EXECUTIVE SUMMARY

ES.1 Description of the Current Maritime Environment

The EIA describes the maritime environment of the Leviathan Field production based on published literature from the region and site-specific data from a background monitoring survey conducted in accordance with guidelines issued by the MNIEWR and MoEP. A regional perspective was provided by calculating Levantine Basin Baseline values for many of the parameters measured during the Background Monitoring Survey. The Levantine Basin Baseline is the mean of all unaffected (pre-drilling) samples from the region.

Geological, Seismic, and Sedimentological Characteristics

Geological Characteristics

Water depth in the Leviathan Field varies from 1,540 m in the south to 1,800 m in the north and seafloor sediments consist primarily of soft sediments (clay and silt with localized sand). Seafloor gradients average approximately 2° and locally increase to more than 15° on the flanks of seafloor drainage channels and seafloor ridges.

The current geotectonic framework of the region is dominated by the collision of the Arabian and African plates with the Anatolian Plate. The Leviathan Field is intersected by three north-northeast, south-southwest trending strike-slip faults and is disrupted by several reverse fault intersections that trend southeast-northwest. Adjacent smaller scale strike-slip faults occur at right angles to this fault-induced ridge. Aside from these channel and fault-related features, the seafloor in the Leviathan Field is generally smooth and featureless.

The seafloor gradient along the proposed pipeline corridor ranges from 0° to 52°. The water depth along the pipeline corridor ranges from 1,696 m near the Leviathan Field to 83 m near the proposed production platform. The pipeline route will cross the north-to-south trending Tamar Channel where the seafloor gradient approaches 20°. The Tamar Channel measures approximately 700 to 900 m across and ranges in water depth from 30 to 35 m. The seafloor along the pipeline corridor is disrupted by large offset faults with a dominant fault trend on the shelf break oriented from northeast to southwest.

Seismic Characteristics

Since 1979, one earthquake (magnitude 4.0) has been recorded within approximately 40 km of the Leviathan Field and near the proposed pipeline corridor. No strong regional earthquakes (magnitude 5.6 or greater) have been recorded since 1983 that are within 200 km of the proposed drillsites or the proposed pipeline corridor.

Sedimentological Characteristics

A shallow stratigraphy analysis of the Leviathan Field identified the three shallowest units below the seafloor (A, B, and C), separated by Horizons H05, H10 (top of salt) and H_20 (base of salt).

Attribute studies of the three units identified no significant anomalous amplitudes indicative of shallow gas.

Surficial sediments collected by geotechnical sampling along the pipeline route to the approximate location of the proposed platform show that the upper meter of sediment consists of very soft clays. A geophysical survey of the proposed pipeline corridor and Leviathan Production Platform (LPP) location from approximately 360 m water depth to approximately 7 to 10 m water depth identified an escarpment, mass movements and their deposits, large-scale sediment bedforms, and outcrops as the main morphological features present in the survey area. The shelf area can be characterized as generally flat and smooth, except for the presence of bedforms, depressions and ridge outcrops primarily found at water depths less than 80 m. At water depths greater than 80 m, the shelf is characterized by an undulated seafloor. Several exposed rocky outcrops were identified in less than 105 m water depth along the proposed pipeline corridor.

Geological Risks

The pipeline corridor will traverse 117.7 km of seabed from the production manifold at a depth of 1,629 m to the production platform 10.3 km off the Israeli coast in 87 m of water, with the pipeline making landfall near Dor. The route will encounter several geologic features: strike-slip faults, seabed ridges underlain by reverse faults, sediment slumps adjacent to seabed channels, active and inactive seabed channels, normal faults and surficial failures at the slope break. Earthquakes, tsunamis and underwater landslides are the primary geologic risks in the Leviathan Field and along the proposed pipeline corridor.

Nature and Ecology

Coastal Habitats and Infrastructure

The Leviathan Field is located approximately 120 km from the nearest shoreline (northern Israel near Rosh HaKarmel) and is not near any coastal habitats. The export pipeline will be installed on the seafloor from the Leviathan Field to the production platform offshore of Dor, 10.3 km from the nearest shoreline.

Benthic Communities

No known chemosynthetic communities are known to exist in the Application Area. Based on surveys conducted in the Application Area, this area of the Levantine Basin is characterized by smooth, relatively flat soft bottoms. Sediments in the Leviathan Field generally are composed of clay and silt. Soft bottom assemblages are composed of biota (typically fauna in depths below the photic zone) living within the sediments (infauna) and on the sediment surface (epifauna). The most common taxa collected in the Leviathan Field were from the phyla Annelida and Arthropoda, which respectively made up 64% and 27% of total infauna collected in the Leviathan Field.

Benthic communities along the pipeline corridor changed with depth. The majority of individuals collected (i.e., highest densities) were found between 500 and 1,000 m water depths. The most common taxa along the pipeline route were from the phylum Annelida (class Polychaeta). In

shallow waters less than 200 m depth, Arthropoda, Mollusca, and Echinodermata also substantially contributed to collected taxa.

Marine Mammals, Sea Turtles, Birds and Fishes

There are no site-specific marine mammal data from the Leviathan Field or from the proposed pipeline corridor. However, based on a literature review, several marine mammal species may be present. Small cetacean species that are considered regular species or visitors in the Levantine Basin include the common bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin (*Delphinus delphus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), striped dolphin (*Stenella coeruleoalba*) and false killer whale (*Pseudorca crassidens*). Large cetaceans that are considered regular residents or visitors in the Levantine Basin include the fin whale (*Balaenoptera physalus*), minke whale (*Balaenoptera acutorostrata*), and sperm whale (*Physeter macrocephalus*).

There are no site-specific sea turtle data from the Leviathan Field or from the proposed pipeline corridor. However, based on a literature review, three sea turtle species are known to occur in the Levantine Basin: green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*) and loggerhead turtle (*Caretta caretta*). The green turtle is listed as Endangered by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, leatherback turtles are listed as Vulnerable, and the Mediterranean subpopulation of the loggerhead turtle is listed as Least Concern. The hawksbill turtle (*Eretmochelys imbricata*), a Critically Endangered species, also occurs occasionally in the Mediterranean Sea but would not be expected within the Levantine Basin.

No site-specific data on birds are available from the Leviathan Field or from the proposed pipeline route. However, the Mediterranean region is home to several hundred bird species, including seabirds, migratory birds and shorebirds that could be present near the proposed production platform. Because the Leviathan Field is more than 100 km offshore, the avifauna in the Leviathan Field are likely to consist mainly of pelagic seabirds – those that spend most of their life cycle in the marine environment, often far offshore over the open ocean. Examples of pelagic seabirds native to Israeli waters include Cory's Shearwater (*Calonectris diomedea*), Leach's Storm-Petrel (*Oceanodroma leucorhoa*), Sooty Shearwater (*Puffinus griseus*), and Yelkouan Shearwater (*Puffinus yelkouan*). Nearshore seabirds that may be likely to occur near the proposed production platform include various species of gulls, terns, pelicans and cormorants. These species could occur in the Leviathan Field, but are likely to be more abundant in coastal waters.

Site-specific data on fishes from deepwater areas in the Levantine Basin are available from previous surveys conducted by Noble Energy. Fish species identified by video transects conducted by a remotely operated vehicle in deepwater areas included the tripod fish *Bathypterois* sp., halosaur (*Halosaurus* sp., eels (order Anguilliformes) and other small unidentifiable fish. A video survey along the general route of the proposed pipeline in waters less than 220 m deep and at the location of the proposed production platform revealed large schools of small, unidentified

fish (approximately 100 to 200 individuals), and occasional large fishes, eels, and rays were observed in waters deeper than 50 m.

Overall, the Mediterranean Sea supports more than 700 fish species. There are 636 marine fish species reported from Israeli waters, including 582 natives and 54 introduced species. A recent set of cruises by the R/V *Nautilus* was performed at depths of 650 to 1,600 m in 2010. Several species emerged as dominant, namely the wreckfish *Polyprion americanus* and the Mediterranean spiderfish *Bathypterois mediterraneus* (synonymous with *B. dubius),* which was the most common fish species observed near the Application Area. Other fishes included shark (*Centrophorus* spp.) and skate (*Dipturus oxyrhinchus*), the anglerfish *Lophius piscatorius,* the forkbeards *Phycis* and *Phycis blennoides,* the ghost shark *Chimaera monstrosa,* the dragonfish *Stomias boa*, and several unidentified hatchetfish, scorpionfishes, triglids, and flatfishes.

The waters of the Levantine Basin are considered oligotrophic (nutrient-starved) and do not support particularly rich fisheries. Of the large pelagics typically found offshore, special note is warranted for Atlantic bluefin tuna (*Thunnus thynnus*). Considered one of the most valuable fish species, if not the most valuable, it is undergoing a commercial collapse and is currently listed by the IUCN as Endangered. Other large offshore pelagic fishes in the Levantine Basin that may be fished commercially include albacore tuna (*Thunnus alalunga*) and other scombrids (e.g., *Euthynnus alletteratus*), dolphinfish, swordfish, sailfish, and pelagic sharks. Of the deepwater ichthyofauna, hake (*Merluccius merluccius)* is worthy of special mention. This species, once caught by Israeli trawlers on the continental slope, has all but disappeared in recent years. Other deepwater species that show significant declines include the wreckfish (*P. americanus*) and the Haifa grouper (*Hyporthodus haifensis*).

Seawater and Sediment Quality

Seawater Quality

Based on the Background Monitoring Survey and data from previous surveys in the Levantine Basin, seawater from the Leviathan Field to the proposed production platform location has low nutrient concentrations, metal concentrations that are below detection limits or below the relevant criteria and standards, concentrations of total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) that are below detection limits, and radionuclide concentrations that are below the U.S. Environmental Protection Agency (USEPA) established maximum contaminant levels.

Sediment Quality

Sediment sampling was conducted in the Leviathan Field and between the Leviathan Field and the location of the proposed production platform offshore Dor. Sediment samples were analyzed for grain size, total organic carbon (TOC), metals, hydrocarbons (TPH and PAH), radionuclides, and polychlorinated biphenyls (PCBs). The findings are summarized as follows:

- Sediment nutrients (TOC) were low in both the Leviathan Field and at all stations sampled between the field and the proposed production platform location. TOC concentration was

significantly correlated with distance to the shoreline, with TOC decreasing closer to the shoreline.

- Most values of metals in the survey area were lower than the effects range low (ERL) and effects range median (ERM) values. Exceptions included arsenic, chromium and copper where metals concentrations were higher than the corresponding ERL value but much lower than the corresponding ERM value. Nickel exceeded both the ERL and ERM values; however, mean marine sediment and continental crust concentrations also exceeded the ERM value. Reported concentrations of arsenic, chromium, and copper were similar to the Levantine Basin baseline mean and below the 99% confidence limit (CL).
- Sediment TPH concentrations within the Leviathan Field ranged from 4.0 to 27.1 ppm and had a mean (± SD) of 13.2 ppm ± 4.8. TPH concentrations throughout the entire survey area were within the 99% CL of the Levantine Basin baseline mean. TPH concentrations in deepwater stations (500 to >1,600 m water depth) ranged from 8.5 to 13.3 ppm and were well below the Levantine Basin baseline 99% CL (21.85 ppm). TPH concentrations of samples in less than 500 m water depth ranged from below the detection limit to 42.4 ppm.
- PAH was analyzed from samples with TPH concentrations higher than the 95% CL of the Levantine Basin baseline mean, indicating hydrocarbon concentrations above background means. Few individual PAHs had concentrations that were higher than the Levantine Basin baseline means. However, the total mean PAH concentration within the Leviathan Field was above the Levantine Basin baseline mean. Although total PAH for both pipeline strata were higher than the Levantine Basin baseline mean, total PAH were lower than the Levantine Basin baseline 99% CL, ERL and ERM values. Individual PAH concentrations along the proposed pipeline corridor were generally below the Levantine Basin baseline mean and the corresponding ERL and ERM values for PAH in marine sediment. Total sediment PAH from stations in water depths less than 500 m were higher than the Levantine Basin baseline mean, but lower than the Levantine Basin baseline 99% CL
- Mean radium and thorium concentrations in the survey area were generally similar to the Levantine Basin baseline concentrations and all samples (except one) were within the 99% CL of the Levantine Basin baseline.

