008 [CLP]	
Propene polymers	CAS: 9003-07-0	60 - 100	Not classified.	Not classified.	[A]

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Type

[A] Constituent
[B] Impurity
[C] Stabilizing additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

SECTION 4: First aid measures

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

5.3 Advice for firefighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Lost Circulation Material
Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Solid.
Color	:	White.
Odor	:	Odorless.
Odor threshold	:	Not available.
pH	:	Not available.
Boiling point	:	Not available.
Melting point/freezing point	:	162 to 168°C (323.6 to 334.4°F)
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Not available.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidizing properties	:	Not available.
Vapor pressure	:	Not available.
Density	:	Not available.
Relative density	:	0.91
Solubility	:	Insoluble in the following materials: cold water.
Partition coefficient: n-octanol/water	:	Not available.
Viscosity	:	Not available.
Vapor density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	No known significant effects or critical hazards.
Ingestion	:	No known significant effects or critical hazards.
Skin contact	:	No known significant effects or critical hazards.
Eye contact	:	No known significant effects or critical hazards.

Acute toxicity

SECTION 11: Toxicological information

Product/ingredient name	Result	Species	Dose	Exposure
Propene polymers	LD50 Oral	Rat	>8 g/kg	-

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.
Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

SECTION 13: Disposal considerations

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	Not regulated.		-	-	
ADN/ADNR Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN/ADNR Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorization

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : Not determined.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

SECTION 15: Regulatory information

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

◤ Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications [CLP/GHS] : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 21 July 2011

Version : 1

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

SAFETY DATA SHEET

XAN-PLEX™ D

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : XAN-PLEX™ D
EC number : 234-394-2
CAS number : 11138-66-2
Product code : 1171DF
Product type : Powder.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Viscosifier

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

Classification according to Directive 67/54[/EEC]DSDL

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 wabel elements

Regulation (EC) No. 1272/200[ ]CwPL

Hazard pictograms :

Hazard pictograms not applicable

Signal 8 ord : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Hazardous ingredients : XAN-PLEX™ D

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards 8 hich do not result in classification : Fine dust clouds may form explosive mixtures with air. Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Product/ingredient name	Identifiers	%	Classification		Type
			67/54[/EEC	Regulation (EC) No. 1272/200[ ]CwPL	
Xanthan gum	EC: 234-394-2 CAS: 11138-66-2	60 - 100	Not classified.	Not classified.	[A]

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.

Type
[A] Constituent
[B] Impurity
[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

SECTION 4: First aid measures

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use dry chemical powder.

Not suitable : Do not use water jet.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : Fine dust clouds may form explosive mixtures with air.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : No specific data.

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labelled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

SECTION 6: Accidental release measures

warge spill : Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labelled waste container. Avoid creating dusty conditions and prevent wind dispersal. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Viscosifier

Not available.

SECTION [: Exposure controls/personal protection

[.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

[.2 Exposure controls

Occupational exposure controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Use explosion-proof ventilation equipment.

SECTION [: Exposure controls/personal protection

Hygiene measures	:	Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Respiratory protection	:	Recommended: No personal respiratory protective equipment normally required.
Hand protection	:	Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Chemical-resistant gloves: nitrile or neoprene
Eye protection	:	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If operating conditions cause high dust concentrations to be produced, use dust goggles.
Skin protection	:	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Environmental exposure controls	:	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Solid. [Powder.]
Colour	:	White. to Tan.
Odour	:	Faint odour.
Odour threshold	:	Not available.
pH	:	7 [Conc. (% w/w): 5% - (H_2O)]
Boiling point	:	>200°C (>392°F)
Melting point/freezing point	:	Not available.
Flammability (solid, gas)	:	May be combustible at high temperature.
Flash point	:	Closed cup: Not applicable.
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	1.55 g/cm³
Relative density	:	Not available.
Solubility	:	Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/8 ater	:	Not available.
Viscosity	:	Not available.
Vapour density	:	Not available.
Evaporation rate (butyl acetate V 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.

10.2 Chemical stability : The product is stable.

10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

10.4 Conditions to avoid : Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Prevent dust accumulation.

10.5 Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials

10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Ingestion : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Eye contact : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the eyes.

Acute toxicity

General : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Ingestion : No specific data.

Skin contact : No specific data.

Eye contact : Adverse symptoms may include the following:
irritation
redness

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
Xanthan gum	Acute LC50 420000 µg/l Fresh water	Fish - Oncorhynchus mykiss	96 hours

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$wogP_{o8}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

SECTION 12: Ecological information

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 = aste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous 8 aste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	wabel
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

SECTION 14: Transport information

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOw73/7[and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIW- wist of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XWI - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black wist Chemicals : Not listed

Priority wist Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

◤ Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Not classified.

SECTION 16: Other information

Procedure used to derive the classification according to Regulation (EC) No. 1272/200[ ]CwP/GHSL

Classification	' ustification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications]CwP/GHSL : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications]DSD/DPDL : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 17 March 2014

Version : 1.05

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination 8 ith any other materials or in any process. Such information is, to the best of the companyJs kno8 ledge and belief, accurate and reliable as of the date indicated. Ho8 ever, no 8 arranty guarantee or representation is made to its accuracy, reliability or completeness. It is the userJs responsibility to satisfy himself as to the suitability of such information for his o8 n particular use.

Material Safety Data Sheet

1 . Product and company identification

Product name	:	X-CIDE™ 207 INDUSTRIAL MICROBIOCIDE ™ a trademark of Baker Hughes, Inc.
Supplier	:	Baker Hughes Drilling Fluids A Baker Hughes Company 2001 Rankin Road Houston, TX 77073
Material Uses	:	Special: Microbiocide
Code	:	7297DF
Validation date	:	8/16/2012.
Print date	:	8/16/2012.
Version	:	1
In case of emergency	:	For Chemical Emergency: 713-439-8900 1-800-424-9300

2 . Hazards identification

Physical state	:	Solid. [Granular.]
Odor	:	Mild.
Color	:	Tan. Red.
OSHA/HCS status	:	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Emergency overview	:	DANGER! CAUSES EYE AND SKIN BURNS. HARMFUL IF SWALLOWED. CAUSES RESPIRATORY TRACT IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. CANCER HAZARD - CONTAINS MATERIAL WHICH CAN CAUSE CANCER. Do not ingest. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.
Routes of entry	:	Dermal contact. Eye contact. Inhalation.
Potential acute health effects		
Inhalation	:	Irritating to respiratory system.
Ingestion	:	Toxic if swallowed. May cause burns to mouth, throat and stomach.
Skin	:	Corrosive to the skin. Causes burns. May cause sensitization by skin contact.
Eyes	:	Corrosive to eyes. Causes burns.
Potential chronic health effects		
Chronic effects	:	Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.
Carcinogenicity	:	Contains material which can cause cancer. Risk of cancer depends on duration and level of exposure.
Over-exposure signs/symptoms		
Inhalation	:	respiratory tract irritation, coughing
Ingestion	:	stomach pains
Skin	:	pain or irritation, redness, blistering may occur
Eyes	:	pain, watering, redness
Medical conditions aggravated by over-exposure	:	Pre-existing skin disorders may be aggravated by over-exposure to this product.

2 . Hazards identification

See toxicological information (Section 11)

3 . Composition/information on ingredients

Name	CAS number	%
Diatomaceous earth, calcined	91053-39-3	30 - 60
Sodium nitrate	7631-99-4	5 - 10
5-chloro-2-methyl-4-isothiazolin-3-one	26172-55-4	5 - 10
Sodium chloride	7647-14-5	1 - 5
2-Methyl-4-isothiazolin-3-one	2682-20-4	1 - 5
Crystalline silica: cristobalite	14464-46-1	0.1 - 1
Crystalline silica: Quartz (SiO2)	14808-60-7	0.1 - 1

4 . First aid measures

Eye contact : Get medical attention immediately. Immediately flush the eye(s) continuously with lukewarm, gently flowing water for at least 20-60 minutes while holding the eyelid(s) open.

Skin contact : Wash affected area with soap and mild detergent for at least 20 - 60 minutes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wear suitable protective clothing and gloves. Remove contaminated clothing and shoes.

5 . Fire-fighting measures

Flammability of the product : No specific fire or explosion hazard.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : carbon dioxide,carbon monoxide,nitrogen oxides,sulfur oxides,halogenated compounds,metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Special remarks on fire hazards : Avoid temperature extremes. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Hazardous combustion products may include hydrogen chloride, carbon monoxide, carbon dioxide and oxides of nitrogen and sulfur.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Persons with a history of skin sensitization problems should not be employed in any process in which this product is used. Do not get in eyes or on skin or clothing. Do not ingest. Use only with adequate ventilation. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
Crystalline silica: cristobalite	US ACGIH	-	0.025	-	-	-	-	-	-	-	[a]
Crystalline silica: cristobalite, as quartz	OSHA PEL 1989	-	0.05	-	-	-	-	-	-	-	[b][A]
Crystalline silica: Quartz (SiO2)	US ACGIH	-	0.025	-	-	-	-	-	-	-	[a]
Crystalline silica: Quartz (SiO2), as quartz	OSHA PEL 1989	-	0.1	-	-	-	-	-	-	-	[b][A]

Form: [a]Respirable fraction; see Appendix C [b]Respirable dust
Notes: [A]as quartz

Consult local authorities for acceptable exposure limits.

Only components of this product with established exposure limits appear in the box above.

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

8 . Exposure controls/personal protection

Engineering measures : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands : Chemical-resistant gloves: Nitrile gloves. Butyl rubber gloves.

Eyes : Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

Skin : Wear long sleeves and chemical resistant apron to prevent repeated or prolonged skin contact.

Additional information

Substance may be harmful if swallowed. In extreme cases (ingestion) may cause liver and/or kidney damage.

9 . Physical and chemical properties

Physical state : Solid. [Granular.]

Flash point : Closed cup: >93.4°C (>200.1°F) [SFCC]

Auto-ignition temperature : Not available.

Flammable limits : Not available.

Color : Tan. Red.

Odor : Mild.

pH : Not available.

Boiling/condensation point : Not available.

Initial Boiling Point : Not available.

Melting/freezing point : Not available.

Relative density : Not available.

Density : 6 (lbs/gal)

Vapor density : >1 [Air = 1]

Odor threshold : Not available.

Evaporation rate : Not available.

VOC : Not available.

Viscosity : Not available.

Solubility (Water) : Dispersible

Vapor pressure : 2.1 kPa (15.8 mm Hg) at 21°C (Calculated Value for all Components.)

Pour Point : -29°C (-20.2°F)

Partition coefficient (LogKow) : Not available.

10 . Stability and Reactivity

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Conditions to avoid : No specific data.

Materials to avoid : Reactive or incompatible with the following materials: oxidizing materials, reducing materials, combustible materials and acids.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Conditions of reactivity : Slightly flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat.
Avoid temperature extremes. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Hazardous combustion products may include hydrogen chloride, carbon monoxide, carbon dioxide and oxides of nitrogen and sulfur.

11 . Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Sodium chloride	LD50 Dermal	Rabbit	>10000 mg/kg	-
	LD50 Oral	Rat	3000 mg/kg	-
	LC50 Inhalation Dusts and mists	Rat	42000 mg/m³	1 hours
Sodium nitrate	LD50 Oral	Rabbit	2680 mg/kg	-
	LD50 Oral	Rat	1267 mg/kg	-
5-chloro-2-methyl-4-isothiazolin-3-one	LD50 Dermal	Rabbit	660 mg/kg	-
	LD50 Oral	Rat	457 mg/kg	-
	LC50 Inhalation Vapor	Rat	0.33 mg/l	4 hours
X-CIDE™ 207 INDUSTRIAL MICROBIOCIDE	LD50 Dermal	Rabbit	>5000 mg/kg	-

Irritation/Corrosion

Conclusion/Summary

Skin : Skin Irritation Score = 4 (Extreme Irritant/Corrosive).

Eyes : Eye Irritation Score = 4 (Extreme Irritant/Corrosive).

Carcinogenicity

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Sodium nitrate	-	2A	-	-	-	-
Crystalline silica: cristobalite	A2	1	-	+	Proven.	None.
Crystalline silica: Quartz (SiO2)	A2	1	-	+	Proven.	+

Chronic toxicity Remarks

1) Diatomaceous earth, calcined

Not available.

2) Sodium nitrate

Swallowing of sodium nitrate can cause gastro enteritis and abdominal pains. Purging and diuresis can be expected. Repeated ingestion of large amounts can lead to cyanosis, convulsions, paralysis or coma. Rare cases of nitrates being converted to the more toxic nitrites have been reported, mostly in infants, which can produce methemoglobinemia. Individuals with a history of kidney or lung disease may be more susceptible to the effects of this chemical. Inhalation of large amounts of sodium nitrate can cause methemoglobinemia, cyanosis, convulsions, tachycardia, dyspnea, coma, and death.

11 . Toxicological information

Generally, nitrates can be reduced to nitrites, under anaerobic conditions (without oxygen). Nitrosating agents that arise from nitrite under acidic gastric conditions react readily with nitrosatable compounds, especially secondary amines and alkyl amides, to generate N-nitroso compounds. Many N-nitroso compounds are carcinogenic. Ingested nitrate under conditions that result in endogenous (originating from within an organ) nitrosation has been classified IARC as probably carcinogenic to humans or Group 2A carcinogens (IARC monographs, vol. 94; 2006).

3) 5-chloro-2-methyl-4-isothiazolin-3-one

Not available.

4) Sodium chloride

Sodium chloride is a component of this product. Intake of 12.4 g/kg of sodium chloride over a period of 23 days resulted in elevation of blood pressure in humans (RTECS, 1997). Sodium chloride caused a variety of genetic effects in E. coli bacteria, rats, and human, hamster, and mouse cells in vitro (RTECS, 1997). When injected in mice at high doses (1900 to 2500 mg), it was embryotoxic and teratogenic in a study designed to pursue a laboratory animal teratogenicity study to its limits (Nishimura & Miyamoto, 1969). In other studies, it was not teratogenic in rats (Grollman & Grollman, 1962); (Minor & Becker 1971; Singh et al, 1973), hamsters (Ferm, 1965) or pigs (Rosendrantz et al, 1970). It was nontoxic when injected into chick embryos (McLaughlin et al, 1963).

5) 2-Methyl-4-isothiazolin-3-one

Not available.

6) Crystalline silica: cristobalite

Silica crystalline as Cristobalite is a component of this product. Cristobalite is listed by NTP as a suspect carcinogen, by OSHA as a possible carcinogen, and by IARC as a possible carcinogen. Silica exists in several forms, but only the crystalline materials produce the chronic pulmonary condition termed specifically silicosis. Chronic inhalation of airborne crystalline silica dust may lead to fibrotic lung disease, silicosis or cancer (based on animal studies and limited evidence of carcinogenicity in humans).

An inhalation study in humans at a dose of 16 mppcf/8H/17.9Y intermittent produced toxic effects to the lungs, thorax, or respiration resulting in fibrosis, focal (pneumoconiosis), cough and dyspnea (RTECS).

An intratracheal (inside the airway tube between the voice box and chest cavity) dose of 200 mg/kg in rats produced lung, thorax, or respiration effects resulting in fibrosis, focal (pneumoconiosis).(RTECS) An intrapleural (inside the membrane lining of the lung cavity) dose of 90, and 100 mg/kg in rats produced tumors, and blood lymphomas (malignant but treatable cancer) including Hodgkin's disease (a type of lymphoma cancer). (RTECS)

7) Crystalline silica: Quartz (SiO_2)

Crystalline silica as quartz is a component of this product. Prolonged inhalation of respirable crystalline quartz may cause delayed chronic lung injury - silicosis. Silicosis is a form of disabling pulmonary fibrosis which can be progressive and may lead to death. Silicosis may progress without further exposure to silica (Hathaway et al, 1991). Chronic inhalation of silica dust suppressed the immune response in mice (Scheuchenzuber et al, 1985), and a decreased immune response has also been shown in silicotics (Barlogova et al, 1981). The effect of silica on the immune mechanism may be mediated by its toxicity to pulmonary macrophages, a critical component of the immune response, and may have implications for the increased susceptibility of silicotics to respiratory infections, particularly tuberculosis. Inhaled crystalline silica particles induced several signs of pulmonary injury and inflammation in rats exposed to an airborne concentration of 50 mg/m3 for 6 hours per day for 5 days (Driscoll et al, 1991).

IARC (International Agency for Research on Cancer) rates crystalline silica as "carcinogenic to humans" (Group 1). The US NTP (National Toxicology Program) rates respirable crystalline silica as a "Proven Carcinogen".

Silica has been inactive for inducing DNA damage in the B. subtilis rec assay (Kanematsu et al, 1980), chromosome damage or sister chromatid exchanges in hamster cells (Price-Jones et al, 1980), chromosome damage in human cells (Oshimura et al, 1984), in vitro oncogenic transformation of hamster cells into cancer cells (Oshimura et al, 1984), and induction of micronuclei in mouse bone marrow (Vanchugova et al, 1985). Crystalline silica has caused DNA strand breaks in vitro; etching the surface with hydrofluoric acid reduced this activity.

11 . Toxicological information

At the time of this review, no reproductive studies were found for silica in humans. Few reproductive data are available for silica. As a component of welding fume, it caused infertility and fetal death in rats (Dabrowski et al, 1966). Intratracheal instillation of silica prolonged the estrus cycle in rats (Parsadanian, 1967). So-called "soluble silica" was tested for reproductive effects in rats, but the results were not available at the time of this review (Smith et al, 1973).

12 . Ecological information

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
Sodium chloride	Acute EC50 402.6 mg/L	Daphnia	48 hours
	Acute LC50 >5600 ppm Fresh water	Crustaceans - Aquatic sowbug - Asellus communis	48 hours
	Acute LC50 6094 mg/L	Fish	96 hours
	Acute LC50 6390 mg/L	Fish	96 hours
	Acute LC50 7050 mg/L	Fish	96 hours
	Acute LC50 7100 mg/L	Fish	96 hours
	Acute LC50 7200 mg/L	Fish	96 hours
	Acute LC50 1000000 ug/L Fresh water	Fish - Striped bass - Morone saxatilis - LARVAE	96 hours
Sodium nitrate	Acute EC50 522 mg/L Fresh water	Fish - Fathead minnow - Pimephales promelas - 0.0014 g	96 hours
	Acute LC50 3400000 ug/L	Crustaceans - Penaeidean shrimp - Penaeus sp. - 500 to 1500 mg	48 hours
	Acute LC50 3581000 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
	Chronic NOEC 720 mg/L Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss - Juvenile (Fledgling, Hatchling, Weanling) - 251 mg	96 hours
2-Methyl-4-isothiazolin-3-one	Acute EC50 0.18 to 0.19 ppm Fresh water	Daphnia - Water flea - Daphnia magna - <24 hours	48 hours
	Acute LC50 0.056 to 0.084 ppm Marine water	Crustaceans - Calanoid copepod - Acartia tonsa	48 hours
	Acute LC50 0.07 to 0.09 ppm Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss	96 hours
5-chloro-2-methyl-4-isothiazolin-3-one	Acute EC50 0.18 to 0.3 ppm Fresh water	Daphnia - Water flea - Daphnia magna - <24 hours	48 hours
	Acute LC50 0.084 to 0.56 ppm Marine water	Crustaceans - Calanoid copepod - Acartia tonsa	48 hours
	Acute LC50 0.19 to 0.31 ppm Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss	96 hours
X-CIDE™ 207 INDUSTRIAL MICROBIOCIDE	Acute LC50 9.2 mg/L	Fish	96 hours

Conclusion/Summary : Not available.

Biodegradability

Conclusion/Summary : Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	UN3261	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Contains: 5-chloro-2-methyl-4-isothiazolin-3-one, 2-Methyl-4-isothiazolin-3-one)	8	II		-
TDG Classification	UN3261	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Contains: 5-chloro-2-methyl-4-isothiazolin-3-one, 2-Methyl-4-isothiazolin-3-one)	8	II		-
IMDG Class	UN3261	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Contains: 5-chloro-2-methyl-4-isothiazolin-3-one, 2-Methyl-4-isothiazolin-3-one)	8	II		**Emergency schedules (EmS)** F-A S-B
IATA-DGR Class	UN3261	CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Contains: 5-chloro-2-methyl-4-isothiazolin-3-one, 2-Methyl-4-isothiazolin-3-one)	8	II		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : 154

15 . Regulatory information

HCS Classification : Toxic material
Corrosive material
Sensitizing material
Carcinogen

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Sodium nitrate; sodium chloride
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: X-CIDE™ 207 INDUSTRIAL MICROBIOCIDE: Immediate (acute) health hazard, Delayed (chronic) health hazard

CERCLA: Hazardous substances.: No products were found.

Clean Water Act (CWA) 307: No products were found.

Clean Water Act (CWA) 311: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :

Not listed

SARA 313

Supplier notification :

Product name	CAS number	Concentration
Sodium nitrate	7631-99-4	5 - 10

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).
Class E: Corrosive material

Canada (CEPA DSL): : All components are listed or exempted.

Additional information

This product is subject to regulation under the US Federal Insecticide, Fungicide and Rodenticide ACT (FIFRA) and is therefore exempt from US Toxic Substance Control Act (TSCA) Inventory listing requirements. EPA Registration No. 10707-44. Offshore Chemical Notification Scheme (OCNS) rating: Group A O-VII

16 . Other information

Label requirements : CAUSES EYE AND SKIN BURNS. HARMFUL IF SWALLOWED. CAUSES RESPIRATORY TRACT IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. CANCER HAZARD - CONTAINS MATERIAL WHICH CAN CAUSE CANCER.

Hazardous Material Information System (U.S.A.) :

Health	3
Flammability	1
Physical hazards	0
Personal protection	J

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

16 . Other information

National Fire Protection Association (U.S.A.) :

Date of printing : **8/16/2012.**

◤ Indicates information that has changed from previously issued version.

Notice to reader

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Gravel Pack Fluid MSDS Baker
END

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **GUAR GUM**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: GUAR GUM
Synonyms: None
Chemical Family: Polysaccharide
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye and respiratory irritation. May cause allergic respiratory reaction. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Guar gum	9000-30-0	60 - 100%		10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Off white
Odor:	Bean
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.3

9. PHYSICAL AND CHEMICAL PROPERTIES

Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	510**Min:** > 93
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause allergic respiratory reaction. May cause respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 9400 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended. *OEL in Section 2 is for dust.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

according to Regulation (EC) No. 453/2010

HALAD® 344 CEMENT ADDITIVE

Revision Date: 05-Jun-2012 **Revision Number:** 14

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name HALAD® 344 CEMENT ADDITIVE

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

Telefone de Emergencia: 0800-701-2008 ou 55-22-2791-4300

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

2. HAZARDS IDENTIFICATION

Classification Not Classified
Risk Phrases None

Label Elements
Not classified

Hazard Pictograms

Signal Word **Not Hazardous**

Contains

Substances	CAS Number
Modified acrylamide copolymer	Proprietary

Other Hazards
Dust can form an explosive mixture in air

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Modified acrylamide copolymer	Not Listed	Proprietary	60 - 100%	Not applicable	-	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures
Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Eyes Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.
Skin Wash with soap and water. Get medical attention if irritation persists.
Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture

Special Exposure Hazards
Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust. Do not swallow. Avoid contact with eyes, skin, or clothing.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modified acrylamide copolymer	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modified acrylamide copolymer	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
- **Respiratory Protection** Dust/mist respirator. (N95, P2/P3)
- **Hand Protection** Nitrile gloves. Polyvinylchloride gloves. Neoprene gloves. Rubber gloves. Butyl rubber gloves. Cloth gloves.
- **Skin Protection** Normal work coveralls.
- **Eye Protection** Wear safety glasses or goggles to protect against exposure.
- **Other Precautions** None known.

Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State: Powder **Color:** White to off white

Odor: Odorless **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	-8
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.37
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	> 600
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
Oxides of nitrogen. Carbon monoxide and carbon dioxide. Oxides of sulfur.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation.
Eye Contact	May cause eye irritation.
Skin Contact	Prolonged or repeated contact may cause skin irritation.
Ingestion	No adverse health effects are expected from swallowing.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Modified acrylamide copolymer	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Modified acrylamide copolymer	EC50: 3300 mg/l (Skeletonema costatum)	LC50: > 1000 mg/l (Scophthalmus maximus)	No information available	TLM48: > 1000 mg/l (Daphnia magna)

Persistence and degradability
Not readily biodegradable

Bioaccumulative potential
Does not bioaccumulate

Substances	Log Pow
Modified acrylamide copolymer	< 0

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

14. TRANSPORT INFORMATION

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory This product, and all its components, complies with EINECS
US TSCA Inventory All components listed on inventory or are exempt.
Canadian DSL Inventory All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 2: Hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 05-Jun-2012
Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HALAD® 322 CEMENT ADDITIVE**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: HALAD® 322 CEMENT ADDITIVE
Synonyms: None
Chemical Family: Blend
Application: Cement Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Sodium formate	141-53-7	1 - 5%	205-488-0	Not applicable
Cellulose derivative		10 - 30%	Not Listed	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust.

Storage Information Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Sodium formate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable
Cellulose derivative	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Sodium formate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Cellulose derivative	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Red
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.28
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	>600
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.

Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

HALAD® 413 CEMENT ADDITIVE

Revision Date: 17-Nov-2010 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name HALAD® 413 CEMENT ADDITIVE

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Acrylic resin	Not applicable	Mixture	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

6. ACCIDENTAL RELEASE MEASURES

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Acrylic resin	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Acrylic resin	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
- **Respiratory Protection** Dust/mist respirator. (95%)
- **Hand Protection** Normal work gloves.
- **Skin Protection** Normal work coveralls.
- **Eye Protection** Wear safety glasses or goggles to protect against exposure.
- **Other Precautions** None known.

Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Brown-black
Odor: Sweet

Property Remarks/ Method	Values
pH:	7.5
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.48
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Oxides of nitrogen. Oxides of sulfur. Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	None known.
Eye Contact	May cause eye irritation.
Skin Contact	May cause skin irritation.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acrylic resin	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Acrylic resin	No information available	No information available	No information available	No information available

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	Product contains one or more components not listed on the inventory.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 2: Hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	17-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HR-4**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: HR-4
Synonyms: None
Chemical Family: Lignosulfonate
Application: Cement Retarder

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Modified lignosulfonate		30 - 60%	Not Listed	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.

Storage Information Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modified lignosulfonate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modified lignosulfonate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Brown
Odor:	Odorless
pH:	9 - 10.3
Specific Gravity @ 20 C (Water=1):	1.20 - 1.30
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: > 1000 ppm (Crangon crangon)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

HR-5

Revision Date: 22-Aug-2011 **Revision Number:** 12

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name HR-5

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Cement Retarder

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Modifed lignosulfonate	Not Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.

6. ACCIDENTAL RELEASE MEASURES

See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modifed lignosulfonate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modifed lignosulfonate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Black
Odor: Molasses

Property Remarks/ Method	Values
pH:	9.5-10.3
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.41
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Oxides of sulfur.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause mild respiratory irritation.
Eye Contact	May cause mechanical irritation to eye.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Modifed lignosulfonate	> 5000 mg/kg	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)

12. ECOLOGICAL INFORMATION

Modifed lignosulfonate	E(B)C50: 1.6 mg/l (Skeletonema costatum) E(R)C50: 2.4 mg/l (Skeletonema costatum)	TLM24: 160-320 mg/l (Oncorhynchus mykiss); LC50: 9650 mg/l (Cyprinus carpio)	No information available	EC50: 38225 mg/l (Daphnia magna); TLM96: > 1000 ppm (Crangon crangon)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

15. REGULATORY INFORMATION

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	22-Aug-2011
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Baroid Fluid Services

HYDRO-PLUG®

Lost Circulation Material — Product Data Sheet

Product Description

HYDRO-PLUG lost circulation material hydrates to plug vugular and cavernous formations.