Polychlorinated biphenyls were not detected from the eight samples tested from the Leviathan Field. Low PCB concentrations were detected from two stations between the Leviathan Field and the proposed production platform. However, given the low concentrations that were detected and the ubiquitous nature of PCB contamination worldwide, it is unlikely that the detected PCBs are biologically significant and likely do not indicate widespread PCB contamination along the pipeline route.

Culture and Heritage Sites

Noble Energy contracted Geoscience Earth & Marine Services (GEMS) to conduct a shallow hazards, geologic and archaeological assessment within the Leviathan Development project area. GEMS used high-resolution sub-bottom profiler, side-scan sonar, and multibeam

bathymetry and backscatter data collected by an Autonomous Underwater Vehicle (AUV) for this assessment.

All information concerning side-scan sonar contacts that may represent shipwreck sites with high potential for historical or archaeological significance was submitted to the Marine Archaeology Unit at Israel Antiquities Authority for further assessment and evaluation.

Meteorology and Air Quality
The EIA uses regional data to describe representative meteorological conditions in the Leviathan Field Development Area. Israel's subtropical location generally brings long, hot, dry summers and short, cool, rainy winters, as modified locally by altitude and latitude. The major pollutant sources of anthropogenic origin in the Mediterranean region are located in central and southern Europe, with minor contribution from North Africa and the Middle East. There are no known special meteorological conditions that might cause conditions of dispersal that would give rise to high air pollution concentrations in the Application Area.

Noise
The most likely dominant source of ambient underwater noise in the Application Area is shipping. Shipping noise is ubiquitous in the world's oceans and is the dominant source of underwater noise at frequencies below 300 Hz in many areas. The Eastern Mediterranean region is one of the busiest sea routes in the world, with a number of high-volume port facilities and crowded shipping lanes.

Marine Transportation System and Infrastructure
Numerous shipping lanes cross Israel's territorial waters. The Leviathan Field, pipeline route and the proposed platform location are not located within a shipping lane. The proposed platform location is shoreward of the major north-south shipping lane in Israeli waters and north of the shipping lane leading offshore from the Hadera area. While the pipeline corridor traverses a shipping lane, the pipeline's presence will not impact shipping activities.

Existing maritime infrastructure within the Application Area includes four previously drilled wells (Leviathan-1 through Leviathan-4), two telecommunications cables and the existing Tamar and Israel Natural Gas Lines Ltd. (INGL) natural gas pipelines. Existing infrastructure in the Leviathan Field is limited to telecommunications cables and existing wellsites.

ES.2 Location and Technology Alternatives and Reasons for Preferring the Proposed Alternatives

Noble Energy evaluated location alternatives and various technological alternatives in determining the Field Development Plan (FDP) for the Leviathan Field. Alternatives considered include: Gathering manifold location, transmission pipeline route, potential use of flexible flowlines, transmission pipeline configuration, materials of construction, control system configuration, hydrate inhibitor selection and distribution, and future entry in to the Northern TAMA

Block. Table ES 1 summarizes the location and technology alternatives evaluated by Noble Energy.

Table ES 1: Summary of Location and Technical Alternatives Evaluated for the Leviathan Field Production

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Location Alternatives			
LPP Location	The LPP is proposed to be located in the northern TAMA block approximately 10 km from the coast of Dor. This location has been determined as part of the TAMA process and is considered fixed for the purpose of this assessment	No alternatives are considered in this assessment.	Section 2.2
Wellhead Locations	Wellhead locations have been determined based on reservoir targets and the well design previously presented in the Leviathan Drilling EIA (Noble Energy Mediterranean Ltd., 2016a). Drilling is not included in the scope this assessment and wellhead locations are considered fixed.	No alternatives are considered in this assessment	Section 2.2.1
Flowline Routing	Flowlines connecting the subsea wellheads to the Infield Gathering Manifold will be routed by the most direct route where practicable to minimize overall length and the associated impacts.	No credible alternatives to the proposed flowline routings have been determined associated with this assessment.	Section 2.2.1
Infield Gathering Manifold Location	The Infield Gathering Manifold is a critical item of the subsea production system. The selected location is central amongst the initial development wells and provides a balance between infield flowline and transmission pipeline lengths.	**Located East of Channel D – Rating: Less Acceptable.** Moving the Infield Gathering Manifold to the east of channel D would remove the requirement for the transmission pipelines to cross the channel; however, infield flowlines would have to cross it instead. This provides no clear benefit and would increase infield flowline length.	Section 2.2.2

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
		Relocated North / South or West – Rating: No Benefit. Relocating the Infield Gathering Manifold either north, south or west of its current location is not considered to present any significant environmental benefit. Any reduction in individual flowline lengths achieved would be offset by increases in length of other flowlines or the transmission lines.	
Transmission Pipeline Route	The transmission pipelines will be routed to minimize overall length, while avoiding unnecessary seabed hazards where possible. The selected route will cross three (3) major deepwater channels and the Tamar production system.	**Routed North of Tamar Field – Rating: Less Acceptable.** The only significant seabed feature between the Leviathan Field and the proposed LPP that can be avoided by a credible pipeline re-routing is the crossing of the Tamar production infrastructure. This would remove the requirement for an engineered crossing of the existing pipelines and umbilical. However, such a rerouting would add approximately 17.5 km to each transmission line (15%) and would necessitate crossing the MED Nautilus cable system as well. The incremental pipe length and cable crossing are considered to outweigh the benefit of not crossing the Tamar production system.	Section 2.2.3
Technology Alternatives – Infield Infrastructure			
Infield Flowline Construction	The infield flowlines will be of rigid construction in carbon steel.	**Flexible Pipe for Infield Flowlines – Rating: Less Acceptable** Flexible flowlines were considered but due to diameter restrictions, the project would require multiple flexible flowlines to deliver the same flow rate as a single carbon steel flowline. Therefore there is no environmental benefit associated with the use of flexible flowlines. Further, use of flexible flowlines would be expected to incur significantly increased CAPEX which further renders them unattractive for this application.	Section 2.3.1.1**Error! Reference source not found.**

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Infield Gathering Manifold	The subsea configuration for the Leviathan development will be centered on a single six (6) slot Infield Gathering Manifold with three (3) production headers. Flowlines will tie each drill center (five (5)) back to the Infield Gathering Manifold. Cross connections and valving will be supplied within the manifold such that any of the six (6) slots may be routed to any of three (3) production headers as operations require. This presents significant operational flexibility and robustness to future system expansion.	**Tie-in Manifold/Structure per Production Pipeline –** **Rating Less Acceptable** Use of a dedicated manifold or tie-in structure per production pipeline (two (2) by DSM and one (1) by REM) have been considered. However such a configuration would substantially reduce operational flexibility and the capacity of the system to manage wells depleting at varying rates. This configuration is not considered to offer any environmental benefit compared to the selected configuration	Section 2.3.1.2
		Daisy Chain Architecture – **Rating Less Acceptable** Use of a daisy chain subsea configuration where wells are tied into specific production pipeline has been considered as an alternative to an Infield Gathering Manifold. However such a configuration presents significant operational restrictions similar to those associated with using a dedicated Tie-in Manifold per pipeline. Further, daisy chain configurations typically result in a lower production availability as well workovers may necessitate the entire shutdown of a production branch due to potential for dropped object impacts. There is no clear environmental benefit to a daisy chain architecture.	
Jumpers	Tie-ins between infield infrastructure and their associated flowlines will be made with jumpers of a rigid construction in carbon steel.	**Flexible Pipe Tie-ins –** **Rating: Less Acceptable** Flexible jumpers were considered but due to diameter restrictions, the project would require multiple flexible jumpers to deliver the same flow rate as a single carbon steel jumper. Therefore there is no environmental benefit associated with the use of flexible jumpers. Further, use of flexible jumpers would be expected to incur increased CAPEX which further renders them unattractive for this application	Section 2.3.1.3

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
MEG Supply (Infield)	MEG will be distributed from the infield MEG SDU to the relevant infield infrastructures by way of dedicated tubes within the infield umbilicals. Spare cores will be allowed for in the umbilicals to provide redundancy to the production critical MEG system	**Dedicated Infield MEG flowlines – Rating: Less Acceptable** Dedicated infield MEG flowlines (standalone) from the MEG SDU to the relevant infrastructures were considered, however this would increase seabed land take by virtue of the presence of additional infield flowlines. Further, in order to maintain redundancy in the MEG supply system dual MEG flowlines would be required between the MEG SDU and each relevant infield infrastructure This would further increase land take.	Section 2.3.1.4
Technology Alternatives – Transmission Infrastructure			
Production Pipeline Configuration	The production pipeline configuration will be: 2x 18" DSM pipelines; 1x 20" REM pipeline; and This configuration is preferred as it offers increased operational flexibility, while retaining segregated flow to the REM thus isolating it from the impact of domestic demand swings	**Fewer Production Pipelines – Rating: Less Acceptable** Reducing the number of production pipelines from three (3) to two (2) is not preferred as this will result either in comingled REM / DSM production, or use of a single transmission line for DSM purposes. Both options will reduce operational flexibility and the capacity of the system to respond to demand swings in the Israeli domestic gas market.	Section 2.3.2.1
		More Production Pipelines – Rating: Less Acceptable Increasing the number of production pipelines will result in increased project CAPEX and environmental footprint with no significant benefit identified. As such, this is not a preferred alternative.	
MEG Supply Lines	Dual 6" MEG supply lines will be utilized to supply MEG from the LPP to the infield MEG SDU. This configuration offers redundancy (2 x 100%) in this production critical system. MEG supply lines may be laid either in a piggyback configuration on the 18" DSM production pipelines, or as standalone lines within the transmission corridor. Final decision on installation will be made following contract award.	**Fewer MEG supply lines – Rating: Less Acceptable** Use of a single MEG line is less acceptable to the project as although it may reduce environmental impact it will remove redundancy in this production critical element of the system. If a single supply line were utilized a blockage or rupture of the line would result in a full field shutdown until the situation could be resolved, thus impacting production availability and Israeli energy security. .	Section 2.3.2.2

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Materials of Construction	All production and MEG pipelines, and infield production lines will be constructed from carbon steel. Corrosion protection from trace levels of reservoir impurities will be by corrosion inhibitor injection. External corrosion protection will be through the application of an external corrosion resistant coating with sacrificial anodes in place for added protection.	**Alternative Pipeline Material (CRA) – Rating: Less Acceptable** Use of CRA for pipeline construction would remove the requirement for corrosion inhibitor injection at the subsea wellheads. This would reduce operational use of chemicals and presents a minor environmental benefit due to reduction in subsea chemical inventory. However, the subsea corrosion inhibitor injection system will be a closed loop system with no normal discharge to the environment and as such the environmental benefit associated with a CRA solution is considered negligible. While the selection of CRA may be beneficial through the removal of the requirement of corrosion inhibitor injection, this is not considered to be BAT due to the negative economic impact of utilizing CRA. Selection of carbon steel with corrosion inhibitor injection in preference to CRA is common practice throughout the offshore oil and gas industry.	Section 2.3.2.3
Controls System – Controls Configuration	A multiplexed, electrohydraulic controls system will be utilized to provide controls and chemicals to the infield infrastructure from the LPP. This will enable monitoring and actuation of subsea valves via a single primary umbilical that is within installation and logistical constraints	**Alternative Hydraulic Controls Configuration – Rating: Not Acceptable.** Non-multipexed hydraulic / electrohydraulic controls systems are not appropriate for the Leviathan development due to the complexity of the subsea production system. This would result in an unacceptably large primary umbilical. **All Electric Control System – Rating: Not Acceptable.** An all-electric controls system is potentially advantageous due to the removal of hydraulic fluid and the associated environmental discharges arising with an open loop system. However, this technology is not field proven and thus presents an unacceptable technology risk to the project.	Section 2.3.2.4

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Controls System – Umbilical Sparing	A single primary umbilical will run from the LPP to the infield controls SDU. Redundancy will be built into this umbilical by way of core sparing. The umbilical as a whole shall be designed and constructed to resist environmental impacts and loads.	**Dual Primary Umbilicals – Rating Less Acceptable** Dual umbilicals were considered by the project in order to increase controls availability by increasing redundancy. However, use of dual umbilicals would increase the seabed land take associated with the controls system rendering it less attractive from an environmental standpoint. Further, the provision of spare cores in a single primary umbilical (as selected) is considered to offer sufficient redundancy that provision of an additional umbilical is not necessary.	Section 2.3.2.4
Controls System – Open versus Closed Loop System	An open loop controls system will be utilized on the Leviathan Field development due to benefits associated with reduced umbilical cores and increased valve response associated with this design. This will generate intermittent discharges of hydraulic fluid when valves move to the fail-safe positions, these are considered to be diminutive, water-based, and with minimal environmental impact.	**Closed Loop Multiplexed System – Rating: Less Acceptable.** A closed loop controls system is technically feasible for the Leviathan development. However, implementation of a closed loop system will result in decreased valve response as a result of backpressure in the return line. Inclusion of a return line in the umbilical will also increase overall umbilical diameter (and associated land take) and increase project CAPEX. Further, the implementation of a closed loop system at the project water depth and step-out distance may raise the potential for the system to fail to respond adequately in an emergency scenario where valves are required to fail closed. The above concerns are considered to outweigh any minor environmental benefit of removing intermittent low volume water based hydraulic discharges.	Section 2.3.2.4

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Hydrate Inhibition	The selected hydrate management strategy for the Leviathan Field development is continuous thermal hydrate inhibition through MEG injection at the subsea wellheads.	**Continuous Methanol Injection – Rating: Less Acceptable** Methanol is a THI which is applied in the same way as MEG. For the Leviathan development it does not offer any benefit with regards to reduced subsea infrastructure or significantly reduced dosage rates. Methanol is less favored than MEG due to its increased volatility and potential challenges associated with carryover into the gas processing system.	Section 2.3.2.4
		Continuous LDHI Injection – Rating: Less Acceptable Use of LDHIs would offer decreased chemical injection rates during normal operation, thus potentially reducing power consumption on the LPP and the subsea distribution infrastructure. However, lack of analogues projects where LDHIs have been applied, increased purchase costs (as OPEX), and the potential for environmental harm as a result of an unintended release of these chemicals renders them less attractive than the commonly applied MEG solution.	
		Temperature Maintenance – Rating: Not Acceptable Use of a thermal solution for the prevention of hydrates in the Leviathan production system is not considered feasible due to the length of the tie-back and the depth at the infield location. An insulation only solution will not provide sufficient heat retention during normal operations, while electrical pipe heating technologies are not field proven at these depths or tie-back lengths.	

Subject	Proposed Action	Alternatives Evaluated and Ratings	Reference
Alternatives – Entry into Territorial Waters			
Future Entry in to Northern TAMA Block	The selected route for the transmission pipelines from the Infield Gathering Manifold to the LPP utilizes an entry point into the Northern TAMA zone that is approximately due west of the LPP location. This route enters territorial waters at a location that is west north west of the LPP location. An alternative pipeline route into the Northern TAMA zone has been identified based on work performed during previous phases of study on the Leviathan development. This route enters into the southern end of the northern TAMA block, having entered Israeli territorial waters approximately 5 km south of the selected entry point for the Leviathan development. From territorial waters this route runs a broadly north west direction for approximately 40 km where at it meets the selected pipeline route for the proposed Leviathan development.		Section 2.3.3

ES.3 Description of Actions Stemming from Performance of the Application

The Leviathan Field is located in the Levantine basin approximately 125 km off the coast of northern Israel in the I/15 Leviathan North and I/14 Leviathan South leases. Water depths at the field range from 1,540 and 1,800 meters. Development of the Leviathan Field is proposed by Noble Energy and its Co-Venturers to provide gas to:

A. The Israeli domestic gas market by tie-in to the Israeli Natural Gas Lines (INGL) infrastructure.

B. Regional gas users by (new) subsea pipelines to regional gas receivers.

Development of the Leviathan Field will result in a number of construction, installation and commissioning actions being performed in both Israeli territorial waters, and Israel's exclusive economic waters. Following installation and commissioning the field will be produced, as defined in the FDP, to supply natural gas to both the Israeli domestic market, and regional importers. The field is expected to operate for more than 30 years, and the ultimate lifetime will be subject to change based on reservoir performance and may be enhanced by future reserves discovered in the nearfield area. Following the cessation of operation the field and all its associated infrastructures will be decommissioned in line with industry best practices and license requirements.

Description of the Application and Facilities

The plan for development of the Leviathan Field is based on a tie-back concept which is broadly analogous to that applied to develop the Tamar Field which achieved first gas in 2013. The development will include subsea wells, flowlines and an Infield Gathering Manifold whereat the production from the wells will be comingled. From the Infield Gathering Manifold, production will be routed through three (3) 117.5 km production pipelines to the Leviathan Production Platform (LPP) located approximately 10 km off the coast of Dor. At the LPP gas will be processed to the relevant specification to allow either; domestic or regional export.

The scope of this assessment is all subsea facilities upstream of the LPP riser tie-in, but specifically excluding the subsea wellheads and wells. Actions associated with production drilling have previously been assessed by Noble Energy in the Leviathan Drilling EIA (Noble Energy Mediterranean Ltd., 2016a).

The project is targeting first gas for domestic supply in 2019 with regional export to follow soon after. The location of the transmission and infield infrastructures are shown in Figure ES-1 and Figure ES-2 respectively while an overall subsea production system isometric is provided in Figure ES-3.