Applications / Functions

- HYDRO-PLUG material will work with all types of water-based and oil-based drilling fluids but must be mixed in fresh water. HYDRO-PLUG material is ideal for use in deep water operations where synthetic base drilling fluids are in use.

Advantages

- Mix and pump without costly trips
- Quick-acting sealant for vugular, fractured formations and severe loss zones
- Rapid mixing through standard hopper
- One-sack product provides compact storage; each pallet of HYDRO-PLUG makes a 25-bbl pill
- No special equipment is required to place the pill, just the rig pump

Typical Properties

Appearance	Mixture of dark gray to black granules and flakes
Specific gravity	2

Recommended Treatment

For normal treatment, add 45 bbls of freshwater (freshwater only) to a clean pit. Add 80 50-lb bags of HYDRO-PLUG material. Do not add CAUSTIC or LIME. Spot the mixture across the loss zone and perform a gentle squeeze (if possible). Do not add directly to active system.
Note: A 90 to 120 minute window is required to mix, pump and squeeze. No special equipment is required to pump the pill. Just use the rig pump.

Packaging

HYDRO-PLUG material is packaged in 50-lb (22.7-kg) bags

HALLIBURTON | Fluid Systems

Baroid Fluid Services • P.O. Box 1675 • Houston TX 77251 • 281-871-5516

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

HYDRO-PLUG is a registered trademark of Halliburton • © 2005 Halliburton All Rights Reserved

April 2005

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **KCL POTASSIUM CHLORIDE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: KCL POTASSIUM CHLORIDE
Synonyms: None
Chemical Family: Inorganic Salt
Application: Additive

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Potassium chloride	7447-40-7	60 - 100%	231-211-8	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid breathing vapors.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to gray
Odor:	Odorless
pH:	9.2
Specific Gravity @ 20 C (Water=1):	1.99
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	25.5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	74.55
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause moderate skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: 100-330 ppm (Crangon crangon)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **KCL POTASSIUM CHLORIDE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: KCL POTASSIUM CHLORIDE
Synonyms: None
Chemical Family: Inorganic Salt
Application: Additive

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Potassium chloride	7447-40-7	60 - 100%	231-211-8	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid breathing vapors.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to gray
Odor:	Odorless
pH:	9.2
Specific Gravity @ 20 C (Water=1):	1.99
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	25.5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	74.55
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause moderate skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: 100-330 ppm (Crangon crangon)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

POTASSIUM CHLORIDE

Revision Date: 17-Nov-2010 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name POTASSIUM CHLORIDE

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Additive
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number
+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Chronic Aquatic Toxicity	Chronic 3

- (H412)

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16
Classification Not Classified
Risk Phrases None

2. HAZARDS IDENTIFICATION

Label Elements

Signal Word **None**

Hazard Statements
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements - EU (§28, 1272/2008)
P273 - Avoid release to the environment

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Potassium chloride	231-211-8	7447-40-7	60 - 100%	Not applicable	Aquatic chronic 3 (H412)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause eye and skin irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Potassium chloride	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Potassium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
- **Respiratory Protection** Dust/mist respirator. (95%)
- **Hand Protection** Normal work gloves.
- **Skin Protection** Normal work coveralls.
- **Eye Protection** Dust proof goggles.
- **Other Precautions** Eyewash fountains and safety showers must be easily accessible.

Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** White to gray
Odor: Odorless

Property Remarks/ Method	Values
pH:	9.2
Melting Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.99
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	74.55
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation.
Eye Contact	May cause severe eye irritation.
Skin Contact	May cause moderate skin irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. Irritation of the mouth, throat, and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

LD50 Oral: > 5000 mg/kg (rat)

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Potassium chloride	> 5000 mg/kg	No data available	No data available

Test species: Rat

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Potassium chloride	No information available	No information available	No information available	TLM96: 100-330 ppm (Crangon crangon)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	17-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

SAFETY DATA SHEET

KD-40™

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

1.1 Product identifier

Product name : KD-40™

Product code : 1631DF

Product type : Liquid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended use : Corrosion inhibitor.

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mixture

Classification according to Directive 1999/45/EC [DPD]

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Classification : Not classified.

Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Dangerous Preparations Directive [1999/45/EC]

Hazard symbol or symbols :

Indication of danger :

Risk phrases : This product is not classified according to EU legislation.

Safety phrases : Not applicable.

Hazardous ingredients :

Supplemental label elements : Not applicable.

2.3 Other hazards

SECTION 2: Hazards identification

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable. P: Not available. B: Not available. T: Not available.
Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable. vP: Not available. vB: Not available.
Other hazards Ghich do not result in classification :	None known.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mixture

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Type

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact :	Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.
Inhalation :	Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.
Skin contact :	Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.
Ingestion :	Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.
Protection of first-aiders :	No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact :	No known significant effects or critical hazards.
Inhalation :	No known significant effects or critical hazards.
Skin contact :	No known significant effects or critical hazards.
Ingestion :	No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact :	No specific data.
Inhalation :	No specific data.
Skin contact :	No specific data.
Ingestion :	No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor :	No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
Specific treatments :	Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : In a fire or if heated, a pressure increase will occur and the container may burst.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
phosphorus oxides
metal oxide/oxides

5.3 Advice for fire-fighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also Section 8 for additional information on hygiene measures.

6.2 Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Corrosion inhibitor.

SECTION 7: Handling and storage

Not available.

SECTION w: Exposure controls/personal protection

w.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

w.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Liquid. [Clear.]

Colour : Yellow or brown.

Odour : Odourless. to Slight Odour

Odour threshold : Not available.

pH : 7 to 8.5

Boiling point : Not available.

Melting point/freezing point : <-15°C (<5°F)

Flammability (solid, gas) : May be combustible at high temperature.

SECTION 9: Physical and chemical properties

Flash point	:	Closed cup: >93.3°C (>199.9°F) [SFCC]
Explosive properties	:	Not available.
Explosion limits	:	Not available.
Oxidising properties	:	Not available.
Vapour pressure	:	Not available.
Density	:	Not available.
Relative density	:	1.3 to 1.4
Solubility	:	Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/Gater	:	Not available.
Viscosity	:	Dynamic: 19 to 21 cP
Vapour density	:	Not available.
Evaporation rate (butyl acetate = 1)	:	Not available.
Decomposition temperature	:	Not available.
Auto-ignition temperature	:	Not available.

9.2 Other information

Pour point	:	-20°C (-4°F)

SECTION 10: Stability and reactivity

10.1 Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	:	The product is stable.
10.3 Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	:	No specific data.
10.5 Incompatible materials	:	No specific data.
10.6 Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation	:	No known significant effects or critical hazards.
Ingestion	:	No known significant effects or critical hazards.
Skin contact	:	No known significant effects or critical hazards.
Eye contact	:	No known significant effects or critical hazards.

Acute toxicity

8 eneral	:	No known significant effects or critical hazards.
Carcinogenicity	:	No known significant effects or critical hazards.
Mutagenicity	:	No known significant effects or critical hazards.
Teratogenicity	:	No known significant effects or critical hazards.
Developmental effects	:	No known significant effects or critical hazards.
Fertility effects	:	No known significant effects or critical hazards.
Inhalation	:	No specific data.
Ingestion	:	No specific data.
Skin contact	:	No specific data.
Eye contact	:	No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{oG}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not applicable.
P: Not available. B: Not available. T: Not available.

vPvB : Not applicable.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Hazardous Gaste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

SECTION 14: Transport information

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 P8 *	Label
ADR/RID Class	Not regulated.		-	-	
ADN Class	Not regulated.		-	-	
IMD8 Class	Not regulated.		-	-	
IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN Class	No.	-	-
IMD8 Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/7wand the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : Not determined.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms : ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/200w[CLP/8 HS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications [CLP/8 HS] : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 29 November 2013

Version : 1

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination Gith any other materials or in any process. Such information is, to the best of the company's knoGledge and belief, accurate and reliable as of the date indicated. HoGever, no Garranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his oGn particular use.

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **LATEX 3000**

Revision Date: 19-Feb-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: LATEX 3000
Synonyms: None
Chemical Family: Polymer
Application: Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview No significant hazards expected.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Contains no hazardous substances	Mixture	60 - 100%		Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Treatment should be directed at preventing absorption, administering to symptoms as they occur, and providing supportive therapy.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Avoid breathing mist. Material is slippery underfoot.
Storage Information	Store in a cool well ventilated area. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Trace amounts of monomers may be released during use of this material. Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally necessary.
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Color: Milky white
Odor: Mild
pH: 4.5
Specific Gravity @ 20 C (Water=1): 1.03
Density @ 20 C (kg/l): 1.05
Bulk Density @ 20 C (kg/m^3): Not Determined
Boiling Point/Range (C): 100
Freezing Point/Range (C): 0
Pour Point/Range (C): Not Determined
Flash Point/Range (C): Not Determined
Flash Point Method: Not Determined
Autoignition Temperature (C): Not Determined
Flammability Limits in Air - Lower (g/m^3): Not Determined
Flammability Limits in Air - Lower (%): Not Determined
Flammability Limits in Air - Upper (g/m^3): Not Determined
Flammability Limits in Air - Upper (%): Not Determined
Vapor Pressure @ 20 C (mmHg): 17
Vapor Density (Air=1): < 1
Percent Volatiles: 46-48
Evaporation Rate (Butyl Acetate=1): < 1
Solubility in Water (g/100ml): Miscible
Solubility in Solvents (g/100ml): Not Determined
VOCs (g/l): Not Determined
Viscosity, Dynamic @ 20 C (centipoise): Not Determined
Viscosity, Kinematic @ 20 C (centistrokes): Not Determined
Partition Coefficient/n-Octanol/Water: Not Determined
Molecular Weight (g/mole): >600
Decomposition Temperature (C): Not Determined

10. STABILITY AND REACTIVITY

Stability Data: Stable

Hazardous Polymerization: Will Not Occur

Conditions to Avoid None anticipated

Incompatibility (Materials to Avoid) Strong oxidizers.

Hazardous Decomposition Products 1,3-Butadiene. Styrene.

Additional Guidelines Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye and skin contact.

Inhalation Not a likely route of exposure.

Skin Contact Prolonged or repeated contact may cause slight skin irritation.

Eye Contact May cause eye irritation.

Ingestion No adverse health effects are expected from swallowing.

Aggravated Medical Conditions None known.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: LC50: (96 hour) 97811 mg/l (fish) estimated
Acute Crustaceans Toxicity: EC50(48 Hour): 16552 mg/l (Daphnia magna) estimated
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Disposal should be made in accordance with federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

END OF MSDS

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **LE SUPERMUL**

Revision Date: 20-Dec-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: LE SUPERMUL
Synonyms: None
Chemical Family: Blend
Application: Emulsifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Diethylene glycol monobutyl ether	112-34-5	1 - 5%	Not applicable	Not applicable
Ethylene glycol monobutyl ether	111-76-2	1 - 5%	20 ppm	50 ppm

3. HAZARDS IDENTIFICATION

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be absorbed through the skin. May be harmful if swallowed. Repeated overexposure may cause liver and kidney effects.

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Eyes
In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion
Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician
Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	> 200
Flash Point/Range (C):	> 100
Flash Point Method:	PMCC
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Use water spray to cool fire exposed surfaces. Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 2, Flammability 1, Reactivity 0
HMIS Ratings: Health 2, Flammability 1, Physical Hazard 0 , PPE: H

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

Storage Information Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Respiratory Protection Organic vapor respirator.
In high concentrations, supplied air respirator or a self-contained breathing apparatus.

Hand Protection Impervious rubber gloves.

Skin Protection Rubber apron.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Amber
Odor:	Mild
pH:	2.6
Specific Gravity @ 20 C (Water=1):	0.924
Density @ 20 C (lbs./gallon):	7.7
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	20
Freezing Point/Range (C):	-6.6
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	280-300
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation. May be absorbed through the skin and produce effects similar to those caused by inhalation and/or ingestion.
Eye Contact	May cause eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea. May cause headache, dizziness, nausea, vomiting, gastrointestinal irritation and central nervous system depression.
Aggravated Medical Conditions	Lung disorders. Skin disorders.

Chronic Effects/Carcinogenicity	Prolonged or repeated exposure may cause liver, kidney and blood effects. Prolonged or repeated exposure may cause fetal damage and testicular effects.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	D2B Toxic Materials

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **LIME**

Revision Date: 18-Jul-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: LIME
Synonyms: None
Chemical Family: Inorganic
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Calcium hydroxide	1305-62-0	60 - 100%	215-137-3	5 mg/m^3	5 mg/m^3	5 mg/m^3	Xi; R-36/37/38

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not Determined

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	12.2
Specific Gravity @ 20 C (Water=1):	2.24
Density @ 20 C (kg/l):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	0.2
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	74.1
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	Causes severe skin irritation. May cause skin burns on prolonged contact.
Eye Contact	Causes severe eye irritation May cause eye burns.
Ingestion	Irritation of the mouth, throat, and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	LD50: 7340 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 100-500 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	TLM96: 478,520 ppm (Mysidopsis bahia) SPP @ 8 ppb
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Empty container completely. Transport with all closures in place. Return for reuse or dispose in a sanitary landfill according to national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases

S22 Do not breathe dust.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S39 Wear eye and face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

Xi - Irritant.
R36/37/38 Irritating to eyes, respiratory system and skin.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **MICA**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: MICA
Synonyms: None
Chemical Family: Mineral
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Mica	12001-26-2	60 - 100%		10 mg/m^3	Not applicable	5 mg/m^3	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Silver
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	2.9
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.

Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Prolonged breathing of mica dust may produce pneumoconiosis. Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).
Toxicity Tests	

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **MICROBLOCK**

Revision Date: 10-Jun-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: MICROBLOCK
Synonyms: None
Chemical Family: Blend
Application: Light Weight Cement Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, quartz	14808-60-7	< 0.5	238-878-4	0.3 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Amorphous silica fume	69012-64-2	30 - 60%	273-761-1	Not applicable	Not applicable	Not applicable	Not applicable

Restrictive exposure limits **More restrictive exposure limits may be enforced by some states, agencies, or other authorities.**

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Under normal conditions, first aid procedures are not required.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Store in a cool, dry location. Store at temperature above 32 F (0 C). Do not freeze. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Gray
Odor:	Odorless
pH:	6
Specific Gravity @ 20 C (Water=1):	1.4
Density @ 20 C (kg/l):	1.397
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	0
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	<50
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Freezing conditions.

Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	This product is not mobile under normal environmental conditions.
Persistence/Degradability	Not applicable
Bio-accumulation	Not applicable

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	LC50(10 day): > 50,000 mg/kg (Corophium volutator) EC50(24 hour): > 1000 mg/l (Daphnia magna)
Acute Algae Toxicity:	EC50(72 hour): 4200 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Microtox: (Photobacterium phosphoreum) non-toxic

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases S22 Do not breathe dust.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

MUSOL SOLVENT

Revision Date: 11-Apr-2012 **Revision Number:** 12

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name MUSOL SOLVENT

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Solvent

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Acute Oral Toxicity - (H302)	Category 4
Acute Toxicity - Dermal - (H311)	Category 4
Acute Inhalation Toxicity - Dusts and Mists - (H332)	Category 4
Skin Corrosion / irritation	Category 2

2. HAZARDS IDENTIFICATION

- (H315)

Serious Eye Damage / Eye Irritation	Category 2

- (H319)

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xn - Harmful.

Risk Phrases

R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R36/38 Irritating to eyes and skin.

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H302 - Harmful if swallowed
H311 - Toxic in contact with skin
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H332 - Harmful if inhaled

Contains

Substances	**CAS Number**
Ethylene glycol monobutyl ether	111-76-2

Precautionary Statements - EU (§28, 1272/2008)
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P312 - Call a POISON CENTER or doctor/physician if you feel unwell
P302 + P350 - IF ON SKIN: Gently wash with plenty of soap and water

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Ethylene glycol monobutyl ether	203-905-0	111-76-2	60 - 100%	Xn; R20/21/22 Xi; R36/38	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Acute Tox. 4 (H332) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed

May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Special hazards arising from the substance of mixture

Special Exposure Hazards

May be ignited by heat, sparks or flames. Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.

Advice for firefighters

Special Protective Equipment for Fire-Fighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas.
See Section 12 for additional information

Environmental precautions

Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections

See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep from heat, sparks, and open flames. Keep container closed when not in use. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Ethylene glycol monobutyl ether	Not applicable	25 ppm	100 mg/m^3	2 ppm	20 ppm

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Ethylene glycol monobutyl ether	20 ppm	98 mg/m^3	98 mg/m^3	100 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment
Respiratory Protection Organic vapor respirator.

Hand Protection Impervious rubber gloves.
Skin Protection Rubber apron.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Liquid **Color:** Colorless
Odor: Mild **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	-70°C
Boiling Point/Range	171°C
Flash Point PMCC	67°C
upper flammability limit	10.6
lower flammability limit	1.1
Evaporation rate	0.06
Vapor Pressure	0.76 mmHg
Vapor Density	4.1

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity	0.9
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	0.8
Autoignition Temperature	230°C
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	118.2
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers. Peroxides. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Eye Contact	May cause eye irritation.
Skin Contact	May be absorbed through the skin and contribute to the symptoms listed under ingestion. May cause skin irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. May produce nervous system effects such as feeling of weakness, unsteady walk, and dilation of blood vessels.

Chronic Effects/Carcinogenicity Prolonged or repeated exposure may cause fetal damage and testicular effects.

LD50 Oral:	470 mg/kg (rat)
LD50 Dermal:	2270 mg/kg (rat)
LC50 Inhalation:	450 ppm (rat) (4-hr)

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylene glycol monobutyl ether	470 mg/kg	2270 mg/kg	450 ppm

12. ECOLOGICAL INFORMATION

Toxicity

12. ECOLOGICAL INFORMATION

Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Ethylene glycol monobutyl ether	EC50: 839.56 mg/l (Skeletonema costatum)	LC50: > 1000 mg/l (Scophthalmus maximus juvenile)	No information available	EC50: >1000 mg/L (Daphnia magna)

Persistence and degradability
Readily biodegradable

Bioaccumulative potential
Does not bioaccumulate

Substances	Log Pow
Ethylene glycol monobutyl ether	0.9

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None

14. TRANSPORT INFORMATION

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3

R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R36/38 Irritating to eyes and skin.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	11-Apr-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

NF-6

Revision Date: 22-Feb-2012 **Revision Number:** 13

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name NF-6

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Defoamer
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16
Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Hazard Pictograms

Signal Word **Not Hazardous**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Vegetable oil	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available
Aluminum stearate	211-279-5	637-12-7	1 - 5%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
Carbon dioxide, dry chemical, foam.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Use water spray to cool fire exposed surfaces. Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep container closed when not in use.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Vegetable oil	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Aluminum stearate	Not applicable	2 mg/m^3	2 mg/m^3	Not applicable	2 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Vegetable oil	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Aluminum stearate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Organic vapor respirator with a dust/mist filter.
Hand Protection Polyvinylchloride gloves.
Skin Protection Normal work coveralls.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid **Color:** Yellow
Odor: Mild **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	182°C
Flash Point	> 170°C
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.93
Water Solubility	Dispersable
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	385°C
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Hydrocarbons. Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation None known.
Eye Contact May cause eye irritation.
Skin Contact May cause skin irritation. May cause an allergic skin reaction.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Vegetable oil	No data available	No data available	No data available
Aluminum stearate	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Vegetable oil	EC50: > 3200 mg/L (Skeletonema costatum)	LC50: > 5600 mg/L (Scophthalmus maximus)	No information available	LC50: > 10000 mg/L (Acartia tonsa)
Aluminum stearate	No information available	TLM96: 1100 mg/l (Oncorhynchus mykiss)	No information available	TLM96: 836400 ppm (Mysidopsis bahia)

Persistence and degradability
Readily biodegradable

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None

14. TRANSPORT INFORMATION

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	Product contains one or more components not listed on the inventory.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	22-Feb-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

SAFETY DATA SHEET

NOXYGEN™ XT

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Product name : NOXYGEN™ XT
EC number :
CAS number :
Product code : 2626DF
Identified uses : Oxygen scavenger
Product type : Solid.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Not available.

1.3 Details of the supplier of the safety data sheet

Baker Hughes
Campus 1, Balgownie Road,
Bridge of Don, Aberdeen,
AB22 8GT, UK

Tel: +44 (0)1224-720800
Fax: +44 (0)1224-720801

e-mail address of person responsible for this SDS : bhdfsds@bakerhughes.com

1.4 Emergency telephone number

Supplier

Telephone number : CHEMTREC Emergency Telephone within UK: 0870 820 0418
CHEMTREC Emergency Telephone outside UK: +44 870 820 0418

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Classification according to Directive 67/548/EEC [DSD]

Not classified.

See Section 16 for the full text of the R phrases or H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms :

Hazard pictograms not applicable

Signal word : No signal word.
Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

SECTION 2: Hazards identification

Supplemental label elements : Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
P: Not available. B: Not available. T: Not available.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII : Not available.
vP: Not available. vB: Not available.

Other hazards which do not result in classification : Not available.

SECTION 3: Composition/information on ingredients

Substance/mixture : Mono-constituent substance

Type

The product is not classified as dangerous according to Directive 1999/45/EC and its amendments.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if irritation occurs.

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to medical doctor : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : Not available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

5.2 Special hazards arising from the substance or mixture

Special exposure hazards : No specific fire or explosion hazard.

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

5.3 Advice for firefighters

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Additional information : Not available.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

6.2 Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

6.4 Reference to other sections : Note: see section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities

Storage : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Recommended Packaging materials : Use original container.

7.3 Specific end use(s) : Oxygen scavenger

Not available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

No exposure limit value known.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure controls

Occupational exposure controls : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Solid. [Crystalline solid.]

Color : White.

Odor : Odorless.

Odor threshold : Not available.

pH : 5 to 8 [Conc. (% w/w): 10% - (H2O)]

Boiling point : Not available.

Melting point/freezing point : Not available.

Flammability (solid, gas) : May be combustible at high temperature.

Flash point : Closed cup: Not applicable.

Explosive properties : Not available.

Explosion limits : Not available.

Oxidizing properties : Not available.

Vapor pressure : Not available.

SECTION 9: Physical and chemical properties

Density : Not available.
Relative density : 1.2

Solubility : Easily soluble in the following materials: cold water.
Partition coefficient: n-octanol/water : Not available.
Viscosity : Not available.
Vapor density : Not available.
Evaporation rate (butyl acetate = 1) : Not available.
Decomposition temperature : Not available.
Auto-ignition temperature : Not available.

9.2 Other information

Pour point : Not available.

SECTION 10: Stability and reactivity

10.1 Reactivity : No specific test data related to reactivity available for this product or its ingredients.
Conditions of reactivity : Slightly flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat.
10.2 Chemical stability : The product is stable.
10.3 Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid : No specific data.
10.5 Incompatible materials : Reactive or incompatible with the following materials: oxidizing materials.
10.6 Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

Potential acute health effects

Inhalation : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Eye contact : No known significant effects or critical hazards.

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
2,3-didehydro-3-O-sodio-D-erythro-hexono-1,4-lactone	LD50 Oral	Rat	>5 g/kg	-

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.
Inhalation : No specific data.
Ingestion : No specific data.
Skin contact : No specific data.
Eye contact : No specific data.

SECTION 12: Ecological information

12.1 Toxicity : No known significant effects or critical hazards.

Conclusion/Summary : Not available.

12.2 Persistence and degradability

Conclusion/Summary : Not available.

12.3 Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Not available.			

12.4 Mobility in soil : Not available.

12.5 Results of PBT and vPvB assessment

PBT : Not available.
P: Not available. B: Not available. T: Not available.

vPvB : Not available.
vP: Not available. vB: Not available.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Hazardous waste : Within the present knowledge of the supplier, this product is not regarded as hazardous waste, as defined by EU Directive 91/689/EEC.

Packaging

Methods of disposal : The generation of waste should be avoided or minimized wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

13.2 Additional information

Special precautions : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

International transport regulations

Regulatory information	14.1 UN number	14.2 Proper shipping name	14.3 Transport hazard class(es)	14.4 PG*	Label
ADR/RID Class	Not regulated.		-	-	
ADN/ADNR Class	Not regulated.		-	-	
IMDG Class	Not regulated.		-	-	

SECTION 14: Transport information

IATA Class	Not regulated.		-	-	

PG* : Packing group

Regulatory information	14.5 Environmental hazards	14.6 Special precautions for user	Additional information
ADR/RID Class	No.	-	-
ADN/ADNR Class	No.	-	-
IMDG Class	No.	-	-
IATA Class	No.	-	-

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorization

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : All components are listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed

15.2 Chemical Safety Assessment : This product contains substances for which Chemical Safety Assessments are still required.

SECTION 16: Other information

16.1 Revision comments : Not available.

Indicates information that has changed from previously issued version.

16.2 Abbreviations and acronyms :
ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
DNEL = Derived No Effect Level
EUH statement = CLP-specific Hazard statement
PNEC = Predicted No Effect Concentration
RRN = REACH Registration Number

SECTION 16: Other information

16.3 Key literature references and sources for data : Not available.

16.4 Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Not classified.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Not classified.	

16.5 Full text of abbreviated H statements : Not applicable.

Full text of classifications [CLP/GHS] : Not applicable.

16.5 Full text of abbreviated R phrases : Not applicable.

Full text of classifications [DSD/DPD] : Not applicable.

16.6 Training advice : Not available.

16.7 Further information

Date of issue/ Date of revision : 12 October 2012

Version : 1

Notice to reader

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

BJ SERVICES MATERIAL SAFETY DATA SHEET

OSCA, Inc., PO Box 80627, Lafayette, Louisiana 70598 (318) 837-6047

……

PRODUCT NAME: OS-8

DOT SHIPPING NAME: Not regulated | **DOT ID #: NA**
HAZARD CLASS: NA | **PKG. GROUP: NA**
EFFECTIVE DATE: August 19, 2009 | **DATE PRINTED: November 13, 2014**

1. INGREDIENTS:

Chemical	TLV	PEL	STEL	SEC. 313	% (optional)
Proprietary	NE			No	

The components of this product are listed on the TSCA inventory.

2. PHYSICAL DATA:

pH: 5.5 – 8.0 (10% solution)
SPECIFIC GRAVITY (Water=1): 1.2
VAPOR PRESSURE: N/D
VOLATILITY: ND
SOLUBILITY IN WATER: Soluble
APPEARANCE: White Crystals
ODOR: Odorless

HMIS:

Health-	1
Fire -	0
React. -	0
Other -	None
PPE:	e

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: None
METHOD USED: N/A

FLAMMABLE LIMITS:

LFL: N/A
UFL: N/A

EXTINGUISHING MEDIA: Use carbon dioxide, dry chemical foam, water fog or water spray.

SPECIAL FIRE FIGHTING PROCEDURES: Product may burn but does not ignite readily. Minimize explosion hazard by controlling dusts. Normal equipment; self-contained breathing apparatus.

4. REACTIVITY DATA:

Stability: Stable under ordinary conditions.

Incompatibility: Strong oxidizers, dust-air mixtures, excessive heat, sparks or open flames.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide.

Hazardous Polymerization: Will not occur.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

If spilled: Ventilate area of leak or spill. Cleanup personnel may require respiratory protection from dust. Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

PRODUCT NAME: OS-8

Disposal Method: Review federal, state and local government requirements prior to disposal. Disposal by controlled incineration or secure landfill may be acceptable.

6. HEALTH HAZARD DATA:

Carcinogen? : NTP?: No IARC?: No OSHA Regulated?: No

EFFECTS OF OVEREXPOSURE

Inhalation: Overexposure may cause minor irritation to the respiratory tract.

Skin Contact: Prolonged or repeated skin contact may cause mild irritation/dermatitis.

Eye Contact: Prolonged or excessive contact with eyes may cause mild irritation.