Figure ES-1: Leviathan Production Infrastructure Map

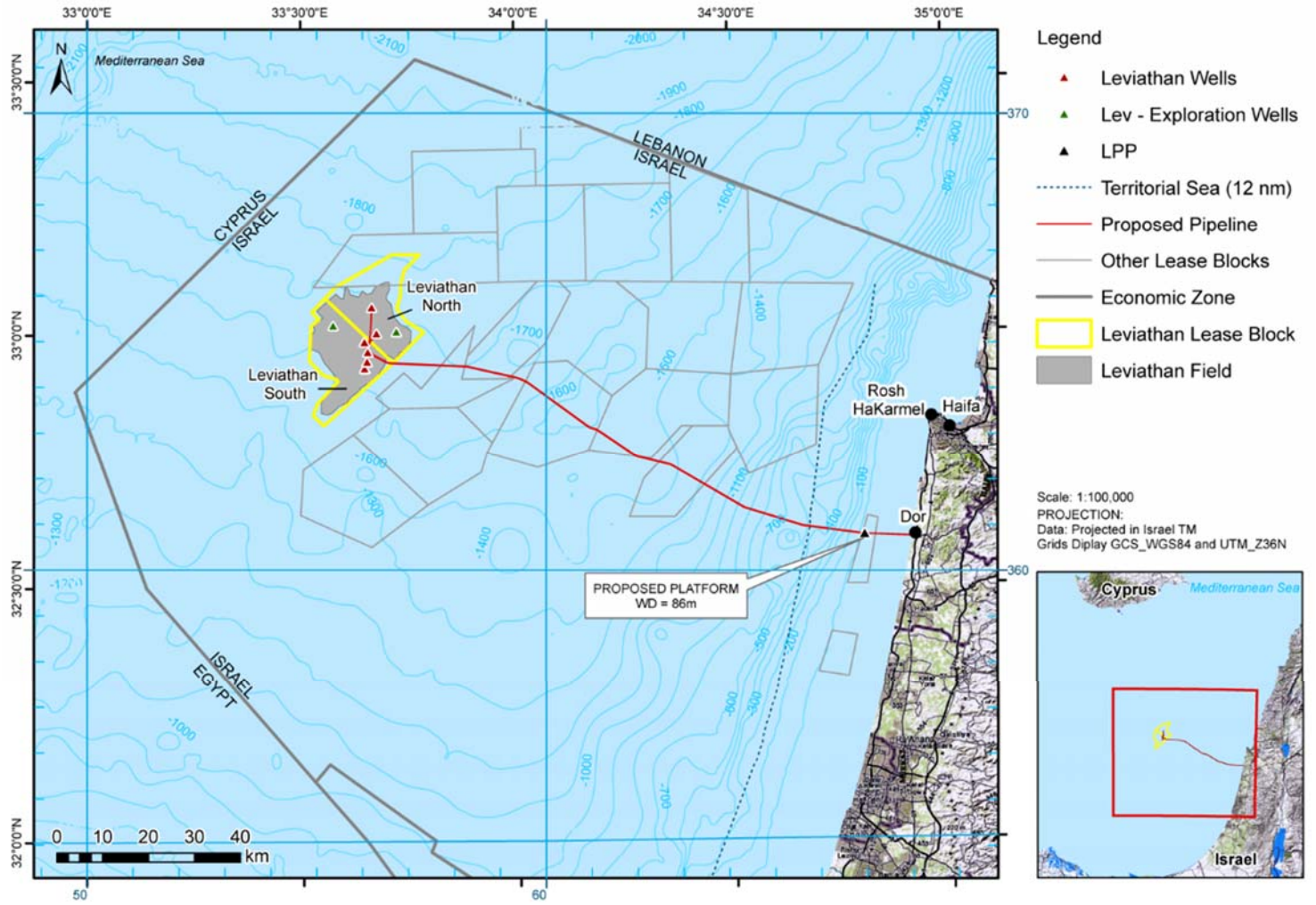


Figure ES-2: Leviathan Infield Infrastructure Map

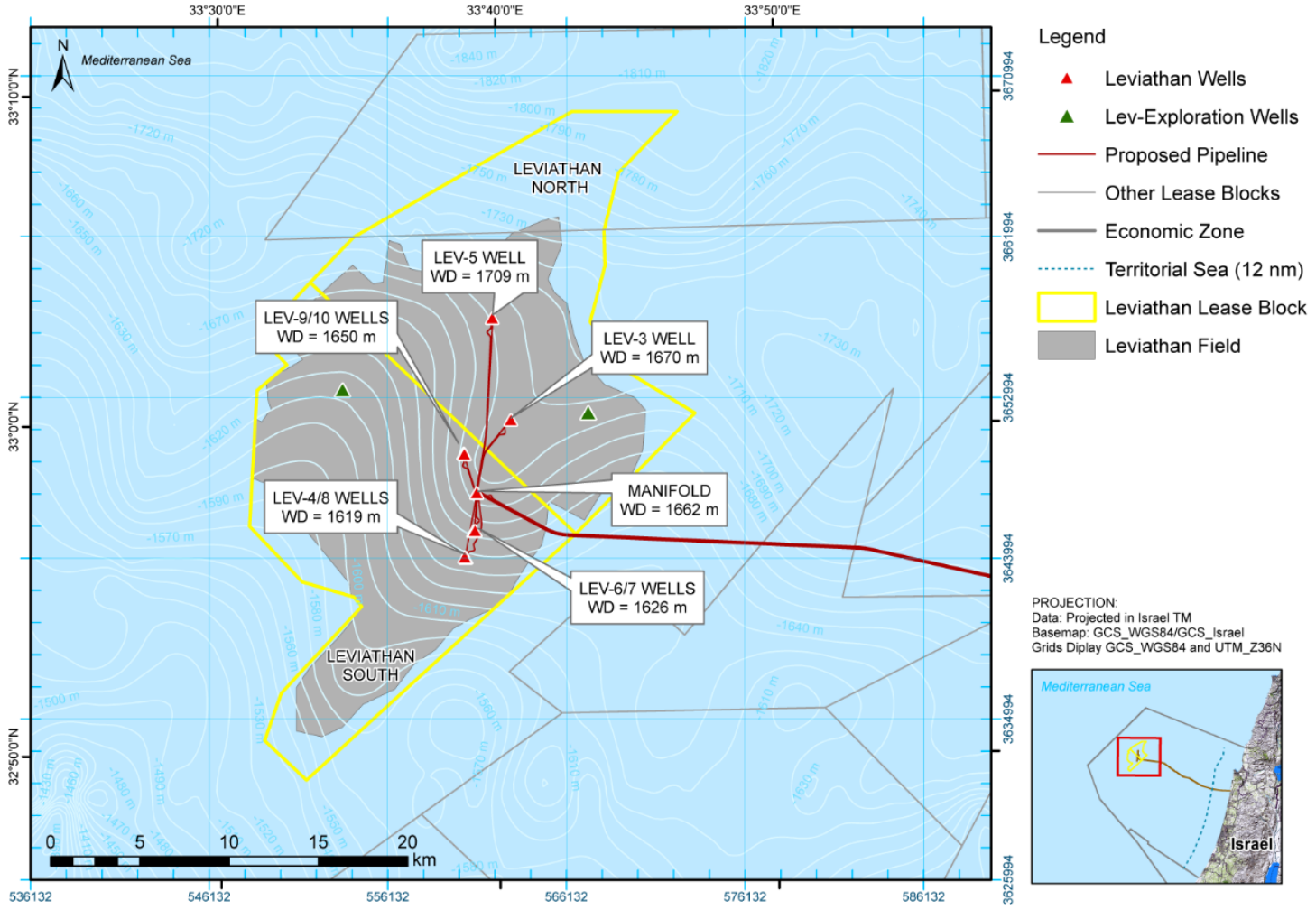
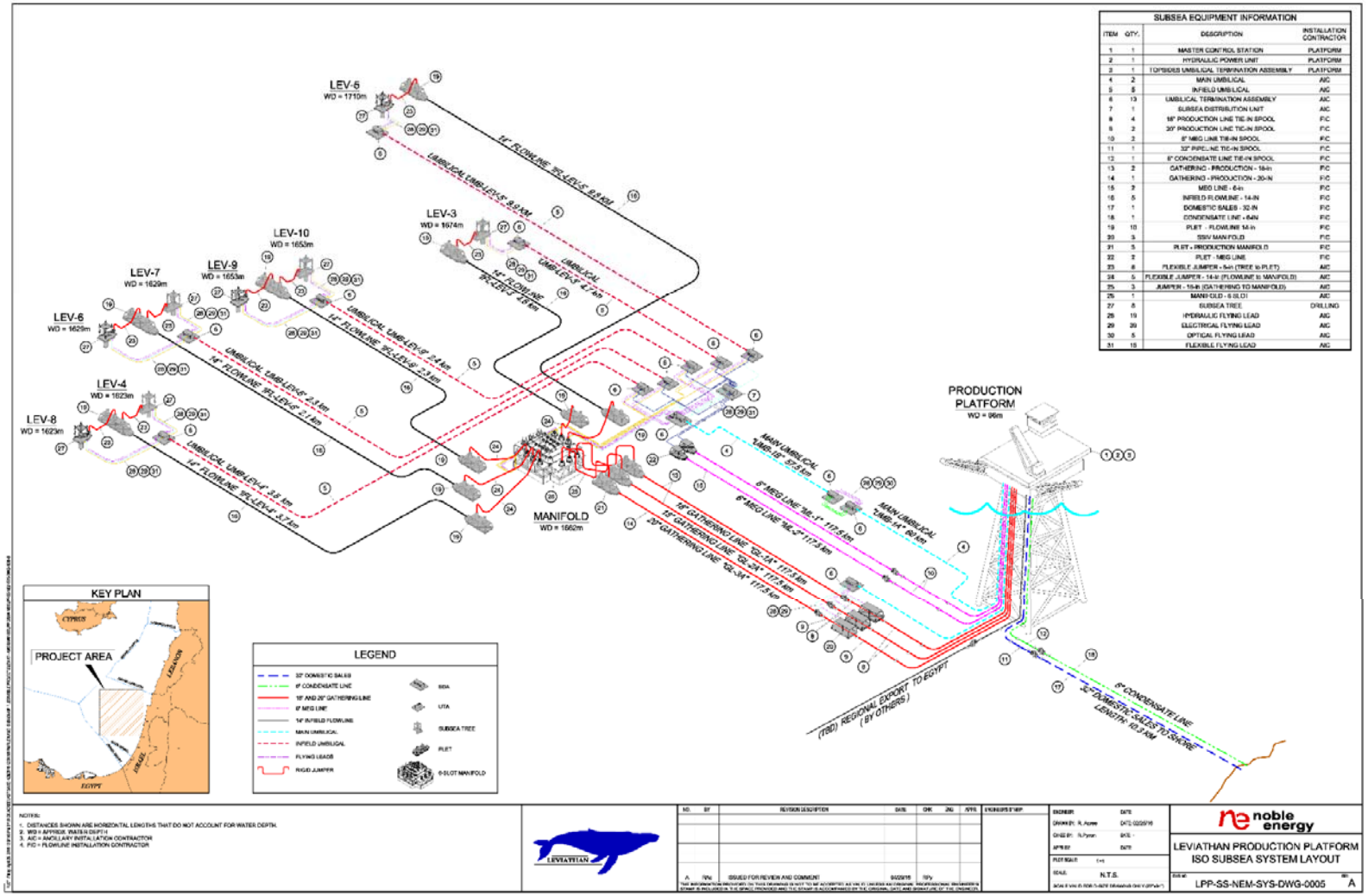


Figure ES-3 Leviathan Development Overview



Development of the Field

The Leviathan development schedule is targeting first gas by Q1 2019, in order to achieve this target it is expected that the subsea production system will be installed and commissioned between Q1 and Q4 2019. The activities associated with installation of the subsea production system, and the associated controls and chemical injection systems are summarized in the following sections.

Installation of Infield Production Infrastructure

The infield production infrastructure planned for the Leviathan development includes the following:

- One (1) six (6) slot Infield Gathering Manifold with three (3) production headers;
- 22.5 km of 14" rigid steel infield flowlines connecting subsea wellheads to the Infield Gathering Manifold;
- 10 infield Pipeline End Terminals (PLETs) to facilitate flowline tie-ins;
- Thirteen rigid carbon steel jumpers connecting the infield PLETs to the infield infrastructures (wellheads and Infield Gathering Manifold);
- 22.8 km of infield umbilicals and 10 Umbilical Termination Assemblies (UTAs) to facilitate controls tie-in;
- Electric and hydraulic flying leads to facilitate electric, controls and chemical tie-ins between infrastructure and infield umbilicals; and,
- One (1) infield MonoEthylene Glycol (MEG) Subsea Distribution Unit (SDU).

The Infield Gathering Manifold and MEG SDU will be installed in their infield location by an Offshore Construction Vessel (OCV) utilizing its main crane. All infield structures, aside from the Infield Gathering Manifold, will be installed on mudmat foundations which negates the requirement for subsea piling activities. Due to its size, weight and complexity, the Infield Gathering Manifold will be installed onto a single six (6) m diameter suction pile, like the manifold this will be installed from the OCV.

The 14" rigid flowlines will be constructed in sections (typically 12 m) at an out of country fabrication yard and then transferred to the infield location ready for installation where it will be installed by a Dynamically Positioned (DP) Pipelay Vessel. Installation operations will involve welding the sections of pipe together on-board the vessel, performing non-destructive weld testing, and lowering of the pipe to seabed in its pre-determined location. Due to the water depth and benign hydrodynamic conditions no trenching, burial or anchoring of the infield flowlines will be required. The flowlines may be laid by either the J-lay or S-lay method (referring to how the flowline is allowed to flex as it is lowered to the seabed) subject to installation contractor selection. This assessment considers S-lay to be the preferred method, however use of J-lay instead is not expected to significantly alter the environmental impact of flowline installation. Each flowline will be installed with a PLET welded onto each end to ultimately allow infrastructure tie-in.

The 22.8 km of infield umbilicals will be installed by reel lay from an OCV equipped for flexible lay operations. Each infield umbilical (five (5) of) will be installed as a single length of umbilical,

with longest single length of umbilical being 9.8 km. The infield umbilicals will be installed with a UTA at each end to enable tie-in to the relevant infrastructure by way of electric and hydraulic flying leads.

Connections between the infield infrastructure and the infield flowlines will be made by installation of rigid steel jumpers while controls and chemical tie-ins will be made with electric / hydraulic flying leads. All of these items will be installed from the OCV, with diverless connections to allow the installation to be completed with ROV assistance.

Within the scope of this assessment (drilling activities are excluded) no pile driving, trenching or burial activities are planned to occur in the infield area.

Following installation the infield infrastructure will require pre-commissioning and commissioning through a range of activities. This typically includes cleaning and gauging of flowlines, hydrotesting (to ensure pressure containment) of flowlines and umbilicals, dewatering and drying of flowlines and function testing of the controls system. A number of these activities will be completed in conjunction with the pre-commissioning and commissioning of the transmission infrastructure. During these operations environmental discharges of MEG, corrosion inhibitor, dye, umbilical storage fluid and water based hydraulic fluid will occur. All discharges will be minimized as far as practicable, and where possible the environmental impact will be minimized by selecting low toxicity alternatives that are Gold rated under the Offshore Chemical Notification Scheme (OCNS).

The specific pre-commissioning and commissioning activities required for the Leviathan Field development will be determined during the future detailed design phase.

In total, installation, pre-commissioning and commissioning activities are predicted to last in the region of 84 days. During this time a range of marine vessels will be present in the infield area, these will include:

- A DP Pipelay Vessel and Pipe Supply Vessel for installation of flowlines
- An OCV for installation of structures, jumpers and umbilicals
- A Multipurpose Support Vessel (MSV) with ROV capability to provide ROV support to the aforementioned vessels.

In addition Standby and Supply vessels will be in operation to support and provide emergency response to the vessels undertaking installation operations. Further, weekly helicopter transfers are expected during flowline installation operations for the purpose of crew and staff transfers.

Installation of Transmission (Production, Supply and Controls) Infrastructure

In order to facilitate transmission of production fluids from the infield area to the LPP, and supply of chemicals and controls signals from the LPP to the infield area the following transmission infrastructure is planned for the Leviathan development:

- Two (2) by 18” 117.5 km rigid steel production pipelines for production to the Domestic Supply Module (DSM);

- Two (2) by 18” PLETs located at the infield end of the DSM production pipelines;
- Two (2) by 18” Sub-Sea Isolation Valves (SSIVs) and structures at the LPP end of the DSM production pipelines;
- One (1) by 20” 117.5 km rigid steel production pipeline for production to the Regional Export Module (REM);
- One (1) by 20” PLET located at the infield end of the REM production pipeline;
- One (1) by 20” SSIV and structure at the LPP end of the REM production pipeline.
- Two (2) by 6” 117.5 km rigid steel MEG supply lines;
- Two (2) by 6” PLETs at the infield end of the MEG supply lines;
- One (1) by 117.5 km primary umbilical of electrohydraulic design – Installed as two (2) lengths of umbilical (one (1) by 60 km and one (1) by 57.5 km) joined with UTAs and flying leads at the mid-point;
- One (1) by Controls SDU at the infield end of the primary umbilical;
- One (1) by independent umbilical to provide electrohydraulic connection between the LPP and the SSIVs;
- One (1) by UTA local to the SSIVs to facilitate controls tie-ins;
- Rigid steel tie-in jumpers / spools for production tie-in;
- Flexible tie-in jumpers / rigid spools for MEG supply tie-in; and
- Electric and hydraulic flying leads to facilitate electric, controls and chemical tie-ins between infrastructures.

All pipelines and umbilicals running between the LPP and the infield area will be installed into a single transmission corridor that will be up to 600 m in width.

Like the infield flowlines the rigid steel production pipelines and MEG supply lines will be fabricated in sections (typically 12 m) at an out of country fabrication yard and then transferred to the installation vessel in preparation for welding and installation into the transmission corridor. This will be performed by a DP pipelay vessel capable of simultaneous welding, testing, installation and resupply operations, it is expected that the same vessel will be used for both the infield flowline installation and the transmission pipeline installation. Due to the water depth and benign hydrodynamic conditions generally present in the Levantine basin: trenching, burial and anchoring will not be required along the transmission route except for in specific locations where seabed features, or existing infrastructure must be crossed.