Ingestion: This product is safe for use in foods.

7. FIRST AID:

Skin Contact: Wash with a large amount of water and non-abrasive soap. If irritation persists, obtain medical attention. Wash contaminated clothing before reuse.

Eye Contact: Wash eyes with a large amount of water for at least fifteen minutes and obtain medical assistance if irritation persists.

If Inhaled: Remove to fresh air. If required, give supportive and symptomatic treatment and get medical attention.

If Ingested: None usually necessary.

8. HANDLING PRECAUTIONS:

Respiratory Protection: NIOSH-approved dust/mist respirator should be worn in dusting conditions or if airborne concentration is high.

Ventilation: Use general mechanical ventilation. Local exhaust is suggested for use, where possible, in enclosed or confined spaces. Explosion-proof exhaust is recommended.

Protective Clothing: Wear protective gloves and clean body-covering clothing. Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

9. ADDITIONAL INFORMATION:

Store in tightly closed container in cool, dry, ventilated area away from sources of heat or ignition.

****

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act of 1970 and shall not be used for any other purpose. The information supplied is presented in good faith and has been derived from sources believed to be reliable. However, no warranty, expressed or implied is extended regarding its accuracy or the results to be obtained from its use. Since conditions of use are beyond our control, all risks are assumed by the user.

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HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **OXYGON®**

Revision Date: 17-Jun-2008

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: OXYGON®
Synonyms: None
Chemical Family: Organic Salt
Application: Oxygen Scavenger

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

Hazard Overview May cause eye and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Organic acid salt		60 - 100%	Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	White
Odor:	Odorless
pH:	5.5-8 (5%)
Specific Gravity @ 20 C (Water=1):	1.2
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	640
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	15
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases

Safety Phrases

S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

MATERIAL SAFETY DATA SHEET
MSDS

Trade Name: Poly Anionic Cellulose (uLV)
Revision date: 19.06.2007
Replaced: 08.05.2007

Poly Anionic Cellulose (uLV)

1. PRODUCT AND COMPANY

TRADE NAME:	Poly Anionic Cellulose (uLV)	APPROVED:	YES
CHEMICAL NAME:		RECEIPT NO:	
FORMULA:		ARTICLE NO:	
SYNONYMS:	PAC ULV	EC-NO:	
INDEX NO:		CAS NO:	
GROUP:		PR.NO:	
SUPPLIER:	Halliburton AS Postboks 200 4065 Stavanger Tlf: 51837000 Fax: 51838383		
TOXIC INFORMATION:	22591300	EMERGENCY PHONE:	51838888
RESPONSIBLE:	Jan Erik Eriksen		
AUTHOR:	Essenticon AS		
APPLICATION:	Fluid Loss aditive with ultra low viscosity		
MORE INFORMATION:			

2. COMPOSITION

EXPLANATION:
CF/CH/CE=Classification fire/-health/-environment, Tx=Very Toxic, T=Toxic, C=Corrosive, Xn=Harmful, Xi=Irritating, IK=No classification required, E=Explosive, O=Oxidizing, Fx=Extremely flammable, F=Highly flammable, N=Danger for environment, M=Genotoxic, A=Sensitisation, K=Carcinogen, R=Causes birth defects.
COMPOSITION COMMENTS:
The product contains several ingredients that either are not classified, or are present i such small amounts that they are not necessary to be stated. HMS Logiconsult has seen and evaluated the whole composition.

3. HAZARDS IDENTIFICATION

MORE INFORMATION:
Not classified as dangerous to health, safety or environment.

4. FIRST AID MEASURES

GENERAL:
No special measures required.

INHALATION:
Fresh air; consult doctor in case of complaints.

SKIN CONTACT:
Rinse with water.

EYE CONTACT:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

INGESTION:
No special measures required.

INFORMATION TO HEALTH PERSONEL:

No special measures required.
5. FIRE FIGHTING MEASURES
SUITABLE EXTINGUISH MEDIA:
Water fog, carbon dioxide, foam, dry chemical.

FIRE AND EXPLOSION HAZARDS:
Not flammable.
In case of fire or exposed to strong heat may be formed carbonmonooxide (CO).
Organic dust in the presence of an ignition source can be explosive in high concentrations.

PERSONAL PROTECTION WHEN FIREFIGHTING:
Firefighters shall wear breathing apparatus.

MORE INFORMATION:
Product forms slippery surface when combined with water.
6. ACCIDENTAL RELEASE MEASURES
PERSONAL PRECAUTIONS:
Use personal proctection as necessary. See chap. 8. Avoid formation/inhalation of dust.
Ensure adequate ventilation.

ENVIRONMENTAL PRECAUTIONS:
No special measures required.

CLEANING MEASURES:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:Warm water
Dispose contaminated material as waste according to Section 13.
The product is not hazardous waste.
7. HANDLING AND STORAGE
SPECIAL PRECAUTIONS:
Prevent formation of dust. Work only in fume cupboard. Product forms slippery surface when combined with water.

HANDLING:
Avoid creating or inhaling dust. Avoid dust accumulations. Ensure adequate ventilation. Use explosion-proof apparatus / fittings and spark-proof tools.

STORAGE:
Store only in the original receptacle. Protect from humidity and water.
Store away from oxidizers.
8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE CONTROL:
A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation. Do not breathe dust.

RESPIRATORY PROTECTION:
In poorly ventilated room use filter P2-filter (dust).

EYE PROTECTION:
Safety goggles which protects against dust.

HAND PROTECTION:
Not required.

SKIN PROTECTION:
Light weight protective clothing

9. PHYSICAL AND CHEMICAL PROPERTIES

FORM:	Powder	ODOUR:	Odourless
COLOUR:	White, light yellow	SOLUBILITY:	
MELTING/FREEZING POINT:		BOILING POINT:	
DENSITY:	1,5 g/cm³	FLASH POINT:	221 °C
EXPLOSION LIMITS LEL-UEL %:	Risk of dust explosion	PH (CONCENTRATE.):	
SOLUBILITY IN WATER:	Soluble	MOL MASS:	
VAPOUR PRESSURE:		VISCOSITY:	Dynamic at 25°C: < 7 mPas (Fann). Water: < 8 %.
SATURATION CONC.:		AUTO IGNITION TEMP:	400 °C
DECOMPOSITION TEMP.:	>150 °C	SMELL LIMIT:	
PH (SOLUTION):	7 - 9 (10 g/l)	REL.VAPOUR DENSITY (AIR=1):	

MORE INFORMATION:
Bulk density at 20°C: 600 - 700 kg/m³

10. STABILITY AND REACTIVITY

STABILITY:
Stable when used at recommended storage and handling conditions.

REACTIVITY:
Strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS:
No dangerous decomposition products known.

OTHER INFORMATION:
Dangerous reactions: Risk of dust explosion.

11. TOXICOLOGICAL INFORMATION

INHALATION:
Inhalation of dust may irritate the respiratory tract.

SKIN CONTACT
No irritant effect.

EYE CONTACT:
No irritant effect.

INGESTION:
No irritant effect.

SENSITIZATION:
No sensitizing effects known.

OTHER TOXOLOGICAL INFORMATION:

When used and handled according to specifications, the product does not have any harmful effects to our experience and the information provided to us.

12. ECOLOGICAL INFORMATION

MOBILITY:
Soluble in water. Low mobility.

BIODEGRADABILITY:
The product is easily biodegradable.

ACCUMULATION:
No bio-accumulation is indicated.

ECOTOXICITY:
The product is classified to be not dangerous for the environment. This excludes not the risk that frequent or small releases may pose a risk for the environment.

MORE INFORMATION:
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water.

13. DISPOSAL

DECONTAMINATION/DISPOSAL:
Smaller quantities can be disposed of with household waste. Disposal must be made according to official regulations. Not hazardous waste.

MORE INFORMATION:
Recommended cleansing agents: Water, if necessary together with cleansing agents.

14. TRANSPORT INFORMATION

ADR(Road)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
PACKING GROUP:	HAZ. ID NO:	

RID(Railway)

UN NO:	CLASS:	
HAZ. ID NO:	DANG. GOODS:	No
PACKING GROUP:		

IMDG(SEA)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
EMS:	PACKING GROUP:	
MARINE POLL:	SUB.RISK:	

IATA(Airplane)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
SUB.RISK:	PACKING GROUP:	

MORE INFORMATION:
Not hazardous goods (ADR/RID/IMDG/IATA).

15. REGULATORY INFORMATION

REFERENCES:
Revised in compliance with national regulations for health, fire and environment labelling. (The Working Environment Act, Pollution Control Act, Act relating to Prevention of Fire, Explosion and Accidents involving Hazardous Substances and the Fire Services) Norwegian Databases: List of Dangerous Substances, The Observation List, List of Priority Substances. Authorities: Norwegian Labour Inspection Authority, Directorate for Civil Protection and Emergency Planning, Norwegian Petroleum Directorate, Petroleum Safety Authority Norway. Transport legislation: The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (ADR/RID),The International Maritime Dangerous Goods (IMDG), International Air Transport Association Dangerous Goods (IATA) EU-directives : 67/548/EEC, 1999/45/EC, 2001/58/EC, 2004/73/EF (29. ATP), 2006/8/EC with later amendments.
16. OTHER INFORMATION
Replace date:: 08.05.2007

MORE INFORMATION:
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Approved and revised in compliance to 29. ATP.

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Signature: R. E. Lunde

Revision 19.06.2007: replaces MSDS of 08.05.2007. Chenhed name form "PAC ULV" to "Poly Anionic Cellulose (uLV)". Else no amendments.

This document was generated by Logichem 2002, a web based library for hazardous chemicals.
http://www.hmslogiconsult.com/

Product data sheet

DPI INDUSTRIER

Product	**Poly Anionic Cellulose (u)LV** **PAC Lovis pure, Equivalent**	
Product information	Description	Anionic carboxymethylated polymer
	Application	Fluid loss additive for KCl based drilling fluids for drilling active shales
Specific properties	Appearance	Off white, free flowing particles
	Compatibility	Resistant to high concentrations of mono-and bivalent cations (Na^+, K^+, Ca^{2+}, Mg^{2+}) Compatible with all drilling fluid additives
	Solubility	Readily soluble in saline drilling fluids
	Suspensibility	Excellent without lumping
	Purity	min. 95 %
	Moisture	max. 8.0 %
	pH (2% sol. at 25ºC)	7.0 – 10.0
	Rate of addition	5 – 15 kg/m^3 (2 – 5 lbs/bbl)
General properties	Storage	Dry
	Shelf life	24 months
	Packaging	25 kg multiply paper bags with PE liner

Product **Poly Anionic Cellulose (u)LV**
PAC Lovis pure, Equivalent

The above given information is provided with care, but the author(s) cannot be held responsible for discrepancies

Product data sheet

DPI INDUSTRIER

Mud composition

	KCl / NaCl solution	
	(g)	*(lbs/bbl)*
Fresh water	1000	350
KCl	80	28
NaCl	40	14
$NaHCO_3$	3	1
OCMA Clay	60	21
Pac- (u)LV	**...**	**...**

Quality control test

	KCl / NaCl solution	
	Requirements	*Pac - LV 5.7 g/l **
Apparent Viscosity (cP) *	max. 10	8
API fluid loss, after 30 min. (ml)	max. 15	11

* For Apparent viscosity test at 8.6 g/l (3 lbs/bbl)

Performance test

		KCl / NaCl solution	
		Requirements	*Pac - LV 5.7 g/l*
Apparent Viscosity (cP)	65ºC, 16 h hot roll	max. 10	3.5
	120ºC, 16 h hot roll	max. 10	3
API, fluid loss (ml)	65ºC, 16 h hot roll	max. 15	10
	120ºC, 16 h hot roll	max. 15	9

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MATERIAL SAFETY DATA SHEET
MSDS

Trade Name: Poly Anionic Cellulose (uLV)
Revision date: 19.06.2007
Replaced: 08.05.2007

Poly Anionic Cellulose (uLV)

1. PRODUCT AND COMPANY

TRADE NAME:	Poly Anionic Cellulose (uLV)	APPROVED:	YES
CHEMICAL NAME:		RECEIPT NO:	
FORMULA:		ARTICLE NO:	
SYNONYMS:	PAC ULV	EC-NO:	
INDEX NO:		CAS NO:	
GROUP:		PR.NO:	
SUPPLIER:	Halliburton AS Postboks 200 4065 Stavanger Tlf: 51837000 Fax: 51838383		
TOXIC INFORMATION:	22591300	EMERGENCY PHONE:	51838888
RESPONSIBLE:	Jan Erik Eriksen		
AUTHOR:	Essenticon AS		
APPLICATION:	Fluid Loss aditive with ultra low viscosity		
MORE INFORMATION:			

2. COMPOSITION

EXPLANATION:
CF/CH/CE=Classification fire/-health/-environment, Tx=Very Toxic, T=Toxic, C=Corrosive, Xn=Harmful, Xi=Irritating, IK=No classification required, E=Explosive, O=Oxidizing, Fx=Extremely flammable, F=Highly flammable, N=Danger for environment, M=Genotoxic, A=Sensitisation, K=Carcinogen, R=Causes birth defects.
COMPOSITION COMMENTS:
The product contains several ingredients that either are not classified, or are present i such small amounts that they are not necessary to be stated. HMS Logiconsult has seen and evaluated the whole composition.

3. HAZARDS IDENTIFICATION

MORE INFORMATION:
Not classified as dangerous to health, safety or environment.

4. FIRST AID MEASURES

GENERAL:
No special measures required.

INHALATION:
Fresh air; consult doctor in case of complaints.

SKIN CONTACT:
Rinse with water.

EYE CONTACT:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

INGESTION:
No special measures required.

INFORMATION TO HEALTH PERSONEL:

No special measures required.
5. FIRE FIGHTING MEASURES
SUITABLE EXTINGUISH MEDIA:
Water fog, carbon dioxide, foam, dry chemical.

FIRE AND EXPLOSION HAZARDS:
Not flammable.
In case of fire or exposed to strong heat may be formed carbonmonooxide (CO).
Organic dust in the presence of an ignition source can be explosive in high concentrations.

PERSONAL PROTECTION WHEN FIREFIGHTING:
Firefighters shall wear breathing apparatus.

MORE INFORMATION:
Product forms slippery surface when combined with water.
6. ACCIDENTAL RELEASE MEASURES
PERSONAL PRECAUTIONS:
Use personal proctection as necessary. See chap. 8. Avoid formation/inhalation of dust.
Ensure adequate ventilation.

ENVIRONMENTAL PRECAUTIONS:
No special measures required.

CLEANING MEASURES:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:Warm water
Dispose contaminated material as waste according to Section 13.
The product is not hazardous waste.
7. HANDLING AND STORAGE
SPECIAL PRECAUTIONS:
Prevent formation of dust. Work only in fume cupboard. Product forms slippery surface when combined with water.

HANDLING:
Avoid creating or inhaling dust. Avoid dust accumulations. Ensure adequate ventilation. Use explosion-proof apparatus / fittings and spark-proof tools.

STORAGE:
Store only in the original receptacle. Protect from humidity and water.
Store away from oxidizers.
8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE CONTROL:
A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation. Do not breathe dust.

RESPIRATORY PROTECTION:
In poorly ventilated room use filter P2-filter (dust).

EYE PROTECTION:
Safety goggles which protects against dust.

HAND PROTECTION:
Not required.

SKIN PROTECTION:
Light weight protective clothing

9. PHYSICAL AND CHEMICAL PROPERTIES

FORM:	Powder	ODOUR:	Odourless
COLOUR:	White, light yellow	SOLUBILITY:	
MELTING/FREEZING POINT:		BOILING POINT:	
DENSITY:	1,5 g/cm³	FLASH POINT:	221 °C
EXPLOSION LIMITS LEL-UEL %:	Risk of dust explosion	PH (CONCENTRATE.):	
SOLUBILITY IN WATER:	Soluble	MOL MASS:	
VAPOUR PRESSURE:		VISCOSITY:	Dynamic at 25°C: < 7 mPas (Fann). Water: < 8 %.
SATURATION CONC.:		AUTO IGNITION TEMP:	400 °C
DECOMPOSITION TEMP.:	>150 °C	SMELL LIMIT:	
PH (SOLUTION):	7 - 9 (10 g/l)	REL.VAPOUR DENSITY (AIR=1):	

MORE INFORMATION:
Bulk density at 20°C: 600 - 700 kg/m³

10. STABILITY AND REACTIVITY

STABILITY:
Stable when used at recommended storage and handling conditions.

REACTIVITY:
Strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS:
No dangerous decomposition products known.

OTHER INFORMATION:
Dangerous reactions: Risk of dust explosion.

11. TOXICOLOGICAL INFORMATION

INHALATION:
Inhalation of dust may irritate the respiratory tract.

SKIN CONTACT
No irritant effect.

EYE CONTACT:
No irritant effect.

INGESTION:
No irritant effect.

SENSITIZATION:
No sensitizing effects known.

OTHER TOXOLOGICAL INFORMATION:

When used and handled according to specifications, the product does not have any harmful effects to our experience and the information provided to us.

12. ECOLOGICAL INFORMATION

MOBILITY:
Soluble in water. Low mobility.

BIODEGRADABILITY:
The product is easily biodegradable.

ACCUMULATION:
No bio-accumulation is indicated.

ECOTOXICITY:
The product is classified to be not dangerous for the environment. This excludes not the risk that frequent or small releases may pose a risk for the environment.

MORE INFORMATION:
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water.

13. DISPOSAL

DECONTAMINATION/DISPOSAL:
Smaller quantities can be disposed of with household waste. Disposal must be made according to official regulations. Not hazardous waste.

MORE INFORMATION:
Recommended cleansing agents: Water, if necessary together with cleansing agents.

14. TRANSPORT INFORMATION

ADR(Road)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
PACKING GROUP:	HAZ. ID NO:	

RID(Railway)

UN NO:	CLASS:	
HAZ. ID NO:	DANG. GOODS:	No
PACKING GROUP:		

IMDG(SEA)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
EMS:	PACKING GROUP:	
MARINE POLL:	SUB.RISK:	

IATA(Airplane)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
SUB.RISK:	PACKING GROUP:	

MORE INFORMATION:
Not hazardous goods (ADR/RID/IMDG/IATA).

15. REGULATORY INFORMATION

REFERENCES:
Revised in compliance with national regulations for health, fire and environment labelling. (The Working Environment Act, Pollution Control Act, Act relating to Prevention of Fire, Explosion and Accidents involving Hazardous Substances and the Fire Services) Norwegian Databases: List of Dangerous Substances, The Observation List, List of Priority Substances. Authorities: Norwegian Labour Inspection Authority, Directorate for Civil Protection and Emergency Planning, Norwegian Petroleum Directorate, Petroleum Safety Authority Norway. Transport legislation: The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (ADR/RID),The International Maritime Dangerous Goods (IMDG), International Air Transport Association Dangerous Goods (IATA) EU-directives : 67/548/EEC, 1999/45/EC, 2001/58/EC, 2004/73/EF (29. ATP), 2006/8/EC with later amendments.
16. OTHER INFORMATION
Replace date:: 08.05.2007

MORE INFORMATION:
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Approved and revised in compliance to 29. ATP.

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Signature: R. E. Lunde

Revision 19.06.2007: replaces MSDS of 08.05.2007. Chenhed name form "PAC ULV" to "Poly Anionic Cellulose (uLV)". Else no amendments.

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http://www.hmslogiconsult.com/

Product data sheet

DPI INDUSTRIER

Product	**Poly Anionic Cellulose (u)LV** **PAC Lovis pure, Equivalent**	
Product information	Description	Anionic carboxymethylated polymer
	Application	Fluid loss additive for KCl based drilling fluids for drilling active shales
Specific properties	Appearance	Off white, free flowing particles
	Compatibility	Resistant to high concentrations of mono-and bivalent cations (Na^+, K^+, Ca^{2+}, Mg^{2+}) Compatible with all drilling fluid additives
	Solubility	Readily soluble in saline drilling fluids
	Suspensibility	Excellent without lumping
	Purity	min. 95 %
	Moisture	max. 8.0 %
	pH (2% sol. at 25ºC)	7.0 – 10.0
	Rate of addition	5 – 15 kg/m^3 (2 – 5 lbs/bbl)
General properties	Storage	Dry
	Shelf life	24 months
	Packaging	25 kg multiply paper bags with PE liner

Product **Poly Anionic Cellulose (u)LV**
PAC Lovis pure, Equivalent

The above given information is provided with care, but the author(s) cannot be held responsible for discrepancies

Product data sheet

DPI INDUSTRIER

Mud composition

	KCl / NaCl solution	
	(g)	*(lbs/bbl)*
Fresh water	1000	350
KCl	80	28
NaCl	40	14
$NaHCO_3$	3	1
OCMA Clay	60	21
Pac- (u)LV	**...**	**...**

Quality control test

	KCl / NaCl solution	
	Requirements	*Pac - LV 5.7 g/l **
Apparent Viscosity (cP) *	max. 10	8
API fluid loss, after 30 min. (ml)	max. 15	11

* For Apparent viscosity test at 8.6 g/l (3 lbs/bbl)

Performance test

		KCl / NaCl solution	
		Requirements	*Pac - LV 5.7 g/l*
Apparent Viscosity (cP)	65ºC, 16 h hot roll	max. 10	3.5
	120ºC, 16 h hot roll	max. 10	3
API, fluid loss (ml)	65ºC, 16 h hot roll	max. 15	10
	120ºC, 16 h hot roll	max. 15	9

The above given information is provided with care, but the author(s) cannot be held responsible for discrepancies

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-LE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-LE
Synonyms: None
Chemical Family: Carbohydrate
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	750
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 1260 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: > 500 mg/l (Golden orfe)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended. *OEL in Section 2 is for dust.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-LE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-LE
Synonyms: None
Chemical Family: Carbohydrate
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	750
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 1260 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: > 500 mg/l (Golden orfe)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended. *OEL in Section 2 is for dust.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-RE**

Revision Date: 05-Jan-2009

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-RE
Synonyms: None
Chemical Family: Polysaccharide
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	400-800
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 16,000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(5 Day): 0 mg/g COD: 900 mg/l
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 27000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-RE**

Revision Date: 05-Jan-2009

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-RE
Synonyms: None
Chemical Family: Polysaccharide
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	400-800
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 16,000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(5 Day): 0 mg/g COD: 900 mg/l
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 27000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **PAC®-L**

Revision Date: 16-Feb-2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: PAC®-L
Synonyms: None
Chemical Family: Carbohydrate
Application: Fluid Loss Additive

Manufacturer/Supplier
Baroid Drilling Fluids
a Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (800) 666-9260 or (713) 753-3000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Cellulose derivative		60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	430
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (F):	752
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 0, Flammability 0, Reactivity 0
HMIS Ratings:	Flammability 0, Reactivity 0, Health 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	White to off white

Odor:	Odorless
pH:	6.5-9 (1%)
Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	40-55
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	LD50: 1260 mg/kg (Rat)
Dermal Toxicity:	Not determined

Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: > 500 mg/l (Golden orfe)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

according to Regulation (EC) No. 453/2010

PEN-11

Revision Date: 19-Nov-2010 **Revision Number:** 8

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name PEN-11

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Surfactant
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number
+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Acute Oral Toxicity	Category 4- H302
Skin Corrosion / irritation	Category 2- H315
Serious Eye Damage / Eye Irritation	Category 2- H319

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

2. HAZARDS IDENTIFICATION

Classification Xn - Harmful.

Risk Phrases R22 Harmful if swallowed.
R36/38 Irritating to eyes and skin.

Label Elements

Hazard Pictograms

Signal Word **Warning**

Hazard Statements
H302 - Harmful if swallowed
H315 - Causes skin irritation
H319 - Causes serious eye irritation

Contains

Substances	CAS Number
Ethoxylated isodecanol	Proprietary

Precautionary Statements - EU (§28, 1272/2008)
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P301+ P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Ethoxylated isodecanol	Not Listed	Proprietary	60 - 100%	Xn; R22 Xi; R36/38	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Acute Tox. 4 (H302)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures
Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

4. FIRST AID MEASURES

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Ingestion	If swallowed, induce vomiting immediately by giving two glasses of water and sticking fingers down throat; never give anything to an unconscious person. Get medical attention.

Most Important symptoms and effects, both acute and delayed
May cause eye and skin irritation. May be harmful if swallowed.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Spills of this product are very slippery.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Keep container closed when not in use. Product has a shelf life of 36 months.

Specific End Use(s)

Exposure Scenario	No information available
Other Guidelines	No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Ethoxylated isodecanol	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Ethoxylated isodecanol	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls None known.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Impervious rubber gloves.
Skin Protection Normal work coveralls.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Liquid
Odor: Alcohol
Color: Colorless
Odor Threshold: No information available

Property Remarks/ Method	Values
pH:	7
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.0
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None known.
Incompatible Materials

10. STABILITY AND REACTIVITY

Strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects

Acute Toxicity

Inhalation	May cause respiratory irritation.
Eye Contact	May cause eye irritation.
Skin Contact	May cause skin irritation.
Ingestion	May be harmful if swallowed.

Chronic Effects/Carcinogenicity No data available to indicate any components present at greater than 0.1% may present a carcinogenic hazard.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethoxylated isodecanol	1140 mg/kg	No data available	No data available

Test species: Rat

12. ECOLOGICAL INFORMATION

Toxicity

Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Ethoxylated isodecanol	EC50: (72 hour) 10-100 mg/l (Skeletonema costatum)	TLM96: 10-100 mg/l (Leuciscus idus)	No information available	EC50: (48 hour) 10-100 mg/l (Daphnia)

Persistence and degradability

Readily biodegradable

Bioaccumulative potential

No information available

Mobility in soil

No information available

Results of PBT and vPvB assessment

No information available.

Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 2: Hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
R22 Harmful if swallowed.

R36/38 Irritating to eyes and skin.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 19-Nov-2010

16. OTHER INFORMATION

Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **QUIK-THIN**

Revision Date: 11-Nov-2002

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: QUIK-THIN
Synonyms: None
Chemical Family: Lignosulfonate
Application: Thinner

Manufacturer/Supplier
Baroid Drilling Fluids
a Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (800) 666-9260 or (713) 753-3000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Ferrochrome lignosulfonate	8075-74-9	60 - 100%	0.5 mg/m^3	0.5 mg/m^3

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 1, Flammability 0, Reactivity 0
HMIS Ratings:	Flammability 0, Reactivity 0, Health 1

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Brown
Odor:	Slight
pH:	3-3.5
Specific Gravity @ 20 C (Water=1):	1.12
Density @ 20 C (lbs./gallon):	Not Determined

Bulk Density @ 20 C (lbs/ft3):	28
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May be harmful if swallowed.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 15000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not applicable

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: 1750 ppm (Orcorhynchus mykiss)
Acute Crustaceans Toxicity: EC50: 1875 mg/l (Daphnia magna)
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	Chromium and Compounds//8075-74-9
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **QUIK-FREE**

Revision Date: 03-Jan-2008

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: QUIK-FREE
Synonyms: None
Chemical Family: Blend
Application: Spotting fluid

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Glycerine	56-81-5	30 - 60%		10 mg/m^3	Not applicable	10 mg/m^3	Not applicable
Fatty acid		30 - 60%	Not Listed	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Wash hands after use.
Storage Information	Store away from oxidizers. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally necessary.
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear light yellow
Odor:	Fatty acid
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	0.98
Density @ 20 C (kg/l):	0.98
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined**Min:** > 180
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Acrolein. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	Not determined

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

RDIF MSDS

Material Safety Data Sheet

1 . Product and company identification

Product name	:	BIO-PAQ™
Supplier	:	Baker Hughes, Inc. 12645 W. Airport Blvd. Sugar Land, TX 77478
Material Uses	:	Special: Filtration Control Agent
Code	:	1156DF
Validation date	:	2/26/2014.
Print date	:	2/26/2014.
Version	:	2
Responsible name	:	Global Regulatory Affairs - Telephone 281-276-5400
In case of emergency	:	CHEMTREC 800-424-9300 (U.S. 24 hour) (001)713-439-8900 CANUTEC 613-996-6666 (Canada 24 hours) CHEMTREC Int'l 01-703-527-3887 (International 24 hour)

2 . Hazards identification

Physical state	:	Solid. [Powder.]
Odor	:	Slight
Color	:	Off-white.
OSHA/HCS status	:	While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.
Emergency overview	:	MAY CAUSE EYE AND SKIN IRRITATION. Fine dust clouds may form explosive mixtures with air. Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat. Keep away from heat, sparks and flame. Prevent dust accumulation. Avoid breathing dust. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.