The transmission pipelines (production and MEG) may be installed by either the J-lay or the S-lay method, depending on installation contractor selection, however it is assumed in this assessment that the S-lay method will be utilized. Revision to J-lay is not expected to significantly impact the environmental impact of the project. At the deepwater end, each pipeline will be installed with a PLET to facilitate diverless tie-in to the relevant infield infrastructure. In the shallow waters around the LPP a valved, diver assisted tie-in point will be used to facilitate tie-in to either the production SSIVs (production lines) or the LPP risers (MEG supply lines).

The MEG supply lines may either be installed directly onto the seabed, or alternatively they may be installed in a piggyback configuration onto the 18" DSM production pipelines. This decision will be made during installation contractor selection depending on contractor capabilities.

Production SSIVs will be installed local to the LPP (within the 500 m exclusion zone) and will form part of the tie-in between the production pipelines and the LPP risers. SSIVs are high dependability isolation valves which will allow the LPP to be isolated from the production pipelines in the event of an emergency situation on or around the LPP. SSIVs will be housed within dedicated structures and installed on mudmat foundations and will thus not require any piling operations to be performed to facilitate their installation. Each SSIV structure will be installed on the seabed from an OCV utilizing its main crane facilities.

The primary umbilical will be installed by the reel lay method from an OCV capable of flexible lay operations. Due to the distance between the LPP and the field location the umbilical will be installed as two (2) lengths which will be joined through the provision of UTAs and flying leads at the approximate mid-point. The dedicated SSIV umbilical will be installed by the same method and as a single length. All UTAs will be installed on mudmat foundations only, with no piling required.

To facilitate controls and chemical distribution to the infield infrastructure a controls SDU will be installed local to the Infield Gathering Manifold. This will be installed from an OCV using its main crane facilities.

All tie-in jumpers and electric / hydraulic flying leads will be installed from the OCV using diverless connections. Tie-in spools in the shallow waters around the LPP will also be installed from the OCV, but will utilize diver assisted connections. All jumper / spool installation operations will require operational support from an MSV to facilitate either ROV or diver assistance.

Following installation the transmission infrastructure will require pre-commissioning and commissioning through a range of activities. Typically this includes cleaning and gauging of pipelines, hydrotesting (to ensure pressure containment) of pipelines and umbilicals, dewatering of all pipelines and drying of the production pipelines, and function testing of the controls system. Pre-commissioning and commissioning of the controls system will be performed in conjunction with the equivalent activities associated with the infield infrastructure.

During pre-commissioning and commissioning environmental discharges of MEG, corrosion inhibitor, dye, umbilical storage fluid and water based hydraulic fluid will occur. All discharges will be minimized as far as practicable, and where possible the environmental impact will be minimized by selecting low toxicity alternatives that are Gold rated under the Offshore Chemical Notification Scheme (OCNS). The majority of discharges associated with the aforementioned activities will occur in the deepwater environment where the risk of significant environmental impact is considered to be decreased. All discharges will be subject to gaining prior approval from the appropriate authority.

The specific pre-commissioning and commissioning activities required for the Leviathan Field development will be determined during the future detailed design phase.

In total, installation, pre-commissioning and commissioning activities associated with the transmission infrastructure are predicted to last between 242 and 324 days depending on the selected installation method for the MEG supply lines. During this time a range of marine vessels will be present at various locations along the transmission corridor, these will include:

- A DP Pipelay Vessel and Pipe Supply Vessel for installation of flowlines
- An OCV for installation of structures, jumpers and umbilicals
- A Multipurpose Support Vessel (MSV) with ROV capability to provide ROV support to the aforementioned vessels.

In addition Standby and Supply vessels will be in operations to support and provide emergency response to the vessels undertaking installation operations. Further, weekly helicopter transfers are expected during pipeline installation operations for the purpose of crew and staff transfers.

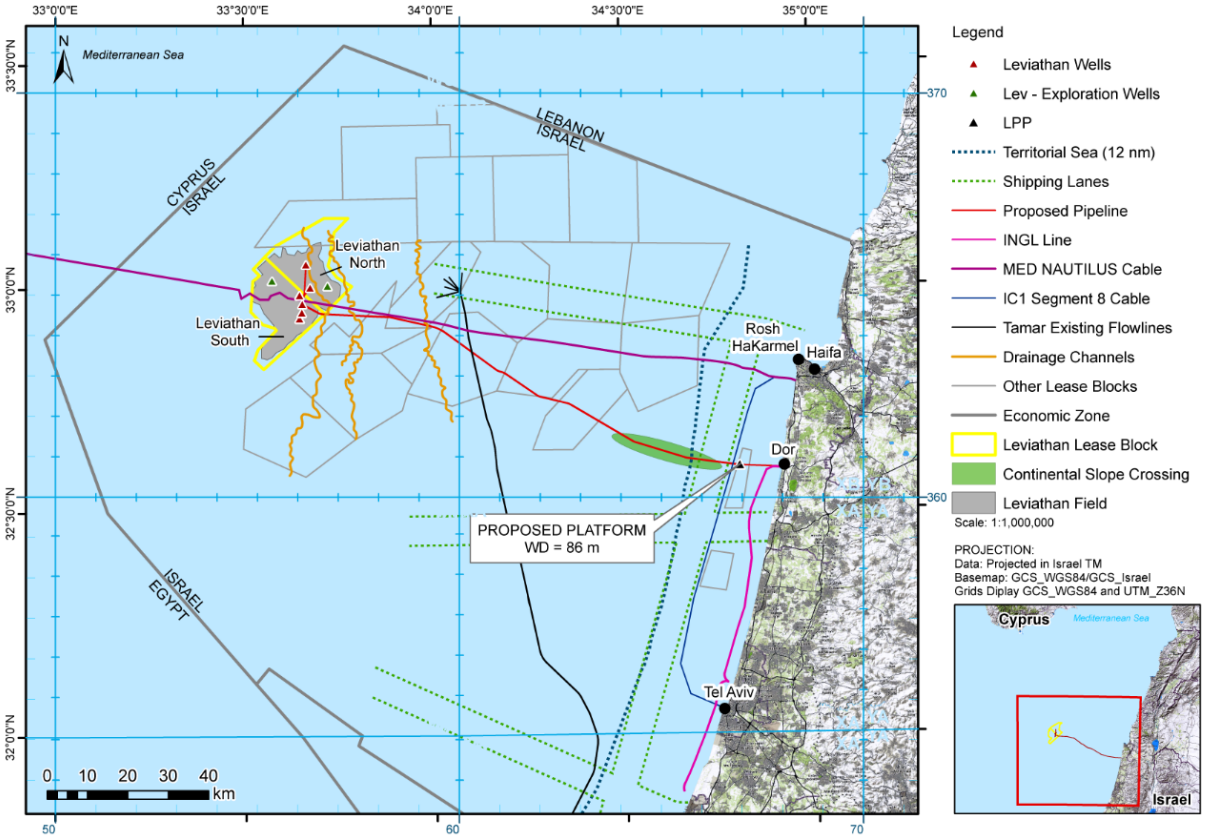
Construction and Installation of Other Planned Infrastructure

In addition to the infrastructure detailed above the following will be developed to enable the transmission infrastructure to cross prominent seabed features:

- Three (3) sets of channel crossings to cross each of:
    - Seabed channel D;
    - Seabed channel E; and,
    - The Tamar seabed channel.
- Two (2) sets of pipeline/cable crossings to cross each of:
    - The Tamar production infrastructure
    - The IC1 Segment 8 cable system in Israeli territorial waters.

The locations of these crossings can be seen in Figure ES-4, all seabed channels and the Tamar production system are located in water depths in excess of 1,500 m. The IC1 Segment 8 cable system is located in the shallower waters of the continental shelf.

Figure ES-4: Additional Infrastructure Locations – Channel / Cable Crossings



A number of options are currently being considered for enabling the transmission infrastructure to cross the identified seabed channels. The suitability of these options remains under evaluation and is dependent on the local hydrodynamic conditions, bathymetry around the channels, and the gradients experienced at the channel entrances. The options being considered are:

- Increased pipeline wall thickness to increase maximum allowable stress: Potentially limited to short free-spans where environmental loads are low;
- Increased pipelay tension to reduce pipeline deformation over seabed features;
- Implementation of pipeline buoyancy and strakes at channel crossings to reduce both static and dynamic loads at freespans;
- Seabed dredging to excavate an installation corridor into, and out of the seabed channels, thus reducing length and number of freespans around channels.

Engineering work is ongoing to determine the technical feasibility of each of the options outlined above however none are expected to have significant regional impact on the marine environment.

Pipeline and cable crossings will be facilitated through engineered crossings consisting of support structures located either side of the infrastructure to be crossed. The Leviathan infrastructure will subsequently be laid over these support structures which will ensure that suitable separation is maintained between the Leviathan pipelines/umbilicals and the infrastructure being crossed. Following installation the Leviathan infrastructure will be secured

to the support structures to ensure it remains in place throughout the Leviathan operations phase.

The support structures will be installed from an OCV and will utilize a mudmat foundation. As such there will be no piling activities associated with these crossings. The overall environmental impact of the engineered pipeline/cable crossings is expected to be negligible.

Leak Detection

The production system for the development of the Leviathan Field will feature in excess of: 352.5 km of subsea production pipelines; 235 km of MEG supply lines; and 117.5 km of electrohydraulic umbilicals. Maintaining system integrity of infrastructure throughout the operations phase is critical to managing the environmental impact of the project. As such a series of systems will be implemented to monitor the system integrity, and alert the operations team to any potential loss of containment. These systems will include:

- Continuous monitoring of arrival pressure and flowrate of production fluids at the LPP to aid in rapid detection of a substantial loss of containment in the subsea production system. A series of automatic trips will be implemented within the controls system which will initiate a controlled shutdown of the production system in the event of a significant loss of containment event;
- A Production Management System (PMS) will be implemented which will receive and process subsea sensor readings from the infield infrastructure. This will be capable of performing a continuous mass balance on the production system and will thus detect potential leaks;
- Continuous monitoring of MEG pumping rates and inventory levels on the LPP to aid in rapid detection of a substantial loss of containment in the subsea MEG system;
- Continuous monitoring of production chemical consumption rates to aid in detection of loss of containment from umbilical cores;
- Continuous monitoring of hydraulic fluid consumption, with any continuous use indicating a loss of containment from the hydraulic cores within the umbilical;
- Annual visual surveys, using ROVs, of the production system to identify signs of infrastructure damage or leaks; and,
- A pipeline integrity assurance program will be implemented in accordance to Noble Energy's Global Integrity Management Program. This is based on a risk based approach and will consider operational data from other systems operating under analogous conditions.

ES.4 Evaluation of Environmental Impacts Expected to Develop Due to Performance of the Application and Measures to be taken to Prevent / Minimize Such

The evaluation of Environmental Impacts arising from the installation and operation of the deepwater subsea production system proposed for the Leviathan development considered the following aspects (activities) and environmental resources:

Aspects (Activities)	*Resources*
Construction and Installation	Seabed sediment;
Pre-Commissioning and Commissioning	Benthic Environment (animals living on or in the seabed);
Normal Operations	Plankton (plant or animals which live in the water column and drift with the ocean currents);
Non-Routine or Accidental Events	Fish;
Abandonment and Dismantling.	Seabirds;
	Marine mammals;
	Sea turtles
	Cumulative impacts, including air quality;
	Culture and heritage;
	Waste including hazardous;
	Geological risks;
	Fishing and marine farming;
	Infrastructure safety; and
	Resource monitoring.
	.

For each Aspect, the resources potentially affected have been identified and the resultant impact detailed. Subsequently, each Aspect/Resource combination has been assessed by applying Noble Energy's risk assessment matrix which combines likelihood and perceived severity to produce a residual risk ranking. The Noble Energy Risk Assessment Matrix is provided in 0. A total of 35 Aspect/Resource combinations have been identified as potentially impacted by the project.

Figure ES-1: Leviathan Production Infrastructure Map

noble energy

Description: Noble Energy, Inc. Global Risk Matrix
Doucment Date: July 1st 2012
Doucment Number:

								INCREASING LIKELIHOOD				
								1	2	3	4	5
							Historical Occurrence	Never occurred or prevented with standard practices, procedures and safeguards.	Possible to occur but unlikely if standard practices, procedures and safeguards are used.	Likely to occur even if standard practices, procedures and safeguards are used. Additional safeguards are required.	Has occurred in the industry. Additional safeguards are required.	Has occurred in Noble. Additional safeguards are required.
CONSEQUENCES												
Severity		Health Safety	Environment	Reputation	Financial	Legal	After Controls/Mitigation (Residual)	Controls have historically been highly effective.	Controls have generally been effective previously.	Controls are unproven but are expected to be effective.	Controls have been ineffective previously.	Controls are likely to fail or be ineffective.
5	Very High	One or more fatalities on workforce or fatalities to public. Serious illness or chronic exposure resulting in significant life shortening effects/death to public.	Adverse permanent impacts on key ecosystem functions and services in larger natural habitats (e.g. restitution time > 5 years).	Extensive negative national and some international news coverage. Extensive negative exposure from elected officials, regulators and NGOs.	> $1 Billion US (Example: Substantial damage to facility or major asset resulting in expenses or loss of production)	Criminal prosecution with potential material sanctions against employees/company. Major/multiple civil litigation (e.g. shareholder or class action) with potential material adverse judgment(s) against company.	HEAT MAP	5	10	15	20	25
4	High	Serious illness or chronic exposure resulting in significant life shortening effects to workforce.	Adverse impact on ecologically valuable natural habitats (e.g. restitution time 2-5 years).	Negative national news coverage. Negative exposure from elected officials, regulators, NGOs.	$100 Million - $1 Billion US (Example: Significant damage to facility or major asset resulting in expenses or loss of production)	Criminal prosecution with potential sanctions against company. Civil litigation with potential material adverse judgment(s) against company.		4	8	12	16	20
3	Medium	Serious injury or illness with possible permanent effects.	Adverse impacts on a significant part of habitats (e.g. restitution time 1-2 years).	Short-lived national negative exposure. Limited negative exposure from national authorities/regulators.	$10 Million - $100 Million US (Example: Major damage to facility or major asset resulting in expenses or loss of production)	Civil enforcement proceeding with potential material administrative penalty. Civil litigation with potential adverse judgment against company.		3	6	9	12	15
2	Low	Medical treatment injury or occupational illness.	Adverse short term impact on natural habitats.	Local/regional negative exposure in media and/ or from local authorities and customers.	$1 Million - $10 Million US (Example: Minor damage to facility or major asset resulting in expenses or loss of production)	Civil enforcement proceeding with potential non-material administrative penalty. Civil litigation with potential non-material adverse judgment against company.		2	4	6	8	10
1	Insignificant	First aid injury or occupational illness/effect with minor impact on health and ability to function.	No or very limited impact on natural habitats. No impact on population level, only on individual organism level.	Short-lived negative exposure with limited importance.	$0 - $1 Million US (Example: Slight damage to facility or major asset resulting in expenses or loss of production)	Non-material issue requiring legal analysis and appropriate action.		1	2	3	4	5
							ERM 24-Month Outlook	< = 10%	10 - 35%	35 - 65%	65 - 90%	> = 90%

Summary of Impacts, Mitigation and Residual Risk

Identified Impacts, Mitigations and Residual Risk are summarized below in Table ES 2.

Table ES 2: Impacts, Mitigations and Residual Risk Ranking Summary

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
Submarine Production Infrastructure and Transmission/ Supply Pipeline						
Installation of flowlines, transmission pipelines and associated subsea infrastructure	Temporary water quality impact & direct losses to benthic infaunal community	Losses or changes to benthic habitats	Optimization of the size of foundations and removal of any non-permanent construction aids. Minimize trenching and backfilling. Use of DP vessels precludes anchor damage	2	2	4
Preparation for installation of Transmission Pipelines	Engineer seabed drainage channels by dredging seabed sediments	Seabed disturbance and changes to benthic community Impact to filter feeding organisms due to temporary suspension of sediments in the water column	Localized impact at limited locations along the 117 km route. No sensitive protected habitat recorded in Application Area or near pipeline route corridor.	3	1	3
Presence of subsea production systems and pipelines	Physical presence & sediment deposition	Reduction of available benthic habitats and changes to benthic community	Seabed survey Minimal footprint associated transmission pipelines. Seafloor currents are very low - not expected to be an environmental issue.	2	1	2
Pre-commissioning and commissioning (cleaning, gauging, hydrotesting, dewatering and drying) infield flowlines and transmission pipelines	Discharge of inhibited hydrotest water and particulate residues such as ferrous oxides within hydrotest water	Impacts to benthic marine fauna and flora and sediment quality	Usage of Inhibitors will be minimized as practicable Selection of chemicals which are classified as 'PLONOR' – Pose Little Or No Risk where practicable Proposed chemicals are 'Gold' rated under the OCNS and thus present a low environmental hazard Permits to be obtained for discharge of hydrotest water	2	2	4

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
Subsea control valve operation	Hydraulic fluid discharges when valves are activated	Impacts to benthic marine fauna and flora and sediment quality	Water based hydraulic fluid. Discharge volumes estimated to be low. Approved low toxicity fluids preferred DREAM modeling conducted	2	2	4
Subsea pipeline design	Pipeline Stability	Impacts to benthic marine fauna and flora and sediment quality	Control in design through application of industry standard procedures Areas of instability will be engineered and designed to withstand spanning strain on pipeline Areas of instability will be monitored post installation	2	2	4
Sea Pollution Event by Oil Based on Extreme Scenarios						
Pipeline gas and hydrocarbon inventory	Loss of containment	Impacts to sediment and water quality and marine flora and fauna	OSRP Pipeline designed to industry standards PMS and controls system programmed to minimize potential release inventory Marine exclusion zone around the LPP	2	2	4
Pipeline gas and hydrocarbon inventory	Loss of containment	Interference with fishing and shipping industry	OSRP Pipeline designed to industry standards PMS and controls system programmed to minimize potential release inventory Marine exclusion zone around the LPP Notification to marine users in the instance of a spill	1	1	2
Pipeline gas and hydrocarbon inventory	Loss of containment	Beach landing (rocky beaches and/or sandy beaches that are rich in biota)	OSRP. Pipeline designed to industry standards. PMS and controls system programmed to minimize potential release inventory. Marine exclusion zone around the LPP. Notification to marine users in the instance of a spill.	1	1	1

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
Pipeline gas and hydrocarbon inventory	Loss of containment	Impacts to leisure and tourism, marinas etc.	OSRP Pipeline designed to industry standards. PMS and controls system programmed to minimize potential release inventory. Marine exclusion zone around the LPP. Notification to marine users in the instance of a spill.	1	1	1
Pipeline gas and hydrocarbon inventory	Loss of containment	Industrial Secondary Users	OSRP Pipeline designed to industry standards. PMS and controls system programmed to minimize potential release inventory Marine exclusion zone around the LPP. Notification to marine users in the instance of a spill.	1	1	1
Noise						
Infield Gathering Manifold	Piling to secure to seafloor	Noise and vibration disturbance to marine fauna	Suction piling	2	1	2
Construction/ Installation and support vessels	Use of DP thrusters for positioning	Noise disturbance to marine fauna	None specific Pipelay vessel utilizing DP will be travelling at a slow speed Reduce vessel speeds upon coastal approach, particularly if activities are conducted during sea turtle nesting seasons	2	2	4
Installation logistical support: Helicopters	Noise & vibration from 'blade slap'	Noise and vibration disturbance to marine fauna	Standard aviation procedures and regulations	2	1	2
Nature and Ecology: Pre- Commissioning and Commissioning Activities						
Pre-commissioning and commissioning (cleaning, gauging and hydrotesting)	Discharge of construction debris and loose mill scale to the marine environment	Sea water quality and marine organism impacts	This material will be returned to the surface within pig receivers and disposed of appropriately onshore	1	1	1

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
infield flowlines and transmission pipelines	Discharge of inhibited hydrotest water	Sea water quality and marine organism impacts	Usage of Inhibitors will be minimized as practicable. Selection of chemicals which are PLONOR where practicable. Proposed chemicals are 'Gold' rated under the OCNS, and thus present a low environmental hazard	2	2	4
	Discharge of particulate residues such as ferrous oxides within hydrotest water	Temporary water quality impact caused by increased turbidity	Permits for discharge of hydrotest water. Pre-cleaning of pipe prior to discharge.	2	1	2
Nature and Ecology: Construction, Installation and Support Vessel/ Helicopter Presence						
Vessel presence	Artificial light employed on vessels	Disturbance to fish and fishery resources	Minimize excess lighting and orient downward SOLAS	1	1	1
Construction/ installation, commissioning and support vessels and helicopters	Movement of vessels during transit and whilst working and helicopter flights	Disturbance/ vessel strike to marine mammals and sea turtles	Installation vessels will generally operate at very slow speeds Communication between vessel masters upon sighting of a marine mammal Vessel speed and distance restrictions upon sightings	2	1	2
Vessel presence	Artificial light employed on vessels	Disturbance to marine mammals and sea turtles	Minimise lighting requirements as far as practicable. All lighting to be SOLAS compliant	2	1	2
Construction/ installation, commissioning and support vessels and helicopters	Movement of vessels during transit and whilst working and helicopter flights	Disturbance to seabirds	Helicopter altitude requirements Installation vessels will typically be operating at very slow speeds Communication between vessel masters upon sighting of a marine and coastal birds Vessel speed restrictions	3	1	3
Vessel presence	Artificial light employed on vessels	Disturbance to seabirds	Minimize lighting requirements as far as practicable. All lighting to be SOLAS compliant	3	1	3
Nature and Ecology: Construction, Installation and Support Vessel Discharges						

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
Construction/ installation and support vessel discharges	Discharge of vessel sewage, drains and food waste	Impacts to water quality and marine fauna and flora	MARPOL 73/78	3	1	3
Nature and Ecology: Ballast Water Discharge						
Presence of construction/ installation and support vessels	De-ballasting of vessels (potentially international)	Introduction of non-native invasive species	Controlled discharge under permit Maintenance and classification of vessels Adherence to IMO and MARPOL 73/78 standards	5	1	5
Nature and Ecology: Subsea Control Valve Operations						
Subsea control valve operation	Hydraulic fluid discharges when valves are activated	Impacts to water quality and marine fauna and flora	Water based hydraulic fluid. Discharge volumes estimated to be low. Approved low toxicity fluids preferred.	2	1	2
Nature and Ecology: Bio-fouling						
Pipeline infrastructure	Biofouling of pipeline	Changes ecosystem	None required	2	2	4
Nature and Ecology: Cumulative Impacts						
Presence of construction/ installation and support vessels	Emissions production	Reduced air quality and contribution to climate change	MARPOL 73 / 78	2	2	4
Presence of construction/ installation and support vessels	De-ballasting of vessels (potentially international)	Introduction of non-native invasive species	Controlled discharge under permit. Maintenance and classification of vessels. Adherence to IMO and MARPOL 73 / 78 standards.	5	1	5
Cultural and Heritage Sites						
Subsea installation	Disturbance to seafloor during pipelay	Damage/ destruction to important archaeological sites	305 m avoidance zone for potential wreck sites and 31 m avoidance zone for other sonar contacts.	2	2	4
Hazardous Materials						
Waste Management	Generation of domestic waste and general non-hazardous waste including scrap metal etc.	Waste transfer to shore	Waste handling, treatment and disposal will be in accordance with the WMP	2	2	4

Activity	Aspect	Potential Impact	Mitigation & Control	Likelihood	Severity	Residual Risk
	Hazardous waste generation including solid spent chemicals, filter elements and waste MEG etc.	Waste transfer to shore	Waste handling, treatment and disposal will be in accordance with the WMP	2	2	4
	Hydrotest water discharge at LPP	Water quality Impact on marine biota	Gold chemicals under the OCNS Optimize and manage discharge rate at LPP to mitigate adverse impact on marine environment. Optimal rate can be determined through modelling	2	2	4
Fisheries						
Construction, installation and support vessels	Vessel presence	Impact to fisheries	500 m exclusion zone Communication with Port Authorities	2	2	4
Overfishing						
Subsea infrastructure	Subsea infrastructure presence	Impact to fish populations due to overfishing	None required	1	1	1
Safety and Protection						
Construction, installation and support vessels	Vessel presence	Impact to other marine users	Communication with Port Authorities Notification to authorities and public of a 500-m radius safety exclusion zone around the pipelay vessel and the OCV while it is operating	2	2	4

Assessment of Potential Impact on Marine Environment

Submarine production infrastructure and transmission / supply pipeline

In order to determine the sensitivity of the benthic environment, a Background Monitoring Survey was conducted along the proposed pipeline route and in the Leviathan Field.