Potential acute health effects

Inhalation	:	Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.
Ingestion	:	No known significant effects or critical hazards.
Skin	:	Slightly irritating to the skin.
Eyes	:	Slightly irritating to the eyes. No significant irritation expected other than possible mechanical irritation.

Potential chronic health effects

Chronic effects	:	Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Over-exposure signs/symptoms

Inhalation	:	respiratory tract irritation, coughing
Ingestion	:	None known.
Skin	:	irritation, redness
Eyes	:	irritation, watering, redness

2 . Hazards identification

See toxicological information (Section 11)

3 . Composition/information on ingredients

Name	CAS number	%
No hazardous ingredient		

4 . First aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

5 . Fire-fighting measures

Flammability of the product : Fine dust clouds may form explosive mixtures with air.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : Do not use water jet.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : carbon dioxide,carbon monoxide,metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing dust. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

6 . Accidental release measures

Large spill : Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Vacuum or sweep up material and place in a designated, labeled waste container. Avoid creating dusty conditions and prevent wind dispersal. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
No exposure limit value known.											

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

Engineering measures : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

8 . Exposure controls/personal protection

Respiratory	:	Approved/certified disposable particulate dust mask. Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: No personal respiratory protective equipment normally required.
Hands	:	Chemical-resistant gloves: nitrile or neoprene
Eyes	:	Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.
Skin	:	Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

9 . Physical and chemical properties

Physical state	:	Solid. [Powder.]
Flash point	:	Not available.
Auto-ignition temperature	:	Not available.
Flammable limits	:	Not available.
Color	:	Off-white.
Odor	:	Slight
pH	:	9 to 10.5 [Conc. (% w/w): 4%]
Boiling/condensation point	:	Not available.
Initial Boiling Point	:	Not available.
Melting/freezing point	:	Not available.
Relative density	:	35 to 45(lb/cu ft)
Density	:	Not available.
Vapor density	:	Not available.
Odor threshold	:	Not available.
Evaporation rate	:	Not available.
VOC	:	Not available.
Viscosity	:	Not available.
Solubility (Water)	:	Soluble
Vapor pressure	:	Not available.
Pour Point	:	Not available.
Partition coefficient (LogKow)	:	Not available.

10 . Stability and Reactivity

Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	:	Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Prevent dust accumulation.
Materials to avoid	:	Reactive or incompatible with the following materials: oxidizing materials.

10 . Stability and Reactivity

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11 . Toxicological information

No additional information.

12 . Ecological information

Aquatic ecotoxicity

Conclusion/Summary : Not available.

Biodegradability

Conclusion/Summary : Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	Not regulated.	-	-	-		-
TDG Classification	Not regulated.	-	-	-		-
IMDG Class	Not regulated.	-	-	-		-
IATA-DGR Class	Not regulated.	-	-	-		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : Not available.

15 . Regulatory information

HCS Classification : Not regulated.

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.
CERCLA: Hazardous substances.: No products were found.
Clean Water Act (CWA) 307: No products were found.
Clean Water Act (CWA) 311: No products were found.
Clean Air Act (CAA) 112 regulated flammable substances: No products were found.
Clean Air Act (CAA) 112 regulated toxic substances: No products were found.
Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :
Not listed

SARA 302/304 : No products were found.

SARA 311/312

Classification : No products were found.

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Not controlled under WHMIS (Canada).

Canada (CEPA DSL): : All components are listed or exempted.

16 . Other information

Label requirements : MAY CAUSE EYE AND SKIN IRRITATION.

HMIS :

Health	0
Flammability	1
Physical hazards	0
Personal protection	E

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :

Date of printing : **2/26/2014.**

Indicates information that has changed from previously issued version.

Notice to reader

16 . Other information

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Material Safety Data Sheet

1 . Product and company identification

Product name : Magnesium Oxide (MAGOX)

Supplier : Baker Hughes Drilling Fluids
A Baker Hughes Company
2001 Rankin Road
Houston, TX 77073

Material Uses : Not available.

Code : 1080DF

Validation date : 10/5/2012.

Print date : 10/5/2012.

Version : 1

In case of emergency : For Chemical Emergency:
713-439-8900
1-800-424-9300

2 . Hazards identification

Physical state : Solid. [Crystalline solid.]

Odor : Odorless.

Color : White.

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Emergency overview : CAUTION!

MAY CAUSE RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.

Avoid contact with eyes, skin and clothing. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.

Potential acute health effects

Inhalation : Moderately irritating to the respiratory system.

Ingestion : No known significant effects or critical hazards.

Skin : Moderately irritating to the skin.

Eyes : Moderately irritating to eyes.

Potential chronic health effects

Chronic effects : Contains material that may cause target organ damage, based on animal data.

Target organs : Contains material which may cause damage to the following organs: lungs, upper respiratory tract, eyes.

Over-exposure signs/symptoms

Inhalation : respiratory tract irritation, coughing

Ingestion : None known.

Skin : irritation, redness

Eyes : irritation, watering, redness

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

3 . Composition/information on ingredients

Name	CAS number	%
Magnesium oxide	1309-48-4	60 - 100

4 . First aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

5 . Fire-fighting measures

Flammability of the product : No specific fire or explosion hazard.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Vacuum or sweep up material and place in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Use only with adequate ventilation. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
Magnesium oxide	US ACGIH	-	10	-	-	-	-	-	-	-	[a]
	OSHA PEL	-	15	-	-	-	-	-	-	-	[b]
	OSHA PEL 1989	-	10	-	-	-	-	-	-	-	[b]

Form: [a]Inhalable fraction. See Appendix C, paragraph A. Inhalable Particulate Mass TLVs (IPM–TLVs) for those materials that are hazardous when deposited anywhere in the respiratory tract. [b]Total particulates

Consult local authorities for acceptable exposure limits.

Only components of this product with established exposure limits appear in the box above.

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands : Chemical-resistant gloves.

Eyes : Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

Skin : Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

9 . Physical and chemical properties

Physical state	:	Solid. [Crystalline solid.]
Flash point	:	Not available.
Auto-ignition temperature	:	Not available.
Flammable limits	:	Not available.
Color	:	White.
Odor	:	Odorless.
pH	:	10 [Conc. (% w/w): 10%]
Boiling/condensation point	:	360°C (680°F)
Initial Boiling Point	:	Not available.
Melting/freezing point	:	Not available.
Relative density	:	Not available.
Density	:	Not available.
Vapor density	:	Not available.
Odor threshold	:	Not available.
Evaporation rate	:	Not available.
VOC	:	Not available.
Viscosity	:	Not available.
Solubility (Water)	:	Not available.
Vapor pressure	:	Not available.
Pour Point	:	Not available.
Partition coefficient (LogKow)	:	Not available.

10 . Stability and Reactivity

Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	:	No specific data.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11 . Toxicological information

Carcinogenicity

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Magnesium oxide	A4	-	-	-	-	-

Chronic toxicity Remarks

1) Magnesium oxide

Not available.

12 . Ecological information

Aquatic ecotoxicity

Conclusion/Summary : Not available.

Biodegradability

Conclusion/Summary : Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	Not regulated.	Not available.	-	-		-
TDG Classification	Not regulated.	Not available.	-	-		-
IMDG Class	Not regulated.	Not available.	-	-		-
IATA-DGR Class	Not regulated.	Not available.	-	-		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : Not available.

15 . Regulatory information

HCS Classification : Irritating material
Target organ effects

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Magnesium oxide
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Magnesium oxide: Immediate (acute) health hazard

CERCLA: Hazardous substances.: No products were found.

Clean Water Act (CWA) 307: No products were found.

Clean Water Act (CWA) 311: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

15 . Regulatory information

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :

Not listed

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Not controlled under WHMIS (Canada).

Canada (CEPA DSL): : All components are listed or exempted.

16 . Other information

Label requirements : MAY CAUSE RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.

Hazardous Material Information System (U.S.A.) :

Health	1
Flammability	0
Physical hazards	0
Personal protection	B

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :

Date of printing : **10/5/2012.**

◤ Indicates information that has changed from previously issued version.

Notice to reader

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Material Safety Data Sheet

b : Product and company identification

Product name	**R** MAX-GUARD™
Supplier	**R** Baker Hughes Drilling Fluids A Baker Hughes Company 2001 Rankin Road Houston, TX 77073
Material Uses	**R** Special: Shale Control Addtive
Code	**R** 1737DF
Validation date	**R** 9/9/2013.
Print date	**R** 9/9/2013.
Version	**R** 1
In case of emergency	**R** For Chemical Emergency: 713-439-8900 1-800-424-9300

- : v awards identification

Physical state	**R** Liquid.
Ador	**R** Mild.
Color	**R** Amber. [Dark]
ASv / 2/ CS status	**R** While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.
1 mergency o. er. ieE	**R** MAY CAUSE RESPIRATORY TRACT, EYE AND SKIN IRRITATION. Avoid breathing vapor or mist. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.

Potential acute health effects

Inhalation	**R** Slightly irritating to the respiratory system.
Ingestion	**R** No known significant effects or critical hazards.
SHin	**R** Slightly irritating to the skin.
1 yes	**R** Slightly irritating to the eyes.

Potential chronic health effects

A. erxezposure signs2symptoms

Inhalation	**R** respiratory tract irritation, coughing
Ingestion	**R** None known.
SHin	**R** irritation, redness
1 yes	**R** irritation, watering, redness

See tozicological information kSection bbO

(: Composition2nformation on ingredients

6 ame	**C/ S num0er**	**4**
No hazardous ingredient		

3 : %irst aid measures

1ye contact — **R** Get medical attention immediately. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.

SHin contact — **R** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation — **R** Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion — **R** Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of firstxaiders — **R** No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

q : %irexfighting measures

%amma0ility of the product — **R** In a fire or if heated, a pressure increase will occur and the container may burst.

1ztinguishing media

Suita0le — **R** Use an extinguishing agent suitable for the surrounding fire.

6ot suita0le — **R** None known.

Special ezposure hawards — **R** Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

v awardous thermal decomposition products — **R** carbon dioxide,carbon monoxide,nitrogen oxides

Special protecti. e eFuipment for firexfighters — **R** Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

L : / ccidental release measures

Personal precautions — **R** No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

1n. ironmental precautions — **R** Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill — **R** Stop leak if without risk. Move containers from spill area. Absorb with an inert material. Dispose of via a licensed waste disposal contractor.

5arge spill — **R** Stop leak if without risk. Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

7 : v andling and storage

v andling

R Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapor or mist. Use only with adequate ventilation. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage

R Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

3 : 1 zposure controls 2 personal protection

Accupational ezposure limits		W9 / k³ hoursO			SW 5 kbq minsO			Ceiling			
IngredientsR	5ist name	ppm	mg2mT	Ather	ppm	mg2mT	Ather	ppm	mg2mT	Ather	6otations
No exposure limit value known.											

If ASv / permissi0le ezposure le. els are shoE n a0o. e they are the ASv / b)³) le. els or are from su0seFuent ASv / regulatory actions: / lthough the b)³) le. els ha. e 0een . acated bbth Circuit Court of / ppeals, BaHer v ughes recommends that these loE er ezposure le. els 0e o0ser. ed as reasona0le E orHer protection:

8 ecommended monitoring procedures

R If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

1 ngineering measures

R Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

v ygiene measures

R Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

8 espiratory

R If a risk assessment indicates it is necessary, use a properly fitted, air purifying or supplied air respirator complying with an approved standard. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: organic vapor filter (Type A)

v ands

R Chemical-resistant gloves: nitrile or neoprene

1 yes

R Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

SHin

R Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

) : Physical and chemical properties

Physical state — **R** Liquid.

%lash point — **R** Closed cup: >93°C (>199.4°F) [PMCC]

/ utoxignition temperature — **R** Not available.

%lamma0le limits — **R** Not available.

Color — **R** Amber. [Dark]

Ador — **R** Mild.

) : Physical and chemical properties

pv	**R** 6.8 to 7.2 [Conc. (% w/w): 2%]
Boiling2condensation point	**R** Not available.
Initial Boiling Point	**R** Not available.
Melting2freewing point	**R** Not available.
8 elati. e density	**R** 1.07 to 1.09
Density	**R** Not available.
Vapor density	**R** Not available.
Ador threshold	**R** Not available.
1. aporation rate	**R** Not available.
VAC	**R** Not available.
Viscosity	**R** Not available.
Solu0ility k9 aterO	**R** Soluble
Vapor pressure	**R** Not available.
Pour Point	**R** Not available.
Partition coefficient k5ogKoEO	**R** Not available.

bN: Sta0ility and 8 eacti. ity

Chemical sta0ility	**R** The product is stable.
Possi0ility of hawardous reactions	**R** Under normal conditions of storage and use, hazardous reactions will not occur.
v awardous polymeriwation	**R** Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to a. oid	**R** No specific data.
v awardous decomposition products	**R** Under normal conditions of storage and use, hazardous decomposition products should not be produced.

bb: Wozicological information

6 o additional information:

b- : 1 cological information

/ Fuatic ecotozicity

Conclusion2Summary	**R** Not available.

Biodegrada0ility

Conclusion2Summary	**R** Not available.

b(: Disposal considerations

9 aste disposal	**R** The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should 0e in accordance E ith applica0le regional, national and local laE s and regulations:

8 efer to Section 7Rv / 6 D5I6 G / 6 D SWA8 / G1 and Section ³ R1 XPASU8 1 CA6 W8 A5S2P1 8 SA6 / 5 P8 AWI CWA6 for additional handling information and protection of employees:

b3 : Wansport information

8 egulatory information	U6 num0er	Proper shipping name	Classes	PG*	5a0el	/ dditional information
DAWClassification	Not regulated.	Not available.	-	-		-
WDG Classification	Not regulated.	Not available.	-	-		-
IMDG Class	Not regulated.	Not available.	-	-		-
I/ W xDG8 Class	Not regulated.	Not available.	-	-		-

PG* : Packing group

DAW8 eporta0le Quantity Not applicable.

Marine pollutant Not applicable.

6 orthx/ merica 6 / 1 8 G **R** Not available.

bq : 8 egulatory information

v CS Classification **R** Not regulated.

U:S: %ederal regulations **R** **United States in. entory kWSC/ ³ 0O** All components are listed or exempted.

CERCLA: Hazardous substances.: No products were found.

Clean 9 ater / ct kC9 / O(N7: No products were found.

Clean 9 ater / ct kC9 / O(bb: No products were found.

Clean / ir / ct kC/ / Obb- regulated flamma0le su0stances: No products were found.

Clean / ir / ct kC/ / Obb- regulated tozic su0stances: No products were found.

Clean / ir / ct Section bb- k0Ov awardous / ir Pollutants kv / PsOR

Not listed

S/ 8 / (N-2(N3 **R** No products were found.

S/ 8 / (bb2(b-

Classification **R** No products were found.

United States in. entory kWSC/ ³ 0O **R** All components are listed or exempted.

Canada

9 v MIS kCanadaO **R** Not controlled under WHMIS (Canada).

Canada kC1 P/ DS5 0R **R** Not determined.

bL : Ather information

5a0el reFuirements **R** MAY CAUSE RESPIRATORY TRACT, EYE AND SKIN IRRITATION.

v MIS **R**

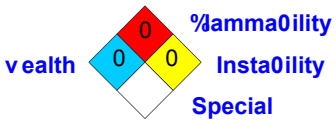
v ealth	0
%amma0ility	0
Physical hawards	0
Personal protection	C

bL : Ather information

CautionRv MIS® ratings are 0ased on a Nx3 rating scale, E ith N representing minimal hawards or risHs, and 3 representing significant hawards or risHs / lthough v MIS® ratings are not reFuired on MSDSs under -) C%8 b) bN: b- NN, the preparer may choose to pro. ide them: v MIS® ratings are to 0e used E ith a fully implemented v MIS® program: v MIS® is a registered marH of the 6 ational Paint & Coatings / ssociation k6 PC/ Ov MIS® materials may 0e purchased ezclusi. ely from J: J: Keller k³ NNO(- 7xL³ L³ :

Whe customer is responsi0le for determining the PP1 code for this material:

6 ational %ire Protection / ssociation kU:S:/ :O **R**



Date of printing **R) 2) 2- Nb(:**

◤ Indicates information that has changed from pre. iously issued . ersion:

6 otice to reader

6 AWI RWhe information on this MSDS is 0ased on data E hich is considered to 0e accurate: BaHer v ughes Drilling %luids, hoE e. er, maHes no guarantees or E arranty, either ezpressed or implied of the accuracy or completeness of this information:

Whe conditions or methods of handling, storage, use and disposal of the product are 0eyond our control and may 0e 0eyond our HnoE ledge: %or this and other reasons, E e do not assume responsi0ility and ezpressly disclaim lia0ility for loss, damage or ezpense arising out of or in any E ay connected E ith the handling, storage, use or disposal of this product:

Whis MSDS E as prepared and is to 0e used for this product: If the product is used as a component in another product, this MSDS information may not 0e applica0le:

Material Safety Data Sheet

1 . Product and company identification

Product name : MUL-FREE™ RS

Supplier : Baker Hughes Drilling Fluids
A Baker Hughes Company
2001 Rankin Road
Houston, TX 77073

Material Uses : Special: Non-Emulsifier

Code : 2027DF

Validation date : 9/1/2011.

Print date : 9/1/2011.

Version : 1.03

In case of emergency : For Chemical Emergency:
713-439-8900
1-800-424-9300

2 . Hazards identification

Physical state : Liquid.

Color : Yellow to amber.

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Emergency overview : MAY CAUSE EYE AND SKIN IRRITATION.
Avoid breathing vapor or mist. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Wash thoroughly after handling.

Potential acute health effects

Inhalation : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Skin : Slightly irritating to the skin.

Eyes : Slightly irritating to the eyes.

Potential chronic health effects

Over-exposure signs/symptoms

Inhalation : None known.

Ingestion : None known.

Skin : irritation, redness

Eyes : irritation, watering, redness

See toxicological information (section 11)

3 . Composition/information on ingredients

Name	CAS number	%
No hazardous ingredient		

4 . First aid measures

Eye contact : Get medical attention immediately. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

5 . Fire-fighting measures

Flammability of the product : In a fire or if heated, a pressure increase will occur and the container may burst.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : No specific data.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Absorb with an inert material. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapor or mist. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
No exposure limit value known.											

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

Respiratory : If a risk assessment indicates it is necessary, use a properly fitted, air purifying or supplied air respirator complying with an approved standard. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands : Chemical-resistant gloves.

Eyes : Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

Skin : Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

9 . Physical and chemical properties

Physical state : Liquid.

Flash point : Closed cup: >230°C (>446°F) [Tagliabue.]

Auto-ignition temperature : Not available.

Flammable limits : Not available.

Color : Yellow to amber.

Odor : Not available.

pH : Not available.

9 . Physical and chemical properties

Boiling/condensation point	:	Not available.
Initial Boiling Point	:	Not available.
Melting/freezing point	:	Not available.
Relative density	:	1.073 (20°C)
Density	:	Not available.
Vapor density	:	Not available.
Odor threshold	:	Not available.
Evaporation rate	:	Not available.
VOC	:	Not available.
Viscosity	:	Kinematic (40°C): 700 to 900 cSt
Solubility (Water)	:	Not available.
Vapor pressure	:	Not available.
Pour Point	:	-21°C (-5.8°F)
Partition coefficient (LogKow)	:	Not available.

10 . Stability and Reactivity

Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	:	No specific data.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11 . Toxicological information

No additional information.

Chronic toxicity Remarks

Not available.

12 . Ecological information

Aquatic ecotoxicity

Conclusion/Summary : Not available.

Biodegradability

Conclusion/Summary : Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	Not regulated.	Not available.	-	-		-
TDG Classification	Not regulated.	Not available.	-	-		-
IMDG Class	Not regulated.	Not available.	-	-		-
IATA-DGR Class	Not regulated.	Not available.	-	-		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : Not available.

15 . Regulatory information

HCS Classification : Not regulated.

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: No products were found.
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: No products were found.

CERCLA: Hazardous substances.: No products were found.

Clean Air Act (CAA) 112 accidental release prevention: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :

Not listed

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Not controlled under WHMIS (Canada).

Canada (CEPA DSL): : All components are listed or exempted.

16 . Other information

Label requirements : MAY CAUSE EYE AND SKIN IRRITATION.

Hazardous Material Information System (U.S.A.) :

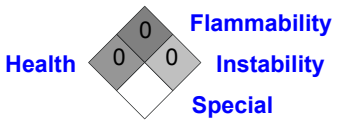
Health	0
Flammability	0
Physical hazards	0
Personal protection	C

16 . Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :



Date of printing : **9/1/2011.**

Indicates information that has changed from previously issued version.

Notice to reader

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Material Safety Data Sheet

1 . Product and company identification

Product name : XAN-PLEX™ D

Supplier : Baker Hughes Drilling Fluids
A Baker Hughes Company
2001 Rankin Road
Houston, TX 77073

Material Uses : Special: Viscosifier

Code : 1171DF

Validation date : 5/24/2011.

Print date : 5/24/2011.

Version : 1

In case of emergency : For Chemical Emergency:
713-439-8900
1-800-424-9300

2 . Hazards identification

Physical state : Solid. [Powder.]

Odor : Faint odor.

Color : White. to Tan.

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Emergency overview : Within the present knowledge of the supplier, this product does not contain any hazardous ingredients in quantities requiring reporting, in accordance with local regulations.

Fine dust clouds may form explosive mixtures with air. Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat. Keep away from heat, sparks and flame. Prevent dust accumulation. Avoid breathing dust. Avoid prolonged contact with eyes, skin and clothing. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use.

Potential acute health effects

Inhalation : Exposure to airborne concentrations above statutory or recommended exposure limits may cause irritation of the nose, throat and lungs.

Ingestion : No known significant effects or critical hazards.

Skin : No known significant effects or critical hazards.

Eyes : No significant irritation expected other than possible mechanical irritation.

Potential chronic health effects

Chronic effects : Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Over-exposure signs/symptoms

Inhalation : respiratory tract irritation, coughing

Ingestion : None known.

Skin : None known.

Eyes : irritation, redness

See toxicological information (section 11)

3 . Composition/information on ingredients

Name	CAS number	%
No hazardous ingredient		

4 . First aid measures

Eye contact : Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention if symptoms occur.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if symptoms occur.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

5 . Fire-fighting measures

Flammability of the product : Fine dust clouds may form explosive mixtures with air.

Extinguishing media

Suitable : Use dry chemical powder.

Not suitable : Do not use water jet.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : No specific data.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing dust. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Vacuum or sweep up material and place in a designated, labeled waste container. Avoid creating dusty conditions and prevent wind dispersal. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

6 . Accidental release measures

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Avoid breathing dust. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
No exposure limit value known.											

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

Respiratory : Approved/certified disposable particulate dust mask. Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands : Chemical-resistant gloves.

Eyes : Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

Skin : Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

9 . Physical and chemical properties

Physical state	:	Solid. [Powder.]
Flash point	:	Closed cup: Not applicable.
Auto-ignition temperature	:	Not available.
Flammable limits	:	Not available.
Color	:	White. to Tan.
Odor	:	Faint odor.
pH	:	7 [Conc. (% w/w): 5%]
Boiling/condensation point	:	>200°C (>392°F)
Initial Boiling Point	:	Not available.
Melting/freezing point	:	Not available.
Relative density	:	Not available.
Density	:	Not available.
Vapor density	:	Not available.
Odor threshold	:	Not available.
Evaporation rate	:	Not available.
VOC	:	Not available.
Viscosity	:	Not available.
Solubility (Water)	:	Soluble
Vapor pressure	:	Not available.
Pour Point	:	Not available.
Partition coefficient (LogKow)	:	Not available.

10 . Stability and Reactivity

Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	:	Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Prevent dust accumulation.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11 . Toxicological information

No additional information.

12 . Ecological information

Aquatic ecotoxicity

Conclusion/Summary	:	Not available.

Biodegradability

Conclusion/Summary	:	Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	Not regulated.	Not available.	-	-		-
TDG Classification	Not regulated.	Not available.	-	-		-
IMDG Class	Not regulated.	Not available.	-	-		-
IATA-DGR Class	Not regulated.	Not available.	-	-		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : Not available.

15 . Regulatory information

HCS Classification : Not regulated.

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: No products were found.
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: No products were found.

CERCLA: Hazardous substances.: No products were found.

Clean Air Act (CAA) 112 accidental release prevention: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :

Not listed

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Not controlled under WHMIS (Canada).

15 . Regulatory information

Canada (CEPA DSL): : All components are listed or exempted.

16 . Other information

Label requirements : Within the present knowledge of the supplier, this product does not contain any hazardous ingredients in quantities requiring reporting, in accordance with local regulations.

Hazardous Material Information System (U.S.A.) :

Health	0
Flammability	1
Physical hazards	0
Personal protection	C

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :

Date of printing : **5/24/2011.**

◤ **Indicates information that has changed from previously issued version.**

Notice to reader

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

RDIF MSDS
END

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **RHEMOD™ L**

Revision Date: 03-Jan-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: RHEMOD™ L
Synonyms: None
Chemical Family: Tall oil fatty acid
Application: Viscosifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Fatty acids, C18-unsatd., trimers	68937-90-6	10 - 30%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye and skin irritation. May be harmful if swallowed.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	518
Flash Point/Range (C):	270
Flash Point Method:	COC
Autoignition Temperature (F):	> 425
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 1, Flammability 1, Reactivity 0
HMIS Ratings:	Health 1, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Wash hands after use.
Storage Information	Store in a cool, dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Dark
Odor:	Fatty acid
pH:	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	0.96
Density @ 20 C (lbs./gallon):	8
Bulk Density @ 20 C (lbs/ft3):	57.30
Boiling Point/Range (F):	> 572
Boiling Point/Range (C):	> 300
Freezing Point/Range (F):	< -4
Freezing Point/Range (C):	< 25
Vapor Pressure @ 20 C (mmHg):	< 0.001
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	0
Evaporation Rate (Butyl Acetate=1):	0
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	1849 @ 25C
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye and skin contact.
Inhalation	May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	Not determined

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

END OF MSDS

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **SODA ASH**

Revision Date: 18-Jul-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: SODA ASH
Synonyms: None
Chemical Family: Carbonate
Application: Buffer

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium carbonate	497-19-8	60 - 100%	207-838-8	10 mg/m^3	Not applicable	Not applicable	Xi; R36

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a cool, dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Localized ventilation should be used to control dust levels.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	White
Odor:	Odorless
pH:	11.5
Specific Gravity @ 20 C (Water=1):	2.5
Density @ 20 C (kg/l):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	105.99
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	Prolonged or repeated contact may cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	LD50: 4220 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM24: 385 mg/l (Lepomis macrochirus)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases
S2 Keep out of reach of children.
S22 Do not breathe dust.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification
Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **SODIUM BICARBONATE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: SODIUM BICARBONATE
Synonyms: None
Chemical Family: Carbonate
Application: Buffer

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium bicarbonate	144-55-8	60 - 100%	205-633-8	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	8
Specific Gravity @ 20 C (Water=1):	1.87
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	LD50: 4220 mg/kg (Rat)

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **SODIUM CHLORIDE**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: SODIUM CHLORIDE
Synonyms: None
Chemical Family: Salt
Application: Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium chloride	7647-14-5	60 - 100%	231-598-3	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	Not Determined
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	35.7
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 3000 mg/kg (Rat)
Dermal Toxicity:	Not determined

Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

Material Safety Data Sheet

1 . Product and company identification

Product name : SODIUM BROMIDE BRINE

Supplier : Baker Hughes Drilling Fluids
A Baker Hughes Company
2001 Rankin Road
Houston, TX 77073

Material Uses : Not available.