The benthic environment in the vicinity of the Leviathan Field Development is considered to be homogenous consisting of very soft clays and silt (GEMS, 2014) and does not alter significantly along the pipeline route to the Leviathan Field Subsea facilities (refer to CSA Ocean Sciences Inc. 2016a&b). The general taxonomic assemblage found consistently, across all survey locations in the Leviathan Field during the site specific environmental baseline survey, found that the dominant phyla were Annelida and Arthropoda, which composed 73.78% and 17.63% of the total infauna, respectively. The phyla Mollusca, Sipuncula, and Platyhelminthes contributed 3.88%, 2.75%, and 1.28%, respectively. Similarly,

along pipeline sections one (1), two (2) and three (3), annelid polychaetes were the dominant phyla representing 71.1%, 61.5% and 61.2% respectively. Such species are low sensitivity, high fecundity species and therefore activities are likely to have no measurable effects on local benthic productivity.

Temporary disturbance will occur to benthic fauna during construction, installation and commissioning activities along the proposed pipeline route and in the vicinity of the Leviathan Field where the subsea facilities will be located. Sessile and sedentary fauna will be most susceptible due to their limited ability to move away from affected areas, particularly immotile species. Motile species such as crustacea will likely move away from the area of activity, however immotile species will be directly impacted due to placement of the infrastructure. The majority of the species inhabiting the benthic environment along the proposed pipeline route and in the Leviathan Field are mobile and are likely to demonstrate quick recovery as a result of disturbance. Temporary direct effects will be limited to the direct area of the footprint of the activity which is of a negligible spatial scale in comparison to the Levantine Basin and no sensitive or protected benthic species have been identified in the vicinity of the Leviathan Field Development Project.

It is possible, however, that dredging activities will be required in order to mitigate any adverse geo-hazard conditions at some locations prior to the installation of the flowlines on the seafloor. A permanent net reduction in the total area of original benthic habitat will occur as a result of the placement of subsea infrastructure on the seabed and the removal of sediment should dredging activities be conducted. Should dredging activities be required, the removed sediment will also be directly displaced to another area of the seabed.

The physical presence of the infrastructure will result in the reduction of seabed habitats and will be a long term impact, lasting for the duration of the development. However, as discussed, no sensitive species or habitats have been identified in the vicinity of the Leviathan Field Development activities and the area that will be directly impacted is small in comparison to the spatial scale of the Levantine Basin. Therefore the impact significance is considered to be low.

Pre-commissioning and commissioning activities will also involve the hydrotesting of the pipeline/ flowline systems in order to ensure integrity. This will involve the discharging of hydrotest fluid into the surrounding environment. DREAM modelling has indicated that due to the water depth at the infield location the seabed currents are low and as a result any discharge plumes will not traverse the seabed at a significant rate, thus giving mobile species significant time to relocate away from the advancing plume. Although, immotile species will not be able to move away from the plume, the discharge of hydrotest fluids will be temporary and only occur twice during the pre- commissioning and commissioning phase. Therefore effects will be short lived and limited to a local area.

Pipeline Stability

Analyses will be conducted to ensure that the Leviathan pipelines will not move from their as-installed position when subjected to extreme storm conditions. These analyses will consider detailed, site-specific geotechnical and metocean environmental data. The geotechnical data is based on the findings of multiple survey campaigns conducted from 2013 to 2016 which utilized a mix of cores, borings, cone penetration or cone penetrometer test (CPT) and sub-

bottom profiles along the pipeline routes. Both field and laboratory tests were used to characterize the soil properties. The metocean data is based on a combination of local historical data, operational hindcasts and field measurements. These sources will be used to determine design values for wind, wave and current characteristics.

Prevention of Damage

The majority of the pipeline and infield facilities associated with the Leviathan Development is located in deep water of greater than 250 m. By virtue of its deep water location the risk of damage resulting from anchor drop as the Leviathan pipelines cross shipping lanes is extremely low as most ship's anchors will not extend beyond 250 m. The LPP and associated facilities within Territorial Waters by virtue of the TAMA a 500 m exclusion zone around the LPP, substructures and pipelines is allowed which protect from trawler fishing in the shallow waters (less than 120 m water depth). Between the shipping lane and the LPP exclusion zone there is roughly 3.65 km of pipeline (from the edge of the shipping lane to the platform) that is potentially "trawlable" and outside the TAMA jurisdiction. This section of the 32" pipeline is currently unburied. Within the vicinity of the 32" line the gathering lines.

The risk of damage to the pipelines due to factors such as landslides, anchors in shipping lanes and trawler fishing will be assessed at all relevant locations along the route will also be considered in the safety risk assessment. Where significant risk is identified, preventative measures will be taken such as burying the pipeline or providing external shielding such as concrete coating, Uraduct® coating or concrete mattresses. The risk due to earthquakes will be assessed through seismic hazard assessment and seismic engineering.

Mitigation and Impact Significance

Proposed mitigation measures and impact significance for Submarine production infrastructure and transmission / supply pipelines are summarized in Table ES-5 above.

Environmental Impacts of a Sea Pollution Event by Oil Based on Extreme Scenarios

The environmental impact of an accidental pollution event arising from a pipeline rupture during operations has been included in this assessment based on the following "most credible" scenarios:

- Dropped object during LPP supply operations impacting on a single production pipeline and resulting in a large hole (defined as 100 mm) downstream of the production SSIV. Worst case of 20" REM pipeline rupture is considered;
- Continuous unabated release of 544 kg/s (1975 MMscfd) for two minutes until SSIV closure; and
- Further release of 10,200 kg (0.43 MMscf), associated with the inventory of the tie in spool and riser downstream of the SSIV (100 m of 20" piping) for a further one minute, thus concluding the discharge period.

The scenario above results in a total release duration of three minutes during which approximately 75,000 kg of gas will be released. The condensate release associated with this scenario is approximately 15.9 bbls.

Releases of hydrocarbons (oil or gas) into the marine environment have the potential to impact marine organisms through the following mechanisms:

- Dissolution of toxic components into the water column leading to poisoning or irritation of marine organisms;
- Indirect asphyxiation due to microbial consumption of released hydrocarbons, resulting in decreased dissolved oxygen in the affected area, potentially leading to a “marine dead zone”; and
- Direct asphyxiation of marine mammals and other marine dwelling air breathing species who rely on access to the sea surface to breath, formation of an oil slick can prevent these creatures from accessing the surface, or where they do, may result in irritation or poisoning as a result of contact with toxic components.

In addition to impacting marine life forms, a release of oil into the marine environment may impact birds (through coating of feathers), shore based terrestrial species, where oil grounding occurs and industries reliant on the marine environment (e.g. fishing and tourism).

The environmental impact of described scenario has been assessed through the application of Oil Spills Contingency And Response (OSCAR) modeling. Due to the nature of the release from the subsea production pipeline (i.e. mostly gas with a very small quantity of condensate) no significant beaching of hydrocarbons was seen in any of the modelling. In the majority of the models none of the released hydrocarbons reach the shoreline, while in the few instances where stranding on the shoreline is seen, the total amount is insignificant (i.e. < 0.1% of the total release) and a result of dispersed oil being washed onto the shore, as opposed to mass beaching of an oil slick. In all instances of beaching the geographic extent is minor. In instances where hydrocarbons reach the shoreline, this takes between two (2) and seven (7) days depending on the specific METOcean conditions.

A large proportion of the release evaporated quickly due to it being primarily gas with a small amount of condensate. This large proportion of gas also helped to increase mixing of the condensate, thus increasing dispersion and aiding in evaporation of the light ends of the condensate once the release reached the sea surface.

In all cases, within 18 hours of release, all visible evidence of an oil slick on the sea surface had disappeared. This means that the oil slick had thinned sufficiently to no longer be visible to the naked eye of an observer (i.e. there is no remaining visual impact).

Water Quality Impacts

The dissolved hydrocarbon components and small oil droplets released into the water column as a result of loss of containment from the pipeline can affect water quality by releasing hydrocarbon concentrations in the water column. The small amount of oil released into the water column, begins to weather and its physical and chemical characteristics change over time. As soon as the oil is released, due to its density, the majority will migrate upwards in the water column and spread over the sea surface. The speed at which it spreads is dependent to a great extent on the viscosity of the oil and the volume spilled. The more volatile components of oil will evaporate to the atmosphere. Warm temperatures and high wind speeds

also increase evaporation. Waves and turbulence at the sea surface can break-up a slick into oil droplets which become mixed in the upper layers of the water column. Smaller droplets remain in suspension while larger droplets rise and coalesce with other droplets at the surface. The dispersed oil mixes with ever greater volumes of sea water resulting in the rapid and very substantial reduction of the oil concentration that will likely disperse completely within a few days if the oil remains fluid and unhindered. Modelling determined that in the instances where a surface slick occurred, it disappeared within hours, primarily as a result of evaporation.

Sediment Quality and Benthic Organisms Impacts

A loss of inventory will increase hydrocarbon concentrations in the sediments and may impact benthic communities by smothering and or coating organisms. Shallow coastal areas are often laden with suspended solids that can bind with dispersed oil droplets. Oil can also be ingested by planktonic organisms and incorporated into faecal pellets which drop to the seabed. However, due to the size of the release expected, and the rapid dilution seen in the OSCAR modelling it is expected that if toxic hydrocarbons come into contact with sediment, they will likely be below thresholds that could create sediment toxicity.

Marine Mammals Impacts

A hydrocarbon spill could potentially affect marine mammals if they were to come into contact with a surface oil slick. Inhalation of volatile components, ingestion (directly or indirectly through the consumption of fouled prey species), skin irritation and inflammation are just some of the symptoms that have been recorded (Geraci and St. Aubin, 1990 and Marine Mammal Commission, 2012).

Following the Macondo spill in the Gulf of Mexico, physiological impacts on dolphins were detected in shallow, enclosed embayments with limited circulation where the animals were exposed to persistent contamination (Schwacke *et al.,* 2014). The impacts included adrenal toxicity and lung disease. Similar habitats do not exist along the Israeli shoreline and it is unlikely that dolphins would be exposed to persistent hydrocarbon contamination from the credible spill scenarios assessed within this Production Development EIA.

However, in scenarios where a slick is present, it is very rapidly evaporated and is not considered to result in a significant impact, particularly due to the low density of marine mammals in the Application Area (refer to CSA Ocean Sciences Inc. 2016a).

Sea Turtle Impacts

According to the Sensitivity Analysis of Israelis Coastlines to Oil Pollution (Pareto, 2006), marine pollution effects to sea turtles is considered to be irreversible. Sea turtles are afforded the highest level of priority in the event of a spill, in addition to official nature preserves (see below) according to ecological parameters. Sea turtles are also a protected species that is in danger of extinction and Israel has undertaken to protect them under the Barcelona Convention (refer to Section 4.2.6.3).

A hydrocarbon oil spill could potentially affect sea turtles if they were to come into contact with a surface oil slick. Several aspects of sea turtle biology and behavior place them at risk,

including lack of avoidance behavior and inhalation of large volumes of air before dives. Similarly to marine mammals, direct exposure may produce irritation and inflammation and hydrocarbons can adhere to turtle skin or shells. In the open ocean, a sea turtles could come into contact with a spill, but impacts to sea turtles population in the Application Area, is extremely unlikely due to their low density, the spill plume (production fluid release) being predominantly gas rises to the surface rapidly and there is a short duration of a potential spill event.

Sea turtle nesting sites have been identified all along the Israeli shoreline. Modelling shows that the earliest incident in which beaching would occur would be 50 hours (refer to Table 4-4) following the event of credible spill scenarios within the scope of this EIA as described in the section above. Upon realization of a spill event, Noble Energy will adopt a similar strategy to the Leviathan Development as they apply to their existing operations in Israel. This oil spill response strategy will able deployment of a response within a timeframe of four (4) to six (6) hours of identification of the spill. The tactic deployed will be based on the Leviathan-specific risk assessment that is currently underway.

Nesting starts at the end of May for loggerhead turtles and in mid-June for green turtles, continuing until about the end of July and mid-August, respectively. Specific locations for sea turtle nesting are noted in Israel Ministry of Environmental Protection, Marine and Coastal Division, Atlas of Israel coastal sensitivity to oil pollution in the Mediterranean. Jerusalem, 2006. As the spill modelling indicated beaching from an oil spill event would arrive to shore after a period of 50 hours and therefore in the unlikely event of hydrocarbons reached these sensitive sites, the hydrocarbon will be highly weathered (tar-balls) and hydrocarbon recovery and remediation response (currently under development for the Leviathan Development Project) would be actioned as a high priority given the likely impact on these sensitive receptors.

Seabirds and Migratory Bird Impacts

Direct exposure of marine birds to hydrocarbons may result in fouling and matting of plumage which can impact their ability to fly as well as their insulating and water repelling properties and buoyancy. Exposure may also produce irritation and inflammation of skin or sensitive tissues. If oil is ingested it can have serious effects, such as congested lungs, intestinal or lung issues and other internal damage. However, although individual marine birds may come into contact with a spill, population level impacts are unlikely due to the relatively small area that would be impacted, the brief duration of a spill event and the density of marine birds in the Application Area.

It is worth noting the presence of two (2) designated coastal International Bird Areas (IBAs) in Israel (refer to Section below entitled ‘Protected Habitats and Species’. Of the 15 IBAs designated in Israel, two include coastal habitats (Bird Life International, 2014c).

Fish

In the open ocean, individual fish species (as well as eggs and larvae) may come into contact with a spill, but population level impacts are extremely unlikely due to the brief duration of a spill event and the relatively small area that would be impacted. Despite the susceptibility of

juvenile stages of fish to relatively low concentrations of oil in the water column, adult fish are far more resilient and effects on wild stock levels have seldom been detected. Free swimming fish are thought to actively avoid oil (ITOPF, 2004).

Fishing

Aquaculture is usually undertaken onshore using traditional earthen ponds, such activities onshore will not be impacted by any spill incidents described above. Mariculture is generally focused in the nearshore environment therefore are unlikely to be affected in the event of a spill since there are only negligible instances of oil reaching the coastline the spill scenarios modelled. Further, the aerial extent of any slicks or areas of increased oil in water concentrations have shown to be minor when simulated in OSCAR, as such the overall fraction of Israeli fishing ground impacted by a spill would be minor.

Offshore marine fishing within the scope of this EIA is relatively sparse as a result of water depths and the oligotrophic nature of the environment (UNFAO, 2007).

Archaeological and Cultural Heritage

A hydrocarbon spill is not expected to impact archaeological sites on the sea floor due to the tendency of condensate to rapidly migrate to the sea surface and for dispersed oil to readily become diluted below observable levels.

Impacts on Marine Transport and Infrastructure

The release of gas inventory due to a pipeline loss of containment could potentially impact shipping activities. Shipping lanes are present, with the nearest approaching the port of Haifa and numerous others crossing Israel's territorial waters. However, the identified spill scenario is specific to within the 500m exclusion zone around the LPP where marine traffic will be controlled. Further, the nearest boundary of the north/south shipping lane is approximately 2-3km from the release site which allows for substantial dilution of any flammable gas cloud prior to it impacting on shipping activities within the shipping corridor.

Oil Spill Beaching Incidents

OSCAR modeling demonstrated that there would be five (5) locations where beaching could occur in the event of a spill. Details pertaining to the amount of time it would take for the spill to beach show that the most rapid beaching incident would occur within 50 hours. With the mitigation measures employed as listed in the Section above, a spill would be detected and reported very quickly and Noble Energy's spills response strategy implemented within a timeframe of four (4) to six (6) hours. Therefore, it is considered unlikely that the spill would make contact with the Israel coast.

In the unlikely instance that this would occur however, it is important that Noble tailors its response strategy according to the priority of the coastal stranding location.

Areas near Haifa and Dor

Beaching of the spill at this location would occur during WWS3 weather conditions and would take approximately 128 hours to make contact with this point of the coast.

According to Israel's Sensitivity Analysis, Haifa is afforded the highest level of priority for remediation and protection. This is primarily due to the fact that it gives rise to the following:

- Power Station – this receives the highest level of priority for response and remediation; and
- Nature Preserves and Sea Turtles – There are four (4) Nature Preserves within the vicinity of Haifa and sea turtle presence and/ or nesting is noted at two (2) locations. Nature Preserves and sea turtles are afforded the second highest level of protection.

Other features include 27 beaches, five (5) aquaculture sites, a harbor, six (6) marine centers, five (5) archaeological sites and four (4) stream mouths.

Therefore, a beaching incident at this location would be given highest priority for Nobles remediation response.

Israel – Lebanon Border and Haifa

Beaching of a spill at this location would occur during SS1 weather conditions and would take approximately 91 hours to make contact with this point of the coast.

For the reasons discussed above, with regards to the sensitivity of Haifa, this area would be given highest priority for Nobles remediation response.

Israel – Lebanon Border

Beaching of a spill at this location would occur during SS3 and SNEW1 weather conditions and would take approximately 107 and 174 hours respectively, to make contact with this point of the coast.

Modeling demonstrated that 100m patches would occur on the Lebanon side of the border. Since the beaching incident would be in Lebanon, the sensitivity of the location cannot be assessed according to the Israel Sensitivity Analysis however, there is the presence of Tyre Coast Nature Reserve approximately 20 km north of the coastal beaching location at Lebanon.

Noble would ensure that response was provided, as stated above within four (4) to Six (6) hours and that the appropriate authorities are immediately informed as part of the ERP.

It should be noted, that it is estimated to take approximately 107 or 174 hours for the spill to make contact with this location therefore, in the instance of a spill, Noble would respond and have implemented its remediation strategy prior to the occurrence of a beaching event.

Area around Haifa, near Israel Lebanon- Border

Beaching of a spill at this location would occur during SNEW2 weather conditions and would take approximately 50 hours to make contact with this point of the coast.

For the reasons discussed above, with regards to the sensitivity of Haifa, this area would be given highest priority for Nobles remediation response.

Mitigation and Impact Significance

Noble Energy employ an oil spill response strategy with allows deployment of necessary response within a timeframe of four (4) to six (6) hours upon becoming aware of a spill incident. Other mitigation measures to be employed and impact significance ranking is presented in Table ES-2.

Noise

Potential noise impacts from the Leviathan Field Development Project are principally associated with the construction, installation and commissioning of the infield flowlines, gathering lines and associated subsea infrastructure. Noise sources include pipelay and support vessel activities, helicopter activity and pile driving.

Marine fauna use sound for navigation, communication and prey detection (e.g. reviews in Southall *et al*., 2007; Richardson*, et al.,* 1995). Therefore, the introduction of any anthropogenic underwater noise has the potential to impact on marine animals if it interferes with the animal's ability to use and receive sound (e.g. OSPAR, 2009). The impact of sound on an animal depends on many factors including the level and characteristics of the sound, hearing sensitivity of the species and behavior of the species.

It is generally accepted that exposure to anthropogenic sound can induce a range of adverse effects on marine life (e.g. OSPAR, 2009). These can vary from insignificant impacts such as temporary avoidance or changes in diving behavior to significant behavioral changes and also include non-injurious effects such as masking of biologically relevant sound signals (Richardson *et al.,* 1995). Activities that generate very high sound levels can cause auditory and other physical injuries and, in some circumstances, lead to mortality (Southall *et al*. 2007; Richardson *et al.* 1995). Auditory effects include temporary or permanent reduction in hearing sensitivity. Non-auditory impacts may include damage to body tissues, especially air-filled cavities including swim bladder and muscle tissues (review by Richardson, *et al.* 1995).

To assess the impact of sound from the Leviathan Field Development Project on marine receptors, the propagation of sound into the surrounding environment was modeled. The sound sources have been modeled using representative spectra from published noise measurements. The propagation of this sound into the environment has been calculated using the Genesis noise model, which incorporates depth-dependent geometrical spreading and empirical functions for frequency attenuation (Jensen *et al.,* 2011; Richardson *et al.,* 1995; Marsh & Schulkin, 1962).

Modelling of the sound generated specifically during pipelay has been carried out using a measured source spectrum for a pipelay vessel (Hannay *et al.,* 2004) and a modelled spectrum for a vessel of a similar size to a guard boat (Breeding *et al*., 1996). As the pipelines are approximately 117.5 km in length and pass from a water depth of approximately 1,700 m to 86 m, two scenarios have been modelled:

1. A deep water scenario representing pipelay operations at the Leviathan Field; and,
2. A shallow water scenario representing pipelay operations in proximity to the LPP.

A comparative assessment was conducted using the information obtained for pipelay and vessel presence activities against the auditory sensitivities of sensitive receptors in the marine environment that could potentially be impacted as a result of these activities. Sensitive receptors identified included marine mammals, sea turtles and fish.

The range at which marine mammals may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound. For pipelay activities, the predicted sound level for both the deep and shallow water operations is 178 dB re one (1) µPa. This is below the Southall *et al*., (2007) thresholds for injury and disturbance to marine mammals.

The low frequency sound produced by vessels coincides with the most sensitive hearing range of baleen whales, of which minke whale, fin whale and sperm whale have the potential to be in the development area (refer to CSA Ocean Sciences Inc. 2016a). However, for these species the source level is predicted to drop below the 90 dBht (species) threshold for disturbance within the first few meters of the source. For all other species of marine mammal know to occur in Israeli waters, the sound levels are predicted to be below the Southall *et al*., (2007) dBht (species) threshold for disturbance. Sea turtles, however, near the vessels may be exposed to sound levels sufficient to elicit behavioral responses and potentially may create auditory interference by masking. The most likely impacts would be short-term behavioral changes for avoidance such as diving and evasive swimming.

There is limited data available in the public domain for the impact of DP thruster noise on sensitive receptors in the marine environment. One identified potential impact would be for the DP thruster noise to mask the hearing of baleen whales. The potential for masking at higher frequencies [one (1) to 25 kHz] exists when the vessel is in close proximity to the particular animal. The DP vessels will be operating in an open offshore area and as such there is no potential for marine mammals to become trapped in a high-noise environment and therefore the risk for a significant impact is considered to be low.

Sound also plays a major role in the lives of fish (Zelick *et al.,* 1999; Fay and Popper, 2000). In addition to listening to the overall environment and being able to detect sounds of biological relevance, many species of bony fish communicate with sounds for a wide range of behaviors including but not limited to mating and territorial interactions (Zelick *et al*., 1999). Most fish cannot hear sounds above approximately three (3) – four (4) kHz and the majority of species are only able to detect frequencies of 1 kHz or below.

Popper *et al.* (2014) recently proposed preliminary sound exposure guidelines for fish exposed to shipping and continuous noise sources and determined that there was no direct evidence of mortality or potential mortal injury to fish from ship noise, but there is some evidence for reversible auditory tissue effects and TTS caused by continuous sound.

Fish near the vessels may be exposed to sound levels sufficient to; elicit behavioral responses, create potential auditory interference by masking and cause recoverable auditory impacts. However, due to the limited extent and recoverable nature of impacts, these are unlikely to be significant on population levels.

Furthermore, sound impacts are primarily associated with construction, installation and commissioning activities which are short term and temporary. Therefore, impacts will be short lived and localized and therefore considered to be of low significance.

Mitigation and Impact Significance

Mitigation measures to be employed and impact significance ranking is summarized above in Table ES-2.

Nature and Ecology

The impacts considered in this Section relate to the following Project activities:

- Pre-commissioning and commissioning (cleaning, gauging and hydrotesting) infield flowlines