Code : 7124DF

Validation date : 9/13/2011.

Print date : 9/13/2011.

Version : 1

In case of emergency : For Chemical Emergency:
713-439-8900
1-800-424-9300

2 . Hazards identification

Physical state : Liquid.

Odor : Odorless.

Color : Clear. Colorless.

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Emergency overview : Within the present knowledge of the supplier, this product does not contain any hazardous ingredients in quantities requiring reporting, in accordance with local regulations.

Avoid prolonged contact with eyes, skin and clothing.

Potential acute health effects

Inhalation : Irritating to respiratory system.

Ingestion : Ingestion may cause gastrointestinal irritation and diarrhea.

Skin : Irritating to skin.

Eyes : Irritating to eyes.

Potential chronic health effects

Over-exposure signs/symptoms

Inhalation : Exposure can cause coughing, chest pains and difficulty in breathing.

Ingestion : Ingestion may cause nausea, diarrhea and vomiting.

Skin : None known.

Eyes : None known.

See toxicological information (section 11)

3 . Composition/information on ingredients

Name	CAS number	%
No hazardous ingredient		

4 . First aid measures

Eye contact : Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention if symptoms occur.

Skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if symptoms occur.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

5 . Fire-fighting measures

Flammability of the product : In a fire or if heated, a pressure increase will occur and the container may burst.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Hazardous thermal decomposition products : halogenated compounds,metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Absorb with an inert material. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Dike spill area and do not allow product to reach sewage system or surface or ground water. Notify any reportable spill to authorities. (See section 12 for environmental risks and 13 for disposal information.) Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

Storage : Store in accordance with local regulations. Store in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredients:	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
No exposure limit value known.											

If OSHA permissible exposure levels are shown above they are the OSHA 1989 levels or are from subsequent OSHA regulatory actions. Although the 1989 levels have been vacated the 11th Circuit Court of Appeals, Baker Hughes recommends that these lower exposure levels be observed as reasonable worker protection.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures : No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Take off contaminated clothing and wash before reuse.

Personal protection

Respiratory : If a risk assessment indicates it is necessary, use a properly fitted, air purifying or supplied air respirator complying with an approved standard. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands : Chemical-resistant gloves.

Eyes : Wear chemical safety goggles. When transferring material wear face-shield in addition to chemical safety goggles.

Skin : Wear long sleeves and other protective clothing to prevent repeated or prolonged skin contact.

9 . Physical and chemical properties

Physical state : Liquid.
Flash point : Not available.
Auto-ignition temperature : Not available.
Flammable limits : Not available.
Color : Clear. Colorless.
Odor : Odorless.
pH : 5.5 to 8.5 [Conc. (% w/w): 5%]
Boiling/condensation point : Not available.
Initial Boiling Point : Not available.

9 . Physical and chemical properties

Melting/freezing point	:	Not available.
Relative density	:	1.01 to 1.53 (20°C)
Density	:	Not available.
Vapor density	:	Not available.
Odor threshold	:	Not available.
Evaporation rate	:	Not available.
VOC	:	Not available.
Viscosity	:	Not available.
Solubility (Water)	:	Soluble
Vapor pressure	:	Not available.
Pour Point	:	Not available.
Partition coefficient (LogKow)	:	Not available.

10 . Stability and Reactivity

Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid	:	No specific data.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11 . Toxicological information

No additional information.

12 . Ecological information

Aquatic ecotoxicity

Conclusion/Summary : Not available.

Biodegradability

Conclusion/Summary : Not available.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	Not regulated.	Not available.	-	-		-
TDG Classification	Not regulated.	Not available.	-	-		-
IMDG Class	Not regulated.	Not available.	-	-		-
IATA-DGR Class	Not regulated.	Not available.	-	-		-

PG* : Packing group

DOT Reportable Quantity Not applicable.

Marine pollutant Not applicable.

North-America NAERG : Not available.

15 . Regulatory information

HCS Classification : Not regulated.

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Sodium bromide
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Sodium bromide: Delayed (chronic) health hazard

CERCLA: Hazardous substances.: No products were found.
Clean Air Act (CAA) 112 accidental release prevention: No products were found.
Clean Air Act (CAA) 112 regulated flammable substances: No products were found.
Clean Air Act (CAA) 112 regulated toxic substances: No products were found.
Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) :
Not listed

United States inventory (TSCA 8b) : All components are listed or exempted.

Canada

WHMIS (Canada) : Class D-2A: Material causing other toxic effects (Very toxic).

Canada (CEPA DSL): : All components are listed or exempted.

16 . Other information

Label requirements : Within the present knowledge of the supplier, this product does not contain any hazardous ingredients in quantities requiring reporting, in accordance with local regulations.

Hazardous Material Information System (U.S.A.) :

Health	1
Flammability	0
Physical hazards	0
Personal protection	C

16 . Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :

Date of printing : **9/13/2011.**

◤ Indicates information that has changed from previously issued version.

Notice to reader

NOTE: The information on this MSDS is based on data which is considered to be accurate. Baker Hughes Drilling Fluids, however, makes no guarantees or warranty, either expressed or implied of the accuracy or completeness of this information.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of this product.

This MSDS was prepared and is to be used for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **SOURSCAV®**

Revision Date: 03-Jan-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: SOURSCAV®
Synonyms: None
Chemical Family: Organometal
Application: Hydrogen Sulfide Scavenger

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Iron gluconate	299-29-6	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. May be harmful if swallowed.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 1, Flammability 0, Reactivity 0
HMIS Ratings:	Health 1, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store away from oxidizers. Store in a cool, dry location. Keep container closed when not in use. Store away from direct sunlight. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Light yellow-green
Odor:	Mild burnt sugar

9. PHYSICAL AND CHEMICAL PROPERTIES

pH:	4-5.5
Specific Gravity @ 20 C (Water=1):	Not Determined
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	400-530
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers. Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide. Metal oxides.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	LD50: 2237 mg/kg (Rat)
Dermal Toxicity:	Not determined

Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **STARCIDE®**

Revision Date: 30-Apr-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STARCIDE®
Synonyms: None
Chemical Family: Oxazolidine
Application: Bactericide

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R34 Causes burns.
R21/22 Harmful in contact with skin and if swallowed.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
N, N' -Methylene bis (5-methyl oxazolidine)	66204-44-2	90 - 100%	266-235-8	Not applicable	Not applicable	Not applicable	C; Xn; R21/22-34

4. FIRST AID MEASURES

Inhalation	If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse. Avoid breathing mist.
Storage Information	Store away from oxidizers. Store away from acids. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.

Hand Protection	Impervious rubber gloves. Butyl rubber gloves. Nitrile gloves.
Skin Protection	Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Light yellow
Odor:	Sweet amine
pH:	10
Specific Gravity @ 20 C (Water=1):	1.05
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	116
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined**Min:** > 100
Flash Point Method:	DIN 51758
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	< 1
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	1.89
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers. Strong acids. Reducing agents.
Hazardous Decomposition Products	Formaldehyde. Oxides of nitrogen. Oxides of sulfur.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.

Inhalation	May cause respiratory irritation.
Skin Contact	Causes severe skin irritation. May cause skin burns.
Eye Contact	Causes severe eye irritation May cause eye burns.
Ingestion	Harmful if swallowed.
Aggravated Medical Conditions	Skin disorders. Eye ailments.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 900 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 57.7 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity:	EC50: 37.9 mg/l (Daphnia magna)
Acute Algae Toxicity:	IC50: 5.7 mg/l (Scenedesmus subspicatus)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR

UN3267,Corrosive Liquid, Basic, Organic, N.O.S.(Contains N, N' -Methylenebis[5-methyl oxazolidine]), 8, III

Air Transportation

ICAO/IATA

UN3267,Corrosive Liquid, Basic, Organic, N.O.S., 8, III
(Contains N, N' -Methylenebis[5-methyl oxazolidine] Solution)

Sea Transportation

IMDG

UN3267,Corrosive Liquid, Basic, Organic, N.O.S.(Contains N, N' -Methylenebis[5-methyl oxazolidine]), 8, III
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification C - Corrosive.

Risk Phrases R34 Causes burns.
R21/22 Harmful in contact with skin and if swallowed.

Safety Phrases S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S28 After contact with skin, wash immediately with plenty of soap and water.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification	C - Corrosive. Xn - Harmful. R21/22 Harmful in contact with skin and if swallowed. R34 Causes burns.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **STEELSEAL®**

Revision Date: 05-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STEELSEAL®
Synonyms: None
Chemical Family: Graphite
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye and respiratory irritation. May cause delayed injury to lungs. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Calcined petroleum coke	64743-05-1	60 - 100%	265-210-9	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin
Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and dark procedures for low oxygen levels should be taken to ensure ample oxygen availability.
Storage Information	Store away from oxidizers. Store in a dry location. Keep from heat, sparks, and open flames. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Dark gray

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.75
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	4200
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 356
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	1
Vapor Density (Air=1):	0.4
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause mild gastric distress.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **STEELSEAL®**

Revision Date: 05-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STEELSEAL®
Synonyms: None
Chemical Family: Graphite
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye and respiratory irritation. May cause delayed injury to lungs. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Calcined petroleum coke	64743-05-1	60 - 100%	265-210-9	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin
Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and dark procedures for low oxygen levels should be taken to ensure ample oxygen availability.
Storage Information	Store away from oxidizers. Store in a dry location. Keep from heat, sparks, and open flames. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Dark gray

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.75
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	4200
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 356
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	1
Vapor Density (Air=1):	0.4
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause mild gastric distress.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **STOP-FRAC D**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STOP-FRAC D
Synonyms: None
Chemical Family: Blend
Application: Sealing and Plugging Agent

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Limestone	1317-65-3	10 - 30%	215-279-6	Not applicable
Graphite	7782-42-5	10 - 30%	231-955-3	Not applicable
Carbon	7440-44-0	10 - 30%	231-153-3	Not applicable
Cellulose	9004-34-6	5 - 10%	232-674-9	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion If swallowed, induce vomiting immediately by giving two glasses of water and sticking fingers down throat; never give anything to an unconscious person. Get medical attention.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Avoid dust accumulations.

Storage Information Store in a dry location. Keep from heat, sparks, and open flames. Store away from oxidizers. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Limestone	Not applicable	10 mg/m^3	10 mg/m^3	10 mg/m^3	Not applicable
Graphite	Not applicable	10 mg/m^3	2 mg/m^3	2 mg/m^3	6 mg/m^3
Carbon	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	10 mg/m^3

Cellulose	Not applicable	10 mg/m^3	2 mg/m^3	10 mg/m^3	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Limestone	Not applicable	Not applicable	10 mg/m^3	10.0 mg/m^3	Not applicable
Graphite	Not applicable	4.0 mg/m^3	Not applicable	2.0 mg/m^3	Not applicable
Carbon	Not applicable	4.0 mg/m^3	Not applicable	Not applicable	Not applicable
Cellulose	Not applicable	Not applicable	Not applicable	6.0 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Pellet
Color:	Black
Odor:	Mild
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.5
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 356
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause mild gastric distress.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **TAU-MOD™**

Revision Date: 20-Nov-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: TAU-MOD™
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Sepiolite	63800-37-3	60 - 100%	Not applicable	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.025 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.025 mg/m^3	$\frac{10\ mg/m^3}{\%SiO2 + 2}$

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye, skin, and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

NFPA Ratings: Health 1, Flammability 0, Reactivity 0
HMIS Ratings: Health 1*, Flammability 0, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Pink to tan to gray
Odor:	Mild earthy
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.9-2.4
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	45-55
Boiling Point/Range (F):	> 1000
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	0
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Insoluble in organic solvents
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight (g/mole): Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach.
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Chronic Health Hazard Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.

EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	Product contains one or more components not listed on the inventory.
WHMIS Hazard Class	D2A Very Toxic Materials Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **TUNED SPACER E+**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: TUNED SPACER E+
Synonyms: None
Chemical Family: Mineral
Application: Cement Spacer

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	Not applicable
Bentonite	1302-78-9	60 - 100%	215-108-5	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3
Bentonite	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable
Crystalline silica, tridymite	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.05 mg/m^3	Not applicable
Crystalline silica, cristobalite	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.05 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable
Bentonite	Not applicable	Not applicable	Not applicable	6.0 mg/m^3	Not applicable
Crystalline silica, tridymite	Not applicable	2 mg/m^3	0.15 mg/m^3	0.1 mg/m^3	Not applicable
Crystalline silica, cristobalite	Not applicable	2 mg/m^3	0.15 mg/m^3	0.1 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to light straw
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide. Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

Baroid Fluid Services

WALL-NUT®

Lost Circulation Material — Product Data Sheet

Product Description

WALL-NUT ground walnut shells are used to help combat lost circulation. WALL-NUT lost circulation material is available in three grades: fine, medium, and coarse. All three grades may be used in pills for spotting opposite thief zones and in high filtration squeeze slurries. WALL-NUT lost circulation material can be used in the active mud system to help prevent lost returns.

Applications / Functions

- Helps stop or reduce the occurrence of lost circulation
- Helps remove sticky clays from the bottomhole assembly

Advantages

- High strength
- Is compatible with other lost circulation materials
- Size can be matched with the type of lost circulation encountered

Typical Properties

- Appearance — Coarse, granular material
- Dry Screen Analysis, See table

Recommended Treatment

Add 10-40 lb/bbl (28.5-114.1 kg/m³).

Packaging

WALL-NUT lost circulation material fine, medium, and coarse are packaged in 50-lb (22.7-kg) sacks.

HALLIBURTON | Fluid Systems

Baroid Fluid Services • P.O. Box 1675 • Houston TX 77251 • 281-871-5516

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

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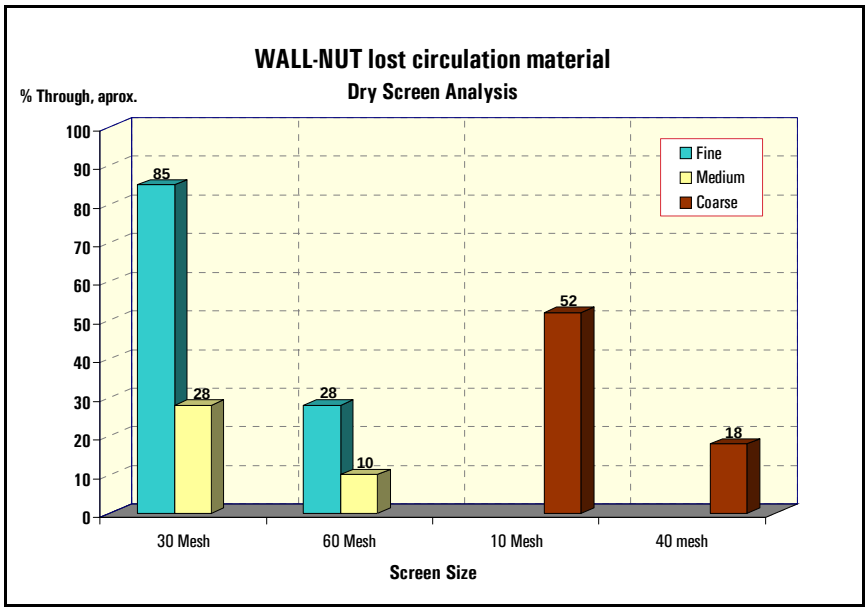
April 2005



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April 2005

HALLIBURTON

SAFETY DATA SHEET

WellLife™ 734

Revision Date: 21-Apr-2011 **Revision Number:** 5

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name WellLife™ 734

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Cement Enhancer

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Glass	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures
Inhalation Under normal conditions, first aid procedures are not required.
Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin Under normal conditions, first aid procedures are not required.
Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Material is slippery underfoot. Keep floors clean of spills.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a dry location. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Glass	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Glass	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls None known.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** White to Variable
Odor: Odorless

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	1200
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Density	No data available
Specific Gravity	2.62
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	None known.
Eye Contact	May cause mechanical irritation to eye.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Glass	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Glass	No information available	No information available	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 21-Apr-2011
Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

APPENDIX G

Drilling Mud Treatment and Processing System

Environmental Evaluation of Drilling Mud and Cuttings Offshore Discharge Option on Future Miocene Wells, Offshore Israel

June 1, 2014

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Acronyms and Abbreviations

CCB	CleanCut Cuttings Blower
CFMOB	clay free mineral oil base mud
CSA	CSA Ocean Sciences Inc.
DNV	Det Norske Veritas
EA	Environmental Assessment
GHG	greenhouse gas
L-1	Leviathan-1 (wellsite)
L-5	Leviathan-5 (wellsite)
MD	measured depth
MEWR	Ministry of Energy and Water Resources
MOBM	mineral oil based mud
MoEP	Ministry of Environmental Protection
MT	metric ton
NADF	non-aqueous drilling fluids
Noble	Noble Energy Mediterranean Ltd
NRC	National Research Council
OGP	International Association of Oil & Gas Producers
OIW	Oil in water
OOC	Oil on cuttings
OPF	Organic-phase drilling fluids
OSPAR	Convention for the Protection of Marine Environment in the Northeast Atlantic
PAH	polycyclic aromatic hydrocarbon
PLONOR	Pose Little or NO Risk to the environment
SBF	synthetic-based fluids
SBM	synthetic-based muds
SPP	suspended particulate phase

TPH	total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
WBM	water-based muds

1.0 INTRODUCTION

Noble Energy Mediterranean Ltd (Noble) operates eight leases offshore Israel. These include seventeen deepwater leases (Alon A, Alon B, Alon C, Alon D, Alon E, Alon F, Amit, Rachel, David, Hanna, Eran, Tamar, Ruth A, Ruth B, Ruth C, Ruth D and Dalit) and two in relatively shallow water (Ashqelon and Noa). This report focuses on the deepwater leases, where water depths range from approximately 1,500 to 1,900 m. Noble plans to drill 3 to 4 wells per year beginning in 2015 in these leases. The wells are expected to be in water depths greater than 1,600 m and will be spaced relatively widely apart (approximately 10 km or more).

This report presents a proposal for offshore discharge of drill cuttings for Noble's Miocene (5,000 m to 5,500 m) gas exploration and development drilling programs. The report focuses on the potential impacts, logistical requirements and other considerations that are specific to the proposed plans. Noble believes that certain environmental benefits can be achieved from utilization of the strategy provided in this report and seeks Ministry of Environmental Protection (MoEP) comments and approval.

1.1 BACKGROUND

To date, all but one of Noble's wells offshore Israel have been drilled using water based muds (WBM). A deep hole portion of Leviathan-1 (L-1) was drilled using mineral oil based mud (MOBM) with the cuttings transported onshore. WBMs have been used worldwide in offshore drilling for more than 50 years (National Research Council [NRC], 1983) and are adequate for many drilling programs. But, WBMs are inefficient and have resulted in large amounts of operational inefficiency (about 15% to 20% longer time to drill wells). To make WBM technically viable, Noble has needed to add a large number of specialty chemicals (glycols, bactericides, potassium, and special shale inhibitors) that have increased the complexity of managing the drilling program in an environmentally responsible manner.

In November 2013 Noble drilled Tamar SW-1, a Miocene well from 3620m to 5,377m MD in 157.3 rotating hours (on bottom) with WBM. Previously between June and August 2013, Noble drilled Cyprus A-2a a similar Miocene well from 3620m to 5,377m MD in 74.09 rotating hours (on bottom) with MOBM. This was 83.2 hours (3.5 days) or a 53% reduction in total drilling hours due to increased rates of penetration with MOBM. This does not include other potential reductions in time that could be achieved from reduced hole stability issues.

These factors have led Noble to pursue the alternatives of non-aqueous drilling fluids (NADF) such as MOBM to maintain proper well control, rheological control, inhibition capability, and lubricity. With the infrastructure currently being installed for use of MOBM for the deep drilling test (ML-1X), Noble would also propose using MOBM for its current Miocene gas exploration and development drilling. Use of MOBM could result in a reduction of as much as 20% of the time required to drill due to increased rates of penetration, reduced hole stability issues and electronic failures currently experienced with the use of salt-saturated WBM.

When wells are drilled exclusively with WBM, all of the cuttings (and some of the drilling mud) are typically discharged to the sea or ocean (NRC, 1983; Neff, 1987, 2005, 2010). Discharges of WBM and cuttings are routinely permitted offshore Israel and in nearly all countries that have an offshore oil and gas industry. However, when NADF are used, the muds are recycled rather than discharged and cuttings discharges are subject to restrictions that vary from country to country (OGP, 2003). Under the Offshore Protocol of the Barcelona Convention (which Israel has signed, but not ratified), NADF cuttings discharges are allowed, subject to an organic-phase drilling fluids (OPF) retention limit of 10% base oil content (by dry weight) on cuttings. A well-established regulatory framework exists in the North Sea and provides the basis for the main options being considered by Noble:

- OSPAR region (Norway, United Kingdom, etc.) – NADF systems are widely used and include both MOBM and SBM. Although OPF cuttings can be discharged, the residual OPF on cuttings is limited to 1% (dry weight) (OSPAR, 2000/3).

Noble's preferred option is to use MOBM for future Miocene gas exploration and development wells due to increased operational efficiency, shale inhibition, wellbore stability, and lubricity while reducing drilling time and chemical usage. Also under this option, the cuttings would be processed to <1% base oil content (by dry weight) on cuttings and disposed of onsite as is currently permitted by OSPAR, 2000. This objective would be achieved by installing a Thermomechanical Cuttings Cleaner (TCC) on the drilling vessel which would process the cuttings prior to discharge. This process is described in this document.

1.2 OBJECTIVES AND SCOPE

The purpose of this document is to present information on the comparative performance for drilling mud and cuttings disposal for Noble's future Miocene gas exploration and development program in leases offshore Israel. Noble's preferred option is to use MOBM and to discharge the cuttings at the wellsites. This document describes the proposed treatment methodology for drill cuttings, potential impacts, logistical requirements, and other considerations that are specific to this scope. The discussion also highlights how the impacts would differ from those associated with drilling using WBM.

2.0 DESCRIPTION OF SYSTEM

2.1 MOBM OVERVIEW

The initial well intervals (before the marine riser is set) would be drilled using a water-based "spud mud," and the cuttings and "spud mud" would be released at the seafloor. The release involves localized impacts to the seafloor and benthic communities around the near wellbore, generally within a few meters to tens of meters. This impact is present under any scenario that uses either WBM or MOBM. However, once the marine riser is set, mud and cuttings are returned to the drilling rig. Under this proposal, the subsequent discharge of the cuttings with retained MOBM would be released approximately 12 m below the sea surface.

The wells would be drilled using MOBM, Escaid® 110. The MOBM would be recovered by solids control equipment and recycled as discussed below. The MOBM cuttings would be discharged onsite, subject to the effluent limitations requirements that are currently used in the North Sea OSPAR region. There would be no discharge of the base MOBM fluid except for small amounts adhering to cuttings (<1% by dry weight on cuttings).

2.2 MUD SYSTEM

The MOBM selected by Noble is INNOVERT® CFMOB (clay free mineral oil base mud), a high-performance invert emulsion fluid system developed by Baroid (a product service line of Halliburton). ExxonMobil Chemical's Escaid® 110 would be the base fluid for the INNOVERT® mud system (see Appendices 1 and 2 for more information). Escaid® 110 mineral base oil is derived from selected petroleum feedstocks which have been highly refined and reacted with hydrogen to convert aromatics to cycloparaffins. This deep hydrogenation results in products of controlled composition with low aromatics content, negligible relative impurities and a low, sweet odor. It is a complex mixture of hydrocracked and desulfurized hydrocarbons with a narrow distillation range (205° to 237°C). Escaid® 110 has a low viscosity and can considerably reduce the friction factor between the drill string and the sides of the borehole. It offers high drilling performance, enhancing rates of penetration and shale inhibition.

The MOBM that Noble is considering is classified as a "Group III NADF" based on its aromatic content less than 0.5% and PAH content less than 0.001% (OGP, 2003). Key components of the INNOVERT® mud system include: (1) ESCAID® 110 – the mineral oil base fluid; (2) LE SUPERMUL™ – a polyaminated fatty acid that can be used to emulsify water into the fluid (helps improve wetting characteristics and is designed for use in high-performance fluids); (3) Lime – that can be used to increase the alkalinity level of the water phase; (4) Calcium Chloride –used as a brine salt in invert emulsion fluids; (4) BAROID® – barite, added as needed as a weighting agent; (5) RHEMOD L™ – a unique, modified fatty acid for providing suspension and viscosity; (6) ADAPTA™ – a copolymer for providing high-pressure/high-temperature filtration control; (7) EZ Mul NT – an invert emulsifier and oil-wetting agent; and (8) TAU MOD – a viscosifier used to improve suspension and hole cleaning capabilities in high-performance fluids.

The advantages of this formulation are:

- Stable mud properties over a wide temperature and density range; suitable for high-temperature/high-pressure applications;

- A better seal than conventional technologies;
- Reduced downhole losses of drilling mud;
- Unique rheological properties that eliminate the need for fine ground weighting agents while providing excellent hole cleaning;
- Increased tolerance to contaminants such as solids and water influxes;
- Significantly lower solids content to help increase penetration rates;
- Fewer products than for conventional synthetics, improving logistics and rig space usage;
- Real-time response to chemical treatments; and
- Enhanced electrical formation evaluation.

2.3 SOLIDS CONTROL EQUIPMENT FOR PROCESSING

Noble plans to use a Thermomechanical Cuttings Cleaner (TCC) (or equivalent system) cuttings handling process unit to process the cuttings to <1% oil on cuttings (OOC) for onsite disposal (see Appendix 4). Figure 1 shows a flow diagram for processing of the drilling mud and cuttings on the drilling rig. Drilling mud is circulated down the drill pipe continuously during drilling and returns to the surface through the annular space between the drill pipe and casing, carrying drill cuttings in suspension. On the drilling rig, the mud and cuttings are passed through solids control equipment designed to separate the drill cuttings so that the mud can be pumped back down the hole. The cuttings are initially separated using mesh screens on shale shakers and then transferred to a process plant that uses mechanical action which is applied directly to the drill cuttings to create temperatures (260°C – 280°C) that rise above the boiling points of water and oil. Reaching these temperatures removes the hydrocarbons from the solids to less than <1% oil on cuttings (OOC). The remaining water and oil vapor is then condensed into the relevant streams and recovered separately. The recovered oil is pumped back into the mud system and the water is disposed overboard if it meets the offshore disposal guidelines. Water which does not meet the discharge limits is transferred to a holding tank and disposed of onshore. Typical oil on water (OIW) content of the recovered water is <30 ppm.

The process mill is the heart of the TCC process. Its main function is to generate friction heat to force the evaporation of water and oils present in the feed material. The rotor operates with the rotational speed of 600-700 rpm, which creates a ring shaped bed of material along the stator wall. Due to the intense agitation of the rotor, motor energy is transferred as heat to the material bed, allowing water and oil in the material to be efficiently flash evaporated. The condenser module is broken into 4 stages with the oil scrubber being the primary vessel that removes the final solids from the recovered vapor. From there the vapor travels through an oil condenser, water condenser and oil/water separator.

Key advantages of the system are:

- Direct heating of the waste stream resulting in maximum energy efficiency;
- Recovered base oil which can be directly recycled;
- Dried solids which are clean and can be disposed on site;
- An easily relocated unit that is ideal for offshore use; and
- Rapid start-up and shutdown, which facilitates simple maintenance tasks.

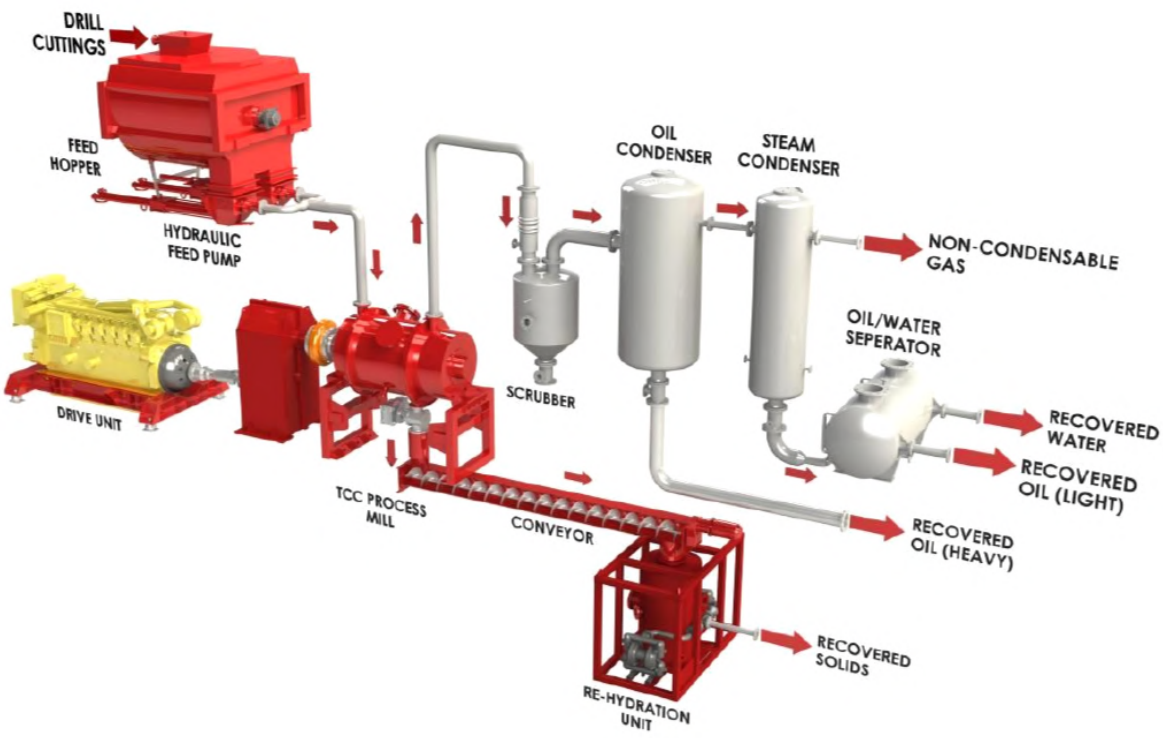

Figure 1. Process flow diagram for separating MOBM cuttings for onsite discharge

3.0 MUD TREATMENT PERFORMANCE DATA

3.1 TCC PERFORMANCE RESULTS

The MOBM cuttings discharges would be expected to meet the effluent limitations under OSPAR Decision 2000/3. The retention on cuttings will be limited to <1% OOC by dry weight.

Data collected from previous operations where the proposed TCC technology has been used in the North Sea show that the <1% limit for oil on cuttings has been achieved more than 90% of the time (information received from UK DECC, 2014). In fact, Noble received information from the UK Department of Energy and Climate Change whose records showed that performance levels achieved from this technology achieved oil removal to levels as low as 0.015% in 2011 and 2012 and 0.1% in 2013. Table 1 shows actual treatment results from a well drilled in the North Sea from December 2012 to January 2013 that included data for the 17.5, 12.25 and 8.5 inch hole sections (data provided to Noble by Halliburton 2014). As shown, the system achieved a treatment level of 0.051% oil on cuttings retention.

3.2 CHARM EVALUATION OF THE MUD SYSTEM

The components of the mud system have been evaluated through the OCNS CHARM system and the findings are provided in Table 2. The majority of the proposed drilling mud system components show a C or better rating under the OCNS Non Charmable registry.

3.3 ESTIMATED MOBM CUTTINGS DISCHARGES

Estimated quantities of MOBM cuttings for the L-5 Miocene well are provided in Table 3. This is a typical example, but discharge calculations for other wells may vary. The cuttings volumes are based on the volume of the hole intervals that would be drilled, plus an additional "washout factor." MOBM amounts are based on a worst case assumption of 1% retention of base fluid on cuttings. The actual retention on cuttings after treatment is expected to be less (see Section 3.1).

For the L-5 well, the total discharges are estimated to be 2,841 bbls (1,059 MT), including 28.4 bbls (3.6 MT) of MOBM base fluid adhering to cuttings. These totals do not include the riserless section (i.e., the initial well intervals where WBM and associated cuttings will be released at the seafloor).

For wells drilled using WBM exclusively, the cuttings volumes would be the same. However, it is estimated that an additional 11,000 bbl of WBM per well would be discharged along with the cuttings.

3.4 LEACHING CHARACTERISTICS OF THE MUD SYSTEM

To determine the suitability of the mud system for offshore disposal, Noble exposed a used drilling mud that had been used in drilling of a well in Cyprus. This testing used three different leaching procedures: 1) California WET Leaching Method; 2) USEPA TCLP Leaching Method; and 3) the Dutch EN 12457-2 Leachate Method. These results are shown in Table 4.

Table 1. Hammermill treatment data from Actual Sections in UK North Sea, December 2012 to January 2013 (data provided by Halliburton 2014).

				Feed Stock						Discharge	
Date	**Hole Section**	**MT Processed**	**M3 Processed**	**Oil**		**Water**		**Solids**		**Oil on Cuttings**	**Oil in Water**
				%	**M3**	**%**	**M3**	**%**	**M3**	**%**	**Mg/l**
Dec 24, 25	17.5	36.7	20.39	33	6.7	22	4.3	47	9.6	0.031	8.0
Dec 25, 26	17.5	100	55.56	34	18.9	22	12.2	45	25.0	0.044	12.0
Dec 26, 27	17.5	68	42.50	36	15.3	22	9.4	43	18.3	0.042	39.0
Dec 27, 28	17.5	95	59.38	39	23.2	21	12.5	41	24.3	0.056	6.5
Dec 29, 30	17.5	10.2	6.38	40	2.6	18	1.2	42	2.7	0.029	43.0
Jan 3, 4	12.25	99	55.00	25	13.8	32	17.6	44	24.2	0.093	53.2
Jan 4, 5	12.25	104	54.74	28	15.3	27	14.8	46	25.2	0.024	19.7
Jan 5, 6	12.25	103	54.21	23	12.5	20	10.8	58	31.4	0.034	21.5
Jan 6, 7	12.25	113	56.50	29	16.4	18	10.2	54	30.5	0.104	21.7
Jan 22, 23	8.5	130	65.00	31	20.2	13	5.5	56	36.4	0.058	8.6
							Average			**0.051**	**26.3**

Table 2. Summary of OCNS CHARM data for the proposed drilling mud system.

Product name	OSPAR derived data			Toxicity data		
	OCNS (UK) Registered	OCNS Rating	Substitution Warning	Toxicity (worse case)	Toxicity Sediment reworker	
LE Supermul	No					Likely to pass pre-screening and the final rating would depend upon the corophium toxicity. Expected to be an OCNS C or D rating.
Escaid® 110 (MSDS Appendix	Yes (NON CHARM)	C	No	1000 mg/l (96 hr LL0) *Onchorhyncus mykiss)*		Readily biodegradable, does not bio-accumulate (69% in 28 days)
Lime	PLONOR	E	No	n.a.	n.a.	
Calcium Chloride	PLONOR	E	No	n.a.	n.a.	
Barite	PLONOR	E	No	n.a.	n.a.	
Rhemod L	Yes (NON CHARM)	B	Yes	237.1 mg/l EC 50 72 hr (*Skeletonema costatum*)	8872 mg/kg (LC50 *Corophium volutator*)	
Adapta	Yes (NON CHARM)	E	Yes	>1000 (mg/l limit test) *Scophtalmus maximus)*	105000 (LC50 *Corophium volutator*)	
EZ Mul NT	Yes (NON CHARM)	D	No	23. mg/l EC 50 72 hr (*Skeletonema costatum*)	10000 mg/kg (LC50 *Corophium volutator*)	SPP in generic @ 15.0 lbs/bbl: 64,600 ppm SPP
TAU MOD	Yes (NON CHARM)	E	No	5600(mg/l limit test) *Scophtalmus maximus)*	13662 mg/kg (LC50 Corophium volutator)	SPP in INNOVERT @ 5.0 lbs/bbl: 68,100 ppm SPP

Table 3. Estimated cuttings discharge volumes for the L-5 well using the MOBM system.

Discharge	L-5 Well	
	Volume (bbl)	Mass (MT)
Total amount of cuttings discharged	2,841	1,059
MOBM base fluid adhering to discharged cuttings (Assuming an OOC of 1%)	28.4	3.6

Totals do not include the riserless section (initial well intervals where WBM and cuttings will be released at the seafloor).

Table 4. Results of leachate tests using three methods on a Mineral Oil Based Mud used in a Cyprus well.

				CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate		CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate	
	Solid Drill Cuttings			Solids (mg/kg)						Aqueous (mg/l)					
	Units	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL
Chloride				8010	420	6620	420	6500	400	762	40	315	20	644	40
Fluoride				34.6	2.1	ND	21	ND	4.2	3.29	0.2	ND	1	ND	0.2
Nitrite				ND	1.1	ND	2.1	ND	1.2	ND	0.1	ND	0.1	ND	0.1
Nitrate				ND	1.1	ND	2.1	ND	1.2	ND	0.1	ND	0.1	ND	0.1
Sulfate				3350	210	2670	210	2590	200	319	20	127	10	256	20
Cyanide, Total				ND	0.11	ND	0.21	ND	0.11	ND	0.1	ND	0.1	ND	0.1
Ammonium as Nitrogen				8.3	0.53	5.6	1.1	3.4	0.5	0.799	0.05	0.268	0.05	0.336	0.05
Carbon, Dissolved Organic (DOC)				8830	2600	9040	5300	9500	2500	840	250	430	250	940	250
Carbon, Total Organic (TOC)	Percent	2.13	0.1	12100	2600	10500	5300	10800	2500	1150	250	500	250	1070	250
Phenolics, Total				ND	0.11	ND	0.21	ND	0.11	ND	0.1	ND	0.1	ND	0.1
Halides, Adsorbable Organic (AOX)				ND	2100	231	210	748	200	ND	200	11	10	74	20

				CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate		CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate	
	Solid Drill Cuttings			Solids (mg/kg)						Aqueous (mg/l)					
	Units	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL	Result	MRL
Solids, Total Dissolved										1840	40	1060	40	1780	40
Solids, Total Volatile	Percent	11.9	0.01												
Antimony				*ND*	*5*	ND	5.3	ND	0.2	ND	0.5	ND	0.3	ND	0.02
Arsenic				ND	5	ND	1.1	ND	0.2	ND	0.5	ND	0.05	ND	0.02
Barium				21.7	2	ND	21	ND	0.5	2.07	0.2	ND	1	ND	0.05
Cadmium				ND	0.5	ND	1.1	ND	0.05	ND	0.05	ND	0.05	ND	0.005
Chromium				1.1	0.5	ND	1.1	ND	0.1	0.1	0.05	ND	0.05	ND	0.01
Cobalt				5.4	0.5	ND	1.1	ND	0.5	0.51	0.05	ND	0.05	ND	0.05
Copper				2.1	0.5	ND	1.1	ND	0.5	0.2	0.05	ND	0.05	ND	0.05
Lead				3.1	2	ND	1.1	ND	0.2	0.3	0.2	ND	0.05	ND	0.02
Mercury				ND	0.1	ND	0.02	ND	0.2	ND	0.01	ND	0.001	ND	0.02
Molybdenum				ND	0.5	ND	1.1	ND	0.5	ND	0.05	ND	0.05	ND	0.05
Nickel				11.5	2	ND	2.1	ND	0.5	1.1	0.2	ND	0.1	ND	0.05

				CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate		CAL-WET Leachate		TCLP Leachate		EN 12457-2 Leachate	
Selenium				ND	5	ND	2.1	ND	1	ND	0.5	ND	0.1	ND	0.1
Vanadium				1.9	0.5	ND	1.1	ND	0.2	0.18	0.05	ND	0.05	ND	0.02
Zinc				10.7	0.5	ND	2.1	ND	0.5	1.02	0.05	ND	0.1	ND	0.05
Total Extractable Hydrocarbons	[mg/Kg]	93	54												
	[mg/Kg]	ND	50												

The used drilling mud that had been used in the leachate tests had received minimal treatment compared to that which would be achieved with the TCC system. The comparative tests demonstrated that the leachates all resulted in concentrations an order of magnitude or more lower concentrations than were measured in the dried cuttings sample. All three leachate methodologies gave comparable results with the Dutch method (EN -12457-2) usually producing concentrations in the aqueous solution that was midway between the California test and the USEPA TCLP procedure. Under the Dutch method and the EPA TCLP leach, non-detectable levels of metals were found at the completion of the test. It is understood that Israel adheres to the Dutch standard in evaluating the hazardous characteristics of a waste for landfilling.

4.0 EVALUATION OF IMPACTS FROM OFFSHORE DISCHARGE

OSPAR Directive 2000/3 provides for discharge of oil based cuttings if less than 1% of the base fluid is retained on the cuttings to be discharged. The philosophy under the OSPAR Directive is based on the use of BAT within the context of the 'five R's' waste management hierarch, i.e. reduce, reuse, recycle/recover, residue disposal and best environmental practice. The use of the TCC technology achieves these OSPAR objectives in the following ways.

Reduce

> *The reduction of discharges of OPF-contaminated cuttings is the primary focus of this Decision. Examples of measures to be taken with a view to reducing these discharges are (i) prohibition on use in the upper well section, except where technically necessary, (ii) horizontal drilling and (iii) slim hole drilling* (OSPAR Directive 2000/3).

Under the proposed drilling program that would utilize the TCC technology, the upper well section will be drilled with water based muds. As described in a previous section above, discharge of as much as 11,000 bbls of water based muds will be avoided.

Reuse

> *Operators will choose techniques from a range of options e.g. mud treatment plants, shale shakers, centrifuges and washing systems for cuttings, i.e. those technologies that maximise reuse consistent with safe and efficient drilling. Use of mass balance (volumetric) reporting will enable national authorities to check that reuse is being carried out effectively* (OSPAR Directive 2000/3).

Because of the relative expense of the MOBM system, economic drivers insure that the best practice is to recover as much of the base fluid material as possible for reuse. This becomes possible, and in fact, is a key driver in the strategy to use the TCC system. This system allows the base fluid to be recovered at the end of the well and to be returned to shore where it is stored and used in future wells. During the actual drilling, solids control equipment is used to clean the cuttings and separate the base fluid for reuse in the on-going drilling operations.

Recycle / Recover

> *In order to avoid discharges into the sea of OPF-contaminated cuttings, recycling/recovery measures should be implemented (e.g. recovery for re-use of the organic phase by distillation onshore or offshore, use of shale shakers and centrifuges)* (OSPAR Directive 2000/3).

The TCC process uses a combination of heat and rinsing that allows the non-aqueous base fluid to be separated from the cuttings. As demonstrated in Table 1 above, the effectiveness of this process is such that oil retained on cuttings can be orders of magnitude less than 1%.

Residue disposal

> *The following options for the management of OPF-contaminated cuttings residue should be considered:*

a. *transportation to shore of cuttings for OPF processing (e.g. oil recovery and residue disposal);*

Transporting the used cuttings to shore will entail an energy cost that will add to the total environmental footprint of the project. Treatment on shore will meet the objective of recycling and reuse of the base fluid system but will result in a need to dispose of the residual at Ramat Havav because of the probable high total dissolved solids (TDS) content. This TDS will be comprised of salts of sodium, calcium and magnesium, none of which poses a serious risk to the offshore environment. This will necessitate additional land take that will further add to filling up the Ramat Havav landfill thereby accelerating the need for expansion of this facility before its time.

b. *reinjection of such cuttings;*

Reinjection of cuttings requires a dedicated well that has the ability to absorb the residual slurry. During drilling, such wells are not generally available because they need a continuous flow of materials to make them feasible. Additionally, high solids content of injected material makes it difficult to keep such wells operational.

c. *offshore treatment of such cuttings with the aim of achieving the target technology standard of 1% OPF fluid by weight on dry cuttings, and the discharge of the cleaned residue;*

This is the objective of the proposed program. It is expected that the TCC system will be able to clean the cuttings to a level below the required 1% limit.

d. *when cleaned residues of cuttings contaminated with synthetic fluid cannot meet that standard, national competent authorities may authorise discharge to the sea having regard to the toxicity, biodegradability and liability to bioaccumulate of the drilling fluid concerned and of the hydrography of the receiving environment.*

As shown by the components to be used in the drilling mud system (as discussed in Section 3.2), the majority of the additives in the base fluid have low toxicity and bioaccumulation indices and are readily biodegradable.

Best Environmental Practice

In considering the various options for the control of organic phase drilling fluids account should be taken of the conservation of resources, including energy (OSPAR Directive 2000/3).

As described previously, treating the cuttings offshore to reduce the retained oil on cuttings limits the amount of material that must be shipped to shore for disposal. This is a significant energy saving in fuel when one considers the transport by ship from the drillsite to a processing facility in Haifa with further transport of residual materials to the Ramat Havav hazardous waste disposal facility. Such disposal logistics is not feasible when it appears that the only justification for such a strategy is to dispose of a product that has a high TDS content. The expected TDS level (based on results from the drill cuttings from the Cyprus well) is less than that of seawater and would have minimal to no impacts if disposed offshore.

Besides energy efficiency and fuel savings that are achieved when onshore transport is eliminated, consideration must also be given to the fact that drilling with the MOBM is expected to reduce the number of days on location to drill to the target objective. Reduced drilling time decreases the

amount of fuel used for drilling with additional savings being achieved in other discharges that result from having a drilling vessel onsite. This achieves an overall smaller environmental footprint from discharges and energy usage.

5.0 OVERALL CONCLUSIONS

Discharge of mineral oil based muds is generally prohibited without applying some form of Best Available Technology which can reduce the concentration of oil retained on cuttings. The TCC system is designed to achieve a level that is <1% oil on cuttings. Applications of this system in actual field projects has shown that this level is achieved over 90% of the time with levels reaching as low as 0.015% in some cases. This is in line with the requirements of OSPAR.

Additionally, under the proposed scenario involving use of the TCC process, it is estimated that impacts of drilling could be less than those of conventional drilling using WBM. This is due to the reduced time required to drill each well as a result of increased rates of penetration, reduced hole stability issues and electronic failures currently experienced with the use of salt-saturated WBM. It is expected that this savings in time on location will be as much as 3.5 days per well. This will result in fewer liquid discharges associated with the overall drilling operations due to fewer days on location (Table 5).

Table 5. Rig process discharges per well assuming 3.5 day reduction on well site

Effluent	Quantity Basis	Quantity Per day	Quantity 3.5 days/well	Quantity 4 wells/year
Sewage	200 POB_{max} at 38 liters per man per day	7.6m³	26.6m³	106.4m³
Gray water	200 POB_{max}	35m³	122.5m³	490m³
Cooling water	(See right)	105,360m³	368,760m³	1,475,040m³
Organic matter (food scraps)	200 POB_{max} at 1kg/person/day	200 kg	700 kg	2800 kg
Brine from potable water maker	(See right)	318m³	1113m³	4452m³
Drain water	based on an average annual rainfall of 539mm for Haifa x the deck area of the vessel 434m³/month	1.2m³	4.2m³	16.6m³

With the use of the MOBM system, the footprint of the cuttings discharge will also be reduced due to the fact that as much as 11,000 more barrels of water based muds would be discharged in those operations where drilling is done by WBM. The main impact of drilling discharges on water quality is localized, intermittent turbidity (NRC, 1983; Neff, 1987, 2005, 2010). In typical drilling operations using WBM, turbid water from drilling mud and cuttings discharges can extend between a few hundred meters and several kilometers down current from the discharge point. The

discharges occur more-or-less continuously during drilling, and dispersion to background levels typically requires several minutes to several hours (Neff, 1987).

Impacts of MOBM cuttings discharges are expected to be less than those of WBM for two reasons. First, MOBM cuttings treated through the TCC process will recover and recycle as much mud as practical (<1% OOC by dry weight). Therefore the amount of mud (fine particles) discharged with cuttings is minimal. And, second, because MOBM tends to adhere tightly to the cuttings particles, they would not be expected to produce much turbidity as the cuttings sink through the water column (Neff et al., 2000). Discharges of treated MOBM cuttings will produce some temporary, localized increases in suspended solids in the water column around the drilling rig.

In a leachate test employing MOBM cuttings from Cyprus, slightly more than 1000 mg/l total organic carbon (TOC) leached from a sample of untreated cuttings that had a background level of 2% organic carbon. The TCC process will reduce the levels of the muds retained on cuttings to less than half that was measured in the leachate test. The toxicity of the Escaid 110 has been reported as 1000 mg/l in 96 hr acute tests (ExxonMobil MSDS, Appendix 1). Given the effectiveness of the TCC in reducing oil on cuttings, it is expected that the amount of organic carbon leaching into the environment from discharged cuttings will be less than that observed in the leachate test

The non-CHARM evaluation of the materials in the mud formulation showed them to be at rankings that indicated low risks to the environment (see Table 2). The chemicals have toxicity ratings mainly at the D and E level indicating low potential risk in the environment. This was especially true in the case of infauna species.

While the discharge of the MOBM cuttings could potentially lead to an increase in organic matter that could cause some anoxia in sediments. However, the base Escaid material readily biodegrades with 69% degraded within 28 days (ExxonMobil MSDS, Appendix 1). This indicates that natural processes will ensure the product is removed from the environment fairly rapidly and that any effects from sediment enrichment should be short lived.

In conclusion, any impacts from discharge of the MOBM cuttings are expected to be low and short lived. Such impacts will be restricted to a small footprint compared to a situation where it is necessary to transport the cuttings over long distances to shore and then to dispose in a hazardous waste landfill because of elevated salt concentrations, none of which are harmful in the offshore environment. The risk potential for an incident occurring during the transport and disposal of the MOBM cuttings is much higher than that which would be expected from the offshore disposal case.

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7.0 APPENDICES

Appendix 1. ExxonMobil Escaid 110 MSDS

Appendix 2. Escaid® 110 Mineral Oil Based Mud Information

Appendix 3. Halliburton – Thermomechanical Cuttings Cleaner (TCC)

APPENDIX H

MUDMAP Model Description

Appendix A: MUDMAP Model Description

MUDMAP is a personal computer-based model developed by ASA to predict the near and far-field transport, dispersion, and bottom deposition of drill muds and cuttings and produced water (Spaulding et al; 1994). In MUDMAP, the equations governing conservation of mass, momentum, buoyancy, and solid particle flux are formulated using integral plume theory and then solved using a Runge Kutta numerical integration technique. The model includes three stages:

Stage 1: **Convective decent/jet stage** – The first stage determines the initial dilution and spreading of the material in the immediate vicinity of the release location. This is calculated from the discharge velocity, momentum, entrainment and drag forces.

Stage 2: **Dynamic collapse stage** – The second stage determines the spread and dilution of the released material as it either hits the sea surface or sea bottom or becomes trapped by a strong density gradient in the water column. Advection, density differences and density gradients drive the transport of the plume.

Stage 3: **Dispersion stage –** In the final stage the model predicts the transport and dispersion of the discharged material by the local currents. Dispersion of the discharged material will be enhanced with increased current speeds and water depth and with greater variation in current direction over time and depth.

MUDMAP is based on the theoretical approach initially developed by Koh and Chang (1973) and refined and extended by Brandsma and Sauer (1983) and Khondaker (2000) for the convective descent/ascent and dynamic collapse stages. The far-field, passive diffusion stage is based on a particle based random walk model. This is the same random walk model used in ASA's OILMAP spill modeling system (ASA, 1999).

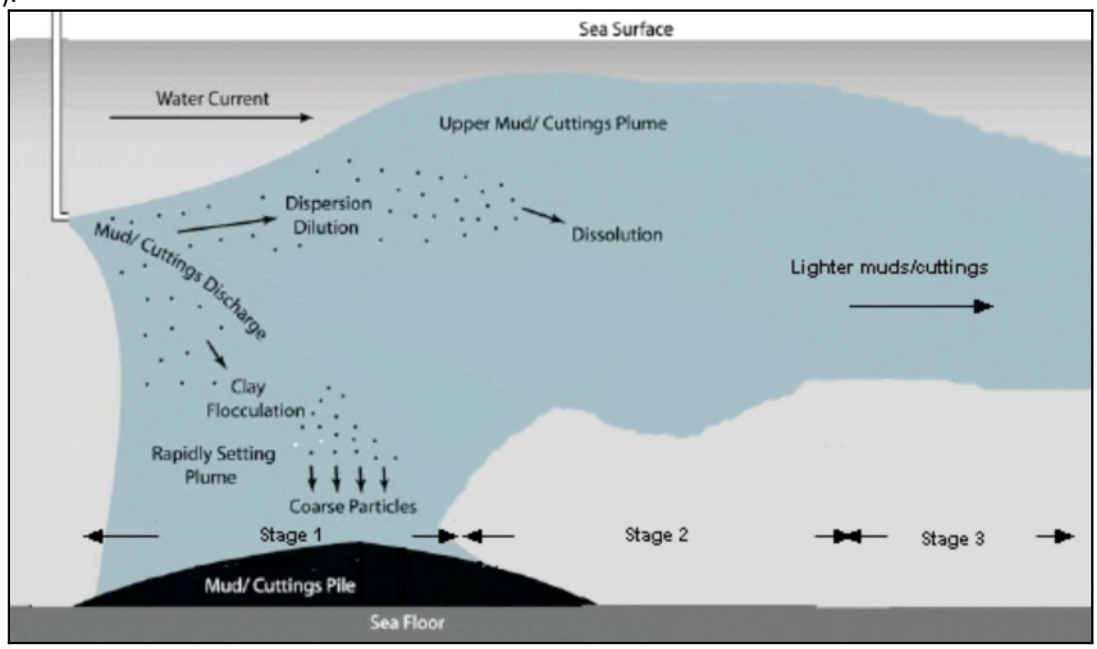

Figure A1. Conceptual diagram showing the general behavior of cuttings and muds following discharge to the ocean and the three distinct discharge phases (after Neff 2005).

The model's output consists of calculations of the movement and shape of the discharge plume, the concentrations of soluble (i.e. oil in produced water) and insoluble (i.e. cuttings and muds) discharge components in the water column, and the accumulation of discharged solids on the seabed. The model predicts the initial fate of discharged solids, from the time of discharge to initial settling on the seabed As MUDMAP does not account for resuspension and transport of previously discharged solids, it provides a conservative estimate of the potential seafloor concentrations (Neff 2005).

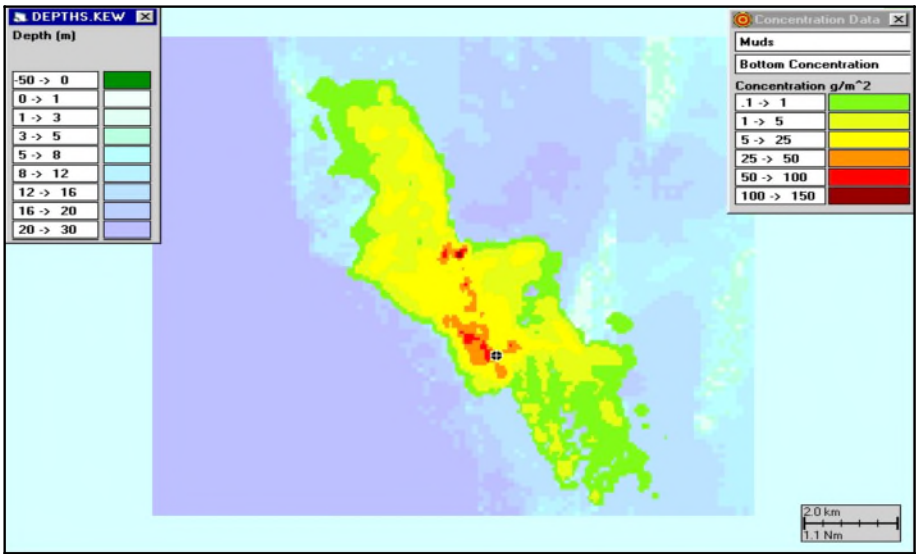

Figure A2 Example MUDMAP bottom concentration output for drilling fluid discharge.

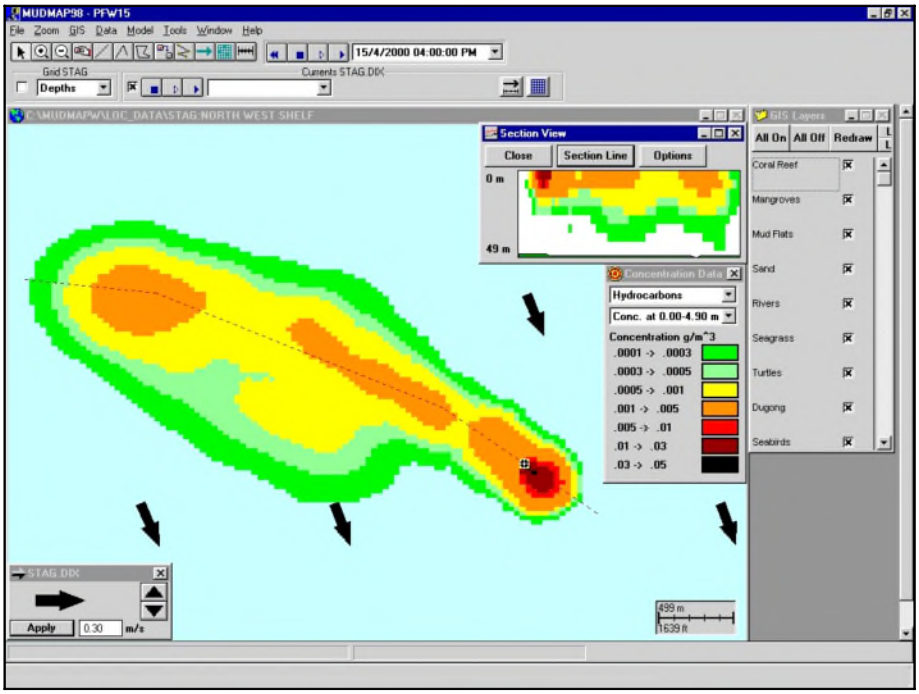

Figure A3. Example MUDMAP water column concentration output for drilling fluid discharge.

MUDMAP uses a color graphics-based user interface and provides an embedded geographic information system, environmental data management tools, and procedures to input data and to animate model output. The system can be readily applied to any location in the world. Application of MUDMAP to predict the transport and deposition of heavy and light drill fluids off Pt. Conception, California and the near-field plume dynamics of a laboratory experiment for a multi-component mud discharged into a uniform flowing, stratified water column are presented in Spaulding et al. (1994). King and McAllister (1997, 1998) present the application and extensive verification of the model for a produced water discharge on Australia's northwest shelf. GEMS (1998) applied the model to assess the dispersion and deposition of drilling cuttings released off the northwest coast of Australia.

MUDMAP References

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APPENDIX I

Tamar SW-1 Discharge Permit

State of Israel
Ministry for Environmental Protection
Marine and Coastal Division

17 Tishri. 5774
September 17, 2013

File: Noble Energy - Tamar SW

E-Mail & Registered Mail with Certificate of Delivery

To
Mr. Lawson Freeman
Vice President
Noble Energy Mediterranean

To
Mrs. Orna Primor
Environmental Manager
Noble Energy Mediterranean

Re: Noble Energy Mediterranean Limited (NBL) – Marine Discharge Permit (Gas Production) – Tamar SW-1

1. Attached hereto is Permit No. 59/2013 for Discharging into the Sea (Oil and Gas Exploration).

2. The contact person in the event of faults and for coordination is Mr. Nir Levinsky, Prevention of Sea Pollution Supervisor, tel.: 050-6237601, beeper: 03-6106666, subscription no. 52112.

3. Pursuant to Decision No. 107 of the Committee for the Grant of Discharge Permits, the Recipient of the Permit must publish a notice of receipt of the Permit in two newspapers, within one month of receipt of the Permit, to the extent set out in sections 8I, 10I and Appendix A to this Permit.

4. The Permit and the composition of the effluent discharged into the sea will be published on the website of the Ministry for Environmental Protection at the following address: www.sviva.gov.il.

5. Following the 2008 amendment of the Prevention of Sea Pollution from Land-Based Sources Law, 5748-1988, the Commissioner may impose a monetary sanction on a person in breach of any of the conditions of a permit for discharging into the sea, and for a failure to report as required under section 4 of this Law.

6. Pursuant to the Prevention of Sea Pollution from Land-Based Sources (Prevention of Sea Pollution Levy) Regulations, 5771-2011, which came into force on October 1, 2011, all permit holders shall be required to pay a levy for the effluent / sanitary waste / brine that they discharge into the sea. This payment shall be made once a quarter, by the 20th of the month, in the months of: January, April, July and October of each year – for the previous quarter, and in accordance with instructions that have been published. See sections 8J and 10J of the Permit.

Yours sincerely,

Dr. Iris Safrai
Commissioner for the Prevention of Sea Pollution
from Industrial Waste

CC:
Mr. David Leffler, Director General, Ministry for Environmental Protection
Mr. Yitshak Ben David, Senior VP Enforcement, Chairman of the Committee for the Granting of Permits, Ministry for Environmental Protection.
Mr. Rani Amir, Head of the Marine and Coastal Environment Division, here.
Mr. Gadi Binstock, Deputy Head of the Marine and Coastal Environment Division, here.
Dr. Ilan Melster, Commissioner of Prevention of Sea Pollution from Land-Based Sources, here.
Mr. Fred Erzuan, Scientific Center for the Prevention of Sea Pollution, here.
Dr. Dror Zurel, Scientific Center for Maritime Monitoring and Research Plans, here.
Mr. Nir Levinsky, Mrs. Yael Shay, Mr. Gidi Betelheim, Supervisors, Prevention of Sea Pollution, here.
Coordinator, Reporting and Control Center, here
Mrs. Sefaa Halabi, Coordinator of Levies, here.
Adv. Iris Shalit, Legal Department, Ministry for Environmental Protection
Mr. Alexander Varshavsky, Petroleum Commissioner, Ministry of Energy and Water
Mr. Ilan Nissim, Head of Environment Division, Ministry of Energy and Water
Mr. Elad Levi, Internet Team, Ministry for Environmental Protection.

The Prevention of Sea Pollution from Land-Based Sources Law, 5748-1988.
The Prevention of Sea Pollution from Land-Based Sources Regulations, 5750-1990.
The Committee for the Grant of Permits for the Disposal / Discharging of Waste / Effluent into the Sea

Permit to Discharge Effluent into the Sea

Updated as at September 17, 2013

Pursuant to the "Procedure No. 8.35 for Convening the Committee for the Grant of Permits for Discharging into the Sea", a Permit for the Discharge of Effluent (Exploratory Drilling) into the Sea is hereby given, as set out below:

1. **Permit Number:** 59/2013.

2. Name of Recipient of Permit: **Noble Energy Mediterranean Ltd., (NBL)** Private Company No. 56-001716-2

   Address: 12 Abba Eban Blvd., Herzliya Pituach
   Tel: 073-2424275; Fax: 073-2424200
   Mr. Lawson Freeman, VP Email: lfreeman@nobleenergyinc.com
   Contact Person:
   Mrs. Orna Primor, Environmental Manager
   Tel. 073-2424235, Fax: 09-9553410, Mobile: 052-6567443,
   email: OPrimor@nobleenergyinc.com

3. Quantity and Composition of Effluents Permitted to be Pumped into the Sea**:**

   A. Quantity of Effluents:
   The quantity of the effluents shall be in accordance with the provisions of section 3B below.

   B. Sources of Effluents:

   Effluents from the floating ENSCO 5006 floating drilling platform, from the gas exploration drilling operations from the Tamar SW-1 drilling site, at a drilling depth of up to approximately 3,630 meters under the seabed, up to 5,300 meters below the surface of the sea, in accordance with Lease Area I/12 for the Tamar Field, in accordance with the details below:

   (1) Water based drilling mud (WBM) –
   Approximately 2,450 tons, approximately 7,200 cubic meters, approximately 43,600 barrels shall be discharged / dumped around the drilling well on the seabed (stage I) and approximately 1,100 tons, approximately 1,200 cubic meters, approximately 7,400 barrels will be discharged form the rig (stage II). Out of a total consumption of approximately 4,240 tons, approximately 8,700 cubic meters, approximately 53,600 barrels;
   Total drilling mud for discharge into the sea – approximately 3,550 tons, approximately 8,400 cubic meters, approximately 51,000 barrels.
   At the end of the drilling, the drilling mud from stage II will be discharged at a capacity of 1,000 barrels per hour, approximately 100 cubic meters per hour.

   (2) Surplus cement - approximately 940 tons consumption (1,200 cubic meters),

of which approximately 215 tons (210 cubic meters) (as an estimate) will be discharged / dumped onto the seabed.

(3) Brine at closure of bore – approximately 120 tons, approximately 200 cubic meters, approximately 1,200 barrels.

(4) Cutting discharge – cutting discharge (quantities) - approximately 1,380 tons (approximately 550 cubic meters) shall be discharged / pumped onto the seabed around the bore opening (stage I) and approximately 800 tons (approximately 320 cubic meters) shall be discharged from the rig (stage II). Total of approximately 2,180 tons (approximately 870 cubic meters) shall be pumped / discharged into the sea.
36” - -47 cubic meters, 125 tons; 26” - -503 cubic meters, 1,255 tons - total of 550 cubic meters, 1,380 tons on the seabed.
17-1/2” - 117 cubic meters, 257 tons; 14-3/4” - 131 cubic meters, 347 tons; 10-5/8” - 47 cubic meters, 125 tons; 12-1/4” - 26 cubic meters, 69 tons.

(5) Sanitary waste – up to 10 cubic meters per day, following preliminary treatment (see section 10B(1)) (estimate – 0.07 cub meters / person / day, 120 persons).

(6) Gray water (shower water, laundry water) - up to 24 cubic meters per day, untreated (estimate - 0.2 cubic meters / person / day, 120 persons).

(7) RO concentrate - up to 250 cubic meters per day, without chemical additives.

(8) Cooling water - up to 8,000 cubic meters per day, without chemical additives.

(9) Organic waste (food) – up to 150 kg per day.

(10) Drain water - up to 100 cubic meters per day.

4. Criteria for Discharge into the Sea**:**

Definitions:
Maximum value – the maximum value measured at any time, being the result of a grab sampling or any other sampling.
Grab sampling – the random taking of a sample, at a particular point in time.
Representative sampling – the taking of a sample from a container faucet, after at least one minute of flow.

The following are the permitted concentrations in effluents (criteria):

Table 1: Criteria – Noble Energy Mediterranean Ltd. (NBL)[1]		
Index	Units	Maximum value
Drilling mud		
pH		9.5>pH>6.0
Sanitary waste		
Free chlorine (following neutralization, for discharging into the sea)	mg/L	0.3 mg/L
Floating solids (TSS) (105°C)	mg/L	50
General BOD_5	mg/L	50
Turbidity	NTU	50
All sources		
pH		9.5>pH>6.0

Notes on Table 1:
[1] There might be other parameters for the criteria, such as TOC, in the drilling mud, composition of oils and organic material in organic kitchen waste.

5. **Method and Location of Discharging:**

Location and Site of Discharging:
The effluent shall be discharged into the sea from the ENSCO 5006 drilling rig, from the Tamar SW-1 drilling site, approximately 98 km north west of Haifa - Carmel Head, at a seabed depth of approximately 1,650 meters.
The Ensco 5006 drilling rig is a floating mobile rig which, when drilling, is anchored to the seabed via 8 anchors, at a radius of approximately 3,000 meters.

Method of Discharge:
***** Cutting discharge & drilling mud (WBM) –
During the first stage of drilling, at diameters of **26", 36" (drilling depth at each stage:** approximately 70 meters, 1,160 meters respectively, total depth of drilling under the seabed – approximately 1,230 meters), discharge to be directly onto the seabed, around the bore opening, at a seabed depth of approximately 1,650 meters (estimate – two weeks);
During the second stage of drilling, after installation of the riser and BOP, at diameters of 17-1/2", 14-3/4" and 10-5/8" (depth of each drilling stage, approximately 620 meters, 1,045 meters, 735 meters, respectively, total drilling depth beneath the seabed of approximately 3,630 meters), pumping will be from the drilling rig, in an 8" pipe, at a depth of 14 meters below the surface of the sea (estimate – approximately 80 working days and as set out in the Supplement Document of August 18, 2013).
Cutting discharge, cement residue and surplus brine; drilling mud – in a uniform expanding pipe the first part of which is 14" (through which the cutting discharge, cement residue, drilling mud and surplus brine are pumped), the second part of which increases to 16" (together with the flow of drilling mud) and the third part increases to 18" (together with the cooling water), at a depth of 14 meters below the surface of the sea.
Discharge of drilling mud, after installation of the riser, shall only be effected at the end of the drilling, whilst the cutting discharge (together with the sticky drilling mud residue) shall be discharged into the sea throughout the duration of the drilling.
At this stage, the drilling mud and the cutting discharge shall be put transferred to the rig, the drilling mud shall be separated from the cutting discharge via sieves and returned to the process.
The cutting discharge will be discharged into the sea throughout the drilling process. The drilling mud shall be discharged into the sea at the end of drilling only, except for discharges due to operations activities (estimate – 30 to 90 cubic meters per day) and the cement residue remaining on the discharge (estimate - approximately 40%).
Surplus cement – directly onto the seabed, around the bore opening at the time of installation of the riser and from the drilling rig via the cutting discharge pipe (above).
* Sanitary waste, gray water, RO concentrate, ground organic waste (food) – 8" pipe at a depth of 14 meters below the surface of the sea.
* Cooling water – in an 18" pipe, in the same pipe as the cutting discharge, cement residue and surplus brine, at a depth of 14 meters under the surface of the sea.
* There is a prohibition against discharging or dumping directly onto the seabed, except for the discharging of drilling mud and cutting discharge during the first stage of drilling, as set out above and cement surpluses. Any other discharging must be done from the rig only, and in accordance with the sources approved in this Permit (section 3B of the Permit).

6. Dates of Discharging**:** In accordance with the needs of the Recipient of the Permit.

7. Means of Monitoring and Control for Examining the Environmental and Health Impacts of Discharging**:**
Methods of sampling and analysis shall be in accordance with the latest edition of:
"Standard Methods for the Examination of Water and Waste Water" (SM) edited and published by APHA-AWWA WPCF, or in accordance with methods approved by the EPA.
The Recipient of the Permit shall conduct the examinations in a laboratory authorized by the National Laboratory Certification Authority or a laboratory authorized in advance by the Ministry for Environmental Protection – Marine and Coastal Department.

The Recipient of the Permit shall take samples in accordance with training for the performance of sampling in accordance with SM.

(1) Monitoring of Effluents Pumped into the Sea: The Recipient of the Permit shall examine the composition of the effluents in accordance with the following sampling program:

Table 2 – Tests – Noble Energy Mediterranean Ltd. – Tamar SW		
Frequency of Tests (at least) | Type of Tests		
1. Drilling mud[1]		
The sampling frequency below has been determined based on the stages of drilling and based on the drilling plan of March 7, 2013. **Grab sampling**, in each drilling segment, 26"+36", 17-1/2", 12-1/4", 8-1/2" Total of at least 4 samples	* General BOD_5	* Toxicity tests(2)
	* TOC	* Nitrate as N
	* Floating solids (TSS) 105°C	* Nitrite as N
	* Mineral oil (FTIR)	* Ammoniacal Nitrogen as N
	* General oils and lipids (FTIR)	* Kjeldahl nitrogen as N.
	* PAH	* General nitrogen (calculated)
	* Phenol	* pH
	* Carzol	* Total Dissolved Solids (TDS)
	* DOX (GC)	* Chlorides
	• Extended metal scan (ICP), including P. • GCMS, probability percentages, half-quantity concentrations and total concentrations. • VOC's, probability percentages, half-quantity concentrations and total concentrations. • Metal content in barite (3)	
2. **Cutting discharge**		
Grab sampling, every 500 meters or in the event of any significant change in the underground fraction of the drilling cross section(4)	* Content of metals: Ag, As, Cd, Cu, Cr, Hg, Ni, Pb, Zn	
	* Content of organic material is expressed as TOC.	
	* Radioactive materials: Ra-226, Ra-228, Th-228, Pb-210(5)	
3. **Sanitary Waste**		
Representative sampling, once a month, unless otherwise required.	* General BOD_5	* Ammoniacal Nitrogen as N
	* TOC	* Kjeldahl nitrogen as N.
	* Floating solids (TSS) 105°C	* General nitrogen
	* Turbidity	* General phosphorus
	* Turbidity - **field test – once a week.**	* Fecal coli per 100 mL
	* Free cholrine – **field test, once a week**	* Enterococci per 100 mL
	* AOX	* pH
	* Oils and lipids (FTIR)	* Total Dissolved Solids (TDS)
	* Mineral oil (FTIR)	* Chlorides
	* Nitrate as N + Nitrite as N	
4. **Gray water**		
Representative sampling, once a month	* Floating solids (TSS) 105°C	* Oils and lipids (FTIR)
	* Detergents (MBAS)	* Total Dissolved Solids (TDS)
5. **Ground Organic Waste (Food)**		
Representative sampling, once a month	* General BOD	* General oils and lipids (FTIR)
	* TOC	* General nitrogen
	* Floating solids (TSS) 105°C	* General phosphorus

1

6. **Quantities**	
Quantity, Recording and Reporting Reports shall include details of the basis for the information – quantity meter / discharging hours / etc. (including an explanation).	* Daily quantity (for each day of the month), monthly and total cumulative from the beginning of discharge for each of the sources, and total discharge into the sea, according to the details set out in section 3B above and as follows. * Drilling mud – volume quantity (cubic meters) and mass quantity (dry tons) * Cutting discharge, cement residue – mass quantity (dry tons) * Maximum no. of persons on the rig each day (POB)

Notes on Table 2:

(1) The results of the tests are to be submitted in units of mass per volume (milligrams per liter) except in tests of barite and cutting discharge.
The results of the tests for drilling mud will be submitted in units of mass per volume (mg/L) and in units of dry mass (mg/kg dry material).
The results of the tests will be submitted noting the depth of the drilling beneath the seabed and beneath the surface of the sea, the diameter of the drilling segment, at the time of sampling.

(2) A toxicity test is to be conducted in a test lasting 96 hours in accordance with the general permissions of the National Pollutant Discharge Elimination System (NPDES) for existing and new sources in the sea, under the sub-category of extraction and removal of oil and gas for the western portion of the coastal threshold of the Gulf of Mexico (29000GMG), or any other pre-approved and relevant protocol. The test will be conducted in an authorized laboratory overseas, subject to the presentation of approval of the authorization of the laboratory, and in accordance with the instructions of the Marine and Coastal Division.

(3) The recipient of the Permit shall conduct metal content tests on the barite, taking a representative sample from the raw material as follows:
Cd and Hg content (AA, at a sensitivity of at least 0.1 mg / kg at least) – **once a month** (at least three tests: At the start of the drilling, in the middle of the drilling and at the end of the drilling, using the method and sensitivity set out above).
Metal content: Ag, As, Cd, Cu, Cr, Hg, Ni, Pb, Zn, **– once every three months.**

(4) The tests shall be performed on the cutting discharge, following normalization (where possible) of the sticky drilling mud for the cutting discharge.

(2) **Monitoring of Marine Environment:**

A. The Recipient of the Permit shall monitor the marine environment up to **six weeks after the end of drilling**, in accordance with a plan approved in advance by the Marine and Coastal Division, and shall report as required (see section 8H below).

B. The monitoring operations shall include the monitoring of physical, chemical and biological variables, in accordance with the document of instructions for monitoring and the approved plan, and in addition, photographs and sampling of the seabed, in the area of the drilling affected by the operations done during the first stage, in which the drilling mud together with the cutting discharge and cement residue is discharged directly onto the seabed, and not returned for treatment and separation on the drilling rig (bore diameters of 26", 36"). The information shall include a description of the height of the heap and an assessment of the area affected by coverage.

C. The recipient of the Permit shall apply to **arrange a meeting** for a presentation and discussion of the results of the findings of the monitoring, **within one month of the date of submission of the summary report.**

8. **Reporting to the Committee:**

A. The Recipient of the Permit shall submit the reports set out below **by electronic mail** to the Marine and Coastal Department at the Ministry for Environmental Protection,

at the following addresses: hofim@sviva.gov.il, gidib@sviva.gov.il, yaels@sviva.gov.il, and nirl@sviva.gov.il.

B. The Recipient of the Permit shall submit the data set out in section 7(1) above **once a month** (by the 20th of the following month).

C. The Recipient of the Permit shall give reasons in these reports for any deviation from the criteria in section 4 above and shall report the activities that it has taken to prevent repeat deviations. This provision shall not be deemed to be a consent to any deviation from such criteria.

D. The Recipient of the Permit shall submit the data in the form of an **Excel** spreadsheet table, in accordance with the format for reporting to the Marine and Coastal Division. The data shall also be provided in graphic form, including data for at least the previous three years (where such data exists). The time of the sampling (for grab sampling) and the time of collection of samples (for complex sampling) must be recorded. The data and results shall be submitted cumulatively, in addition to the submission of the laboratory results, on the original form, signed (in pdf format).
The file name shall be written according to year and month, as follows: NBL-TAMAR-SW1-YYYY-MM.xls.
One digital photograph shall be attached to the report, containing a representative sample of every source of pumping, which shall be photographed once a month, in a transparent one liter glass bottle. Each photograph shall be no larger than 500 kb.

E. The Recipient of the Permit shall, **within one month of termination of discharging, and by the 20th of the following month**, submit the cumulative discharging data for each of the sources and indexes checked under section 7 of this Permit, including minimum concentration, maximum concentration, average concentration, quantity and load (tons). The data shall be presented on a calendar basis, and on a cumulative basis over the entire period.
In addition, the report shall contain a description of the actions taken to close the bore, with an emphasis on the discharge of effluent into the sea, together with a schematic flowchart of the drilling.

F. **Report of Milestones:**
The Recipient of the Permit shall report the dates of the following milestones: The date of completion of mooring of the rig and the commencement of discharge, **one week after commencement of discharge; the date of conclusion of operations and abandonment / closure of the bore upon completion of drilling**, **two weeks in advance.** In the event of a change in the closing plan submitted on August 18, 2013, the Recipient of the Permit shall submit an up-to-date plan including a schematic flow-chart; date of completion of discharge, **within one week of completion of discharge**.

G. **Progress Report:**
The Recipient of the Permit shall, **once a month**, by the 20th of such month, submit a progress report of drilling actions and an additive report, in accordance with the stages of the drilling based on the diameter of the bore – 10.625", 14.75", 17.5-1/2", 12-1/26", 36-1/2", including: Notation of the diameter of the drilling segment.
Dates of performance (from when to when), duration of each stage of drilling / action and cumulative time (days); cumulative summary of each additive to the drilling mud and cement (consumed / discharged into the sea) and brine additives used during bore abandonment / closure operations.
A chart of a schematic cross-section of the progress of drilling operations over time shall be attached to the progress report, similar to the chart in Appendix H to the Application for the Permit.
The final progress report shall be submitted by the 20th of the month following the end of discharging.

H. **Monitoring of Marine Environment:**

(2) The recipient of the Permit shall submit a summary marine environment monitoring report **up to seven months after the end of the drilling**, including the results of the monitoring at the end of the drilling and a comparative analysis against the results of the background monitoring, and at the end of the drilling, and with respect to the actual discharge data (the data in section 8E above which shall be attached as an Appendix to the summary report), in accordance with the instructions of the Marine and Coastal Division, and as set out in section 7(2) above.

The summary report shall be submitted in two printed copies, and electronically, and in accordance with the instructions of the Marine and Coastal Division, and as set out in section 7(2) above.

I. Publication in Newspapers**:**

The Recipient of the Permit shall electronically submit a copy of publication of the newspaper notice **within one week of the date of publication and not later than one month after receipt of the Permit**, as set out in section 10I and in Appendix A to this Permit.

J. **Levy:**

The Recipient of the Permit shall report **once a quarter, by the 20th of the month**, in the months of: January, April, July and October of each year, for the previous quarter, of payment of the levy, including the date of payment, the sum of the payment, certification of a bank transfer, the quantity in fact pumped into the sea, including cases in which there was "no discharging", and where the quantity is 0 (see section 10J below).

K. The Recipient of the Permit shall report to the Marine and Coastal Division, by telephone or other means, **immediately**, any fault that might affect the quality of the effluents being discharged into the sea, of the measures taken to remedy the situation and of any deviation from the conditions of the Permit.

L. The Recipient of the Permit shall report in writing to the Marine and Coastal Division in the event that it intends to make any amendments to the production process or to the raw materials amounting to a possible deterioration in the quality of discharging into the sea, **prior to doing such**.

9. **Recording Procedures**:

A. The Recipient of the Permit shall maintain records as set out in sections 7 and 8 above, and 9B below, and shall keep such records for at least 3 years.

B. The Recipient of the Permit shall keep and manage an electronic journal for the documentation of faults in the effluent treatment facilities on the drilling rig, including documentation of the source of the fault, the duration of the fault and the actions taken to repair the situation, and shall present such upon demand.

10. **Notes and Special Provisions regarding Discharging:**

A. Effluents and Materials the Discharging of which is Prohibited:

***** Any kinds of effluents or materials that do not appear in this Permit and that have not been approved (sections 3B, 10D of the Permit).

***** Any sludge, other than drilling mud.

***** Oil-based drilling mud.

***** The concentration of mercury and cadmium in the barite shall not be greater than 1 mg / kg and 3 mg / kg, dry weight, respectively.

***** Additives not reported in advance and/or for which no information sheets have been submitted and no permit has been obtained for discharging into the sea (see section 10D of the Permit).

B. Pre-Treatment – sanitary effluent / food waste:

(1) The Recipient of the Permit shall routinely and continuously operate the sanitary effluent treatment facilities (2 Omni-pure 12 MC units for electro-chemical treatment, to generate hypochlorite for oxidation and disinfection) and shall keep the facilities in good condition at all times and to the extent required in order to comply with the criteria. Free chlorine shall be tested with a free chlorine meter prior to being discharged, in compliance with the criteria.

(2) The Recipient of the Permit shall discharge the organic waste (food) into the sea on condition that it has been ground and that it can pass through a sieve, the size of the holes in which is not greater than 25 square millimeters, and following collection and separation of oils in the kitchen of the rig, and removal thereof to an authorized site on land.

C. Work Procedures:

(1) The Recipient of the Permit shall implement work procedures which shall include detailed instructions for the treatment of faults that might cause deviations from the criteria set out in section 4 above.

(2) The Recipient of the Permit shall keep record and documentation on the rig of any removal effected from the rig including date, the party performing the work, the quantity and destination of the removal, including maintenance, recording and updating of the oil book and the waste book, in accordance with Annex 1 and Annex 5 to MARPOL, respectively. In the event of removal to the shore using a different vessel / service ship, the Recipient of the Permit shall leave a true copy on the rig, stamped by the service ship which effected actual removal to the shore.

(3) The Recipient of the Permit shall make the work procedures and the oil book and the waste book available at all times and shall update them as necessary, and shall submit them to the Marine and Coastal Department, upon demand.

D. Additives:

Any alteration or addition of materials to the list of drilling mud materials and additives in general for discharging into the sea shall require prior notice, together with information sheets (MSDS), an explanation and details of quantities, and the obtaining of the prior consent of the Marine and Coastal Department.

E. Use of detergents and cleaning agents

The Recipient of the Permit shall exclusively use only biodegradable cleaning agents and detergents suitable for seawater.

F. Additional Tests:

A supervisor shall be entitled to take up to four random samples a year of brines, and to submit such for testing in an authorized external laboratory (authorized by the Laboratory Certification Authority) at the expense of the Recipient of the Permit.

G. Compliance with Conditions of Permit:

* Failure to comply with the conditions of the Permit might give rise to cancellation of the Permit and/or to the issue of a termination order for the prevention or reduction of sea pollution.

* Under section 11 of the Prevention of Sea Pollution from Land-Based Sources Law, 5748-1988, a business license or other license for the running or establishment of a business shall be conditional upon compliance with the provisions of the Law.

* The failure to comply with the conditions of this Permit constitutes an offense under the Prevention of Sea Pollution from Land-Based Sources Law, and under the Business Licensing Law. Likewise, the Commissioner may impose a monetary

sanction on the breach of any of the conditions of this Permit.

H. Closure / Abandonment of Drilling Bore:

The Recipient of the Permit shall implement the plan for closure or abandonment of the drilling bore in such a way as to ensure that the bore is fully sealed, without any leakage into the marine environment.

The Recipient of the Permit shall be responsible for performing the abandonment / bore closing actions, subject to a plan approved in advance by the Commissioner at the Ministry of Energy & Water and shall present such upon request, and shall take care to ensure the doing of any actions required to amend or prevent environmental damage that may arise as a result of the drilling, prior to the abandonment / closure or thereafter.

I. Publication in Newspapers:

The Recipient of the Permit shall publish a notice of receipt of the Permit in two newspapers – a national newspaper and a local newspaper relevant to the pumping site, **within one month of the date of receipt of the Permit**, as set out in Appendix A to the Permit, and shall report as required (section 8I above, Appendix A to the Permit).

J. Discharging Levy:

The Recipient of the Permit shall pay the discharge levy **once a quarter, by the 20th of the month,** in the months of: January, April, July and October of each year – for the previous quarter (see section 8J above).

K. Factory Emergency Plan (FEP):

The Recipient of the Permit shall act in accordance with a factory emergency plan (LEP) in handling incidents of sea pollution by oil (extreme scenario), approved by the Marine and Coastal Division, as a condition of the Discharge Permit.

L. **Remarks:**

* The Permit shall not stand in place of any other approval required by any law.
* The term of the Permit (section 11 below) takes into account four months of actual discharge and the date of submission of the summary marine environment monitoring report at the end of the drilling (section 8H above).

M. Renewal of Permit:

In the event that the Recipient of the Permit wishes to renew the Discharge Permit, it shall submit a request to renew the permit, including electronically, two months prior to the end of the term of the Permit**.**

11. Validity of Permit**: Up until October 31, 2014, up to four months of actual discharge.**

September 17, 2013

Date

Signature
Yitshak Ben David
Senior VP Enforcement
Chairman of the Committee for the Granting of Permits

State of Israel
Ministry for Environmental Protection
Marine and Coastal Division

Appendix A
Publication of Permits in Newspapers

Publication of Notice in Newspapers regarding Receipt of Permit for Discharging / Dumping in the Sea

1. The Permit shall be published in a national and a local newspaper (relevant to the discharge site).
2. Overall size of notice: 10.5 x 10.5 cm.
3. The following shall appear: The name of the business (discharging into the sea) and the number of the Permit granted, in 16 point font.
4. The following shall appear: The method of discharging and the location thereof, in 12 point font.
5. The following shall appear: Where the details of the Permit can be inspected (the website of the Ministry for Environmental Protection), in 12 point font.
6. The following shall appear: The name of the owner of the Permit and the town in which the business discharging into the sea is situated, in 11 point font.
7. The notice shall be published within one month of the date of receipt of the Permit.
8. The notifying party shall provide a copy of the notice from the newspapers by electronic means to the Marine and Coastal Department, within one week of the date of publication.
9. The Recipient of the Permit shall be entitled to request an exemption from publication of the Permit from the Committee, subject to the submission of a detailed request in writing to the Chairman of the Committee, within one week of receipt of the Permit.

The following is an example:

Notice by Recipient of Permit

Sea Cucumber Canning
Discharge Permit No. 123/2010
Recipient of Permit – Sea Cucumber Canning Ltd. – Kiryat Abba
Company No. 57-12345678

Method and Location of Discharging:
[For example]

The discharging shall be effected via an 800 meter long marine pipe in Coconut Bay, in the quantities and qualities set out in the Discharge Permit.

The discharging shall be effected via the Alexandria brine removal terminal, in the quantities and qualities set out in the Discharge Permit.

The Discharge Permit may be viewed on the website of the Ministry for Environmental Protection: www.sviva.gov.il.

APPENDIX J

Discharge Monitoring Procedures

J.1 SUMMARY OF PROCEDURES AND INSTRUCTIONS – NOBLE ENERGY AND ATWOOD OCEANICS INTERFACE

Tables J-1 through **J-3** summarize information regarding relevant references and source documents that outline the lines of responsibility and accountability associated with drilling operations in Tamar Field, including operational procedures and instructions associated with drilling and production test performance, hazardous waste handling, and environmental management. These tables outline those responsibilities as expected to be established between Noble Energy and the operator (Operator) of the selected drilling unit as they pertain to the safe drilling and drillship operations, and appropriate measures to protect the environment and personnel.

Table J-1. Operational procedures and instructions applicable to the drilling and production test performance for the Tamar wells, including support vessel and aircraft operations.

Operations Procedure and Instructions	Reference Source		Reference
	Noble Energy	Operator	
Drilling Procedure	●		Noble Energy GMS (EHS-MS-001) Section 3 – Safe Work & Operating Procedures Operator Drilling Operations Manual
Well Control Procedures		●	Operator Drilling Operations Manual
Support Vessels	●		Noble Energy/Operator
Management of Vessel Activities		●	Operator Marine Operating Manual
Aircraft and Heliport	●		Noble Energy/Operator
MODU Aviation Provisions (i.e., helideck, emergency response and escape provisions, competent landing crew, communications and refueling systems)		●	Noble Energy/Operator Operator Marine Operating Manual Operator Helicopter Operations Manual
Shore Base	●		Noble Energy/Operator

GMS = Global Management System; MODU = mobile offshore drilling unit.

Table J-2. Hazardous waste handling procedures associated with drilling.

Environmental Management	Reference Source		Reference
	Noble Energy	Operator	
Environment		●	HSE Risk Assessment for Evaluation of Environmental Aspects
Hazardous Material		●	Operator Hazardous Materials Storage and Handling Procedures Operator ChemAlert MSDS Management System
Oil Spill Management – Deck		●	Operator SOPEP
Oil Spill Management – Overboard	●		Noble Energy: OSRP – Offshore Operations Noble Energy GMS Section 9 – Emergency Preparedness & Community Preparedness

GMS = Global Management System; HSE = Health, Safety and Environment; MSDS = material safety data sheet; OSRP = Offshore Spill Response Plan; SOPEP = Shipboard Oil Pollution Emergency Plan.

Table J-3. Environmental management procedures applicable to the reduction and prevention of harm to land, seawater, and coastline, including marine ecology associated with drilling.

Environmental Management	Reference Source		Reference
	Noble Energy	Operator	
Environment		●	HSE Risk Assessment for Evaluation of Environmental Aspects
Hazardous Material		●	Operator Hazardous Materials Storage and Handling Procedures Operator ChemAlert MSDS Management System
Oil Spill Response – Deck		●	Operator MODU SOPEP
Oil Spill Response – Overboard	●		Noble Energy: OSRP – Offshore Operations Noble Energy GMS (EHS-MS-001) Section 9 – Emergency Preparedness and Community Preparedness
Waste Management	●	●	Noble Energy Waste Management Program Operator Waste Management Program

GMS = Global Management System; HSE = Health, Safety and Environment; MODU = mobile offshore drilling unit; MSDS = material safety data sheet; OSRP = Offshore Spill Response Plan; SOPEP = Shipboard Oil Pollution Emergency Plan.
Note: Environmental management activities, in relation to drilling and completion operations, will be performed in accordance with Operator's Management System requirements. Management of hazardous materials must be implemented in accordance with the Operator's Management System requirements. Waste and discharge management must be executed in accordance with the Noble Energy Waste Management Program and Discharge Plan.

Tables J-4 and **J-5** identify the specific analytical parameters, analysis methods, reporting units, and reporting limits of quantification for seawater and sediment samples, respectively, acquired (or to be acquired) during monitoring surveys.

Table J-6 outlines the environmental management procedures applicable to monitoring systems associated with drilling, and specific to discharge monitoring and reporting associated with air emissions and waterborne discharges.

Table J-7 identifies the parameters to be measured, the drilling mud samples to be collected (by well section) and analyzed, and the toxicity testing to be completed, pursuant to discharge permit requirements.

Table J-8 outlines the emergency response procedures associated with drilling.

Additional information regarding responsibilities and procedures will be included in an interface document to be prepared by Noble Energy and the Operator, including incident reporting and investigation; health, safety and environment (HSE) training and competency; and audit inspection and verification.

Table J-4. Monitoring Survey: analytical parameters, analysis methods, reporting units, and reporting limits of quantification for seawater samples. (Actual laboratories used for the Tamar Field Development Project may differ.)

Parameter/ Analyte	Digestion/ Extraction Method	Primary Analytical Laboratory	Analytical/Detection/ Quantification Method	Limit of Quantification[1]	CCC[2]	Israeli Mediterranean Seawater Quality Standards[3]		Unit
						Mean	Max.	
Arsenic	N/A	Geological Survey of Israel	ICP-MS	7	36	36	69	µg L^{-1}
Antimony	N/A		ICP-MS	0.2	500[p]	--	--	µg L^{-1}
Barium	N/A		ICP-MS	0.2	200	--	--	µg L^{-1}
Beryllium	N/A		ICP-MS	0.5	--	--	--	µg L^{-1}
Cadmium	N/A		ICP-MS	0.1	8.8	0.5	2	µg L^{-1}
Chromium III	N/A		ICP-MS	5	27.4	10	20	µg L^{-1}
Chromium IV	N/A		ICP-MS	5	50.0	10	20	µg L^{-1}
Copper	N/A		ICP-MS	1	3.1	5	10	µg L^{-1}
Lead	N/A		ICP-MS	0.1	8.1	5	20	µg L^{-1}
Mercury	N/A		Based on USEPA 1631E	0.01	0.94	0.16	0.4	µg L^{-1}
Nickel	N/A		ICP-MS	0.1	8.2	10	50	µg L^{-1}
Selenium	N/A		ICP-MS	7	71	60	150	µg L^{-1}
Silver	N/A		ICP-MS	0.5	--	3	7	µg L^{-1}
Thallium	N/A		ICP-MS	0.1	--	--	--	µg L^{-1}
Vanadium	N/A		ICP-MS	2	50	50	100	µg L^{-1}
Zinc	N/A		ICP-MS	2	81	40	100	µg L^{-1}
Alkanes	Hexane	TDI-Brooks	USEPA 1664/8100/8015 GC-MS	0.069 – 0.277	--	--	--	µg L^{-1}
TPH	Hexane		USEPA SW-846 Modified 8100/8015C	13	--	--	--	µg L^{-1}
PAHs	Hexane		USEPA SW-846/8260 GC-MS	0.74 – 2.91	--	--	--	ng L^{-1}
Total Nitrogen	Persulfate digestion	Chesapeake Biological Laboratory	Diazo colorimetric method	0.01	--	1.0		mg L^{-1}
Total Phosphorus	Persulfate digestion		Ascorbic acid colorimetric method	0.0013	--	0.1		mg L^{-1}
TOC	N/A		High-temperature combustion	0.24	--	--		mg L^{-1}
Radium 226	N/A	ALS Environmental - Fort Collins	USEPA Method 903.1	1	--	--	--	pCi L^{-1}
Radium 228	N/A		USEPA Method 904.0 and SW-846 9320	1	--	--	--	pCi L^{-1}

GC-MS = gas chromatography-mass spectrometry; ICP-MS = inductively coupled plasma-mass spectrometry; N/A = not applicable; PAH = polycyclic aromatic hydrocarbon; TOC = total organic carbon; TPH = total petroleum hydrocarbons; USEPA = U.S. Environmental Protection Agency.

[1] Limits of quantification are the detection limits for metals and reporting limits for alkanes and PAHs.

[2] CCC = Criterion Continuous Concentration (Buchman, 2008); CCC is an estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in unacceptable adverse effects.

[3] Proposed by Israeli Ministry of Environmental Protection.

[p] = Proposed.

Table J-5. Analytical parameters, analysis methods, reporting units, and reporting limits of quantification for sediment samples.

Parameter/ Analyte	Digestion/ Extraction Method	Analytical Laboratory	Analytical/Detection/ Quantification Method	Quantification Limit	ERL	ERM	Unit
Particle size distribution	N/A	Weatherford	Laser diffraction particle size analysis	0.1	--	--	µm
Total organic carbon	N/A		Based on European Standard Norm 1484	5	--	--	ppm
Aluminum	HF[1]	TAMI	Based on ISO 11885	2	--	--	ppm
Antimony	HF[1]		Based on ISO 11885	1	--	--	ppm
Arsenic	HF[1]		Based on ISO 11885	3	8.2	70	ppm
Barium	HF[1]		Based on ISO 11885	0.5	--	--	ppm
Beryllium	HF[1]		Based on ISO 11885	1	--	--	ppm
Cadmium	HF[1]		Based on ISO 11885	0.5	1.2	9.6	ppm
Chromium	HF[1]		Based on ISO 11885	1	81	370	ppm
Copper	HF[1]		Based on ISO 11885	1	34	270	ppm
Iron	HF[1]		Based on ISO 11885	1	--	--	%
Lead	HF[1]		Based on ISO 11885	5	46.7	218	ppm
Mercury	HF[1]	Geological Survey of Israel	Based on USEPA 1631E	0.02	0.15	0.71	ppm
Nickel	HF[1]	TAMI	Based on ISO 11885	1	20.9	51.6	ppm
Selenium	HF[1]		Based on ISO 11885	1	--	--	ppm
Silver	HF[1]		Based on ISO 11885	1	1	3.7	ppm
Thallium	HF[1]		Based on ISO 11885	1	--	--	ppm
Vanadium	HF[1]		Based on ISO 11885	1	--	--	ppm
Zinc	HF[1]		Based on ISO 11885	1	150	410	ppm
Alkanes	Hexane	TDI-Brooks	USEPA 1664/8100/8015/GC-MS	0.004 – 0.019	--	--	$\mu g\ g^{-1}$
Total petroleum hydrocarbons	Hexane		USEPA/SW-846 Modified 8100/8015C	1.4	--	--	$\mu g\ g^{-1}$
Polycyclic aromatic hydrocarbons (PAHs)	Hexane		USEPA SW-846/8260/GC-MS	0.342 – 0.041	552[2] 4,002[3]	3,160[2] 44,792[3]	$ng\ g^{-1}$
Radium 226	N/A	ALS Environmental - Ft. Collins	USEPA Method 901.1	1	--	--	$pCi\ g^{-1}$
Radium 228	N/A		USEPA Method 901.1	1	--	--	$pCi\ g^{-1}$
Thorium 228	N/A		USEPA, EMSL/LV	0.2	--	--	$pCi\ g^{-1}$
Lead 210	N/A		Liquid scintillation counting USEPA 906.0	1	--	--	$pCi\ g^{-1}$

EMSL/LV = Environmental Monitoring Systems Laboratory, Las Vegas; ERL = effects range low (Buchman 2008); ERM = effects range median (Buchman, 2008); GC-MS = gas chromatography-mass spectrometry; N/A = not applicable; ppm = parts per million; TAMI = IMI TAMI Institute for Research and Development Ltd.; USEPA = U.S. Environmental Protection Agency.

[1] HF = hydrofluoric acid (this digestion procedure results in the release of nearly all the metal content of a sample and it is believed to more accurately estimate the metal concentrations in all sample matrices).

[2] PAHs = low molecular weight PAHs.

[3] Total PAHs.

Table J-6. Environmental management procedures applicable to monitoring systems associated with drilling and specific to discharge monitoring and reporting associated with air emissions and waterborne discharges.

Environmental Management	Reference Source		Reference
	Noble Energy	Operator	
Discharge Monitoring and Reporting	●		Noble Energy Discharge Plan

Note: Environmental management activities, in relation to drilling and completion operations, will be performed in accordance with the Operator's management system requirements.

Table J-7. Summary of testing of drilling muds.

Frequency of Testing (minimum)	Type of Test/Target Analyte	Method/Standard
Drilling Muds/Liquids		
The sampling frequency below has been determined based on the stages of drilling and based on the drilling plan. **Grab sampling**, in each drilling segment: • 36 in. + 26 in. • 18⅛ in. × 22 in. • 16½ in. × 20 in. • 14½ in. × 17 in. • 12¼ in. × 14¾ in. • 10⅝ in. × 8½ in. • 8½ in. Total of at least 7 samples	Biological Oxygen Demand (BOD_5)	SM-5210 B
	TOC	TOC Cell Test
	Suspended solids 105°C (TSS)	SM-2540 D
	Mineral oil (FTIR)	EPA 418.1
	PAH by GC-MS	EPA 8270
	Phenol	SM-5530 D
	Cresol	SM-5530 D
	Nitrate (as N)	SM-4500-NO_3 B
	Nitrite (as N)	SM-4500-NO_2 B
	Ammonium nitrogen (as N)	SM-4500-NH_3 C
	Kjeldahl nitrogen (as N)	SM-4500-Norg B
	Total nitrogen (calculated)	SM-4500-Norg B + SM-4500-NO_2 B + SM-4500-NO_3 B
	Reaction value (pH)	SM-4500-H+B
	Total dissolved solids (TDS)	SM-2540 C
	DOX/AOX	Hach-Lange Cell Test
	Chlorides	SM-4500-CI-D
	Toxicity testing – once a month	EPA 1619; 96-hr Static Acute Toxicity Test (*Mysidopsis bahia*)
	Broad screening for metals (ICP), including P	EPA 6010 B
	GCMS, probability percentages, half quantity concentrations and total concentration	EPA 8270
	VOCs, probability percentages, half quantity concentrations and total concentration	EPA 8260

Table J-8. Emergency response procedures associated with drilling.

Emergency Response	Reference Source		Reference
	Noble Energy	Operator	
Emergency Evacuation and Escape		●	Operator Emergency Management and Response Plans
Emergency Response Plans		●	Operator Emergency Management and Response Plans
Emergency Transportation, including Medical Evacuation	●	●	Noble Energy/Operator Drilling Contract; Operator Emergency Management and Response Plans
Emergency Drills and Exercises		●	Operator Emergency Management and Response Plans Operator Minimum Operating Standard – Emergency Response Drills
Onshore Incident Management	●	●	Noble Energy GMS Section 5 – Emergency Preparedness and Community Preparedness Operator Emergency Management and Response Plans

Notes:

Noble Energy has primary responsibility for emergency management arrangements. In the event of an accident or emergency, the designated person in charge, Operator offshore installation manager, is in overall command. Operator emergency response plans and procedures must be applied to manage well site emergency situations to ensure safe evacuation, escape, and rescue of wellsite personnel. All incidents must be reported to the offshore Noble Energy representative as soon as practicable.

The maintenance and safe operation of evacuation and escape equipment is the responsibility of Operator.

Both Noble Energy's and Operator's incident management processes must apply to incidents that require onshore emergency response coordination via remove incident management teams. An Operator representative must attend and liaise with the Noble Energy incident management team at the designated Noble Energy location.

J.2 SUMMARY OF APPLICABLE INTERNATIONAL STANDARDS TO ISRAEL'S OFFSHORE OIL AND GAS OPERATIONS BEYOND 12 NMI FROM SHORE

Existing international conventions and protocols are important environmental guidelines for minimizing and monitoring environmental impacts from project-related activities located more than 12 nmi from shore, potentially including discharges, emissions, and accidental losses. Israel has ratified most of the major international maritime conventions, which are incorporated into the Domestic Law via Annex 17 of the National Safety of Shipping Regulations. Although the State of Israel has not ratified several conventions, it acts in the spirit of the United Nations Convention on the Law of the Sea (UNCLOS) and *de facto* implements all international conventions (Safe Med Project, 2012). The following summary outlines the pertinent international conventions and protocols that are applicable to the Tamar Field Development Project.

J.3 RELEVANT INTERNATIONAL ENVIRONMENTAL CONVENTIONS AND ASSOCIATED PROTOCOLS

Several key international conventions and protocols apply directly or have relevance to environmental issues associated with offshore oil and gas development activities in Israel. Israel is party to and has ratified numerous international environmental conventions and several of their protocols. Implementation is through the enactment of the necessary laws, decrees, and ordinances. These include:

- Convention on Prevention of Pollution of the Sea by Oil (ratified 1966);
- Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention, signed 1976, ratified 1978), revised as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (revised June 1995);

- Convention on Protection Against Hazards of Benzene Poisoning (ratified 1979);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, ratified 1979);
- Convention on Conservation of Migratory Species of Wild Animals (ratified 1983);
- Convention on Prevention of Pollution from Ships (MARPOL Convention, ratified 1983);
- Vienna Convention on Protection of the Ozone Layer (ratified 1992);
- Montreal Protocol on Substances that Deplete the Ozone Layer (ratified 1992);
- Basel Convention on Control of Trans-boundary Movement of Hazardous Wastes (ratified 1994);
- Convention on Biological Diversity (ratified 1995);
- Convention on Combating Desertification (ratified 1996);
- United Nations Framework Convention on Climate Change (ratified 1996);
- RAMSAR Convention on Wetlands of International Importance Especially as Waterfowl Habitat (ratified 1997);
- Kyoto Protocol on Climate Change (signed 1998);
- Rotterdam Convention on Prior Informed Consent (PIC) Procedure for Hazardous Chemicals and Pesticides in International Trade (signed 1999);
- Convention on Protection of World Cultural and Heritage (ratified 1999), which includes two world heritage sites, Massada and Acre on the coast north of Haifa;
- Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990 (ratified 1999); and
- Stockholm Convention on Persistent Organic Pollutants (POPs, signed 2001).

Of the international environmental conventions and protocols identified above, several key conventions and protocols are relevant to Noble Energy's proposed drilling operations offshore Israel. Of particular importance is the MARPOL Convention with its six Annexes and the Barcelona Convention with its associated protocols.

J.3.1 MARPOL Convention

The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978, respectively, and updated by amendments. It must be emphasized that MARPOL does not apply to stationary platforms such as the existing Mari-B or Tamar Platforms. However, MARPOL standards and regulations could be viewed as indicative guidelines.

The MARPOL Convention was adopted on 2 November 1973 at International Maritime Organization and covers pollution by oil, chemicals, harmful substances in packaged form, sewage, and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety and Pollution Prevention in February 1978, held in response to a series of tanker accidents that occurred in 1976-1977. Additional measures relating to tanker design and operation also were incorporated into a 1978 Protocol, as originally developed during the 1974 Convention on the Safety of Life at Sea. The Convention includes regulations designed to prevent and minimize ship pollution from both accidents and routine operations; it currently includes six technical Annexes (**Table J-9**). Party states to the convention are to accept Annexes I and II; remaining Annexes (Annexes III through IV) are voluntary.

Table J-9. Technical annexes of MARPOL Convention 73/78.

Annex	Scope of Annex
I	Regulations for the Prevention of Pollution by Oil
II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
IV	Prevention of Pollution by Sewage from Ships
V	Prevention of Pollution by Garbage from Ships
VI	Prevention of Air Pollution from Ships (entry into force 19 May 2005)

MARPOL = International Convention for the Prevention of Pollution from Ships.

J.3.2 Barcelona Convention

Following the establishment of the United Nations Environmental Programme (UNEP) in 1972, the countries surrounding the Mediterranean Sea were the first to establish a regional action plan. Termed the Mediterranean Action Plan (MAP), it is based on three fundamental components:1) the application of specific protocols to deal with various aspects of marine pollution; 2) the establishment of a monitoring system to assess levels of pollution; and 3) the establishment of a socioeconomic plan that will provide for sustainable development around the Mediterranean Sea.

The Barcelona Convention was initially termed the Convention for the Protection of the Mediterranean Sea Against Pollution (1976) and subsequently revisited as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (1995). The initial convention, in which delegates from 16 countries gathered to establish the first protocols, was originally signed in 1976 and came into effect in 1978. Israel signed the Barcelona Convention in 1978, and subsequently ratified it later the same year.

According to the Convention, the parties are to take appropriate measures to protect and improve the Mediterranean marine environment in order to contribute to sustainable development in the area and to prevent, abate, combat, and as far as possible, eliminate pollution in the area. The Convention gave particular attention to the following four types of pollution:

- Pollution caused by dumping from ships and aircrafts;
- Pollution from ships;
- Pollution resulting from exploration and exploitation of the continental shelf and the seafloor and its subsoil; and
- Pollution from land-based sources.

The Convention lays down provisions on cooperation and information among the parties in the event of a critical situation causing pollution in the Mediterranean Sea in order to reduce or eliminate any resulting damage. The parties also are to endeavor to establish continuous pollution monitoring and to establish procedures to supervise the application of the Convention. They are to cooperate in the fields of science and technology and work out appropriate procedures for the determination of liability and compensation for damage resulting from pollution deriving from violations of the provisions of the Convention, as well as for the settlement of any disputes arising as to the interpretation or application of the Convention.

In June 1995, following conceptual changes discussed at the Rio Conference (1992), the original Barcelona Convention was amended (i.e., renamed during revision as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean), and a second phase action (MAPII) was declared. The practical amendments adopted in 1995 concern a number of the protocols, most notably in prevention of pollution from land-based sources, dumping waste, and the protection of specially protected areas and biodiversity. These amendments do not refer to the kind of waste dumped in the sea, which remains in the original protocols. These amendments

concern, in particular, the extension of the Convention's geographical field of application to the coast, the application of the precautionary and "polluter pays" principles, the obligation on the parties to carry out and promote impact assessments, protect and preserve biological diversity as well as combat pollution from cross-border movements of dangerous waste, and promote access to information and public participation. Important protocols present in the Barcelona Convention are summarized in **Table J-10**.

Table J-10. Protocols to the Barcelona Convention that are potentially applicable to Noble Energy's proposed drilling operations (Adapted from: United Nations Environment Programme, 2011, 2013).

Protocol	Relevant Dates
Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft (Dumping Protocol) (1976) **Revision**: Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea (1995)	Adopted 1976; in force 1978; revised 1995
Protocol Concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and other Harmful Substances in Cases of Emergency (Emergency Protocol) **Update**: Protocol Concerning Cooperation in Preventing Pollution from Ships and in Case of Emergency Combating Pollution of the Mediterranean Sea	Adopted 1976; in force 1978; update signed January 2002; currently open for ratification
Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (LBS Protocol) **Amendment**: Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities	Adopted 1980; in force 1983; amended 1996
The Protocol Concerning Mediterranean Specially Protected Areas (SPA Protocol) **Revision**: Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA and Biodiversity Protocol)	Adopted 1982; in force 1986; revised 1995
Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil (Offshore Protocol)	Adopted 1994; not yet in force
Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal (Hazardous Wastes Protocol)	Adopted 1996; not yet in force

J.4 LITERATURE CITED

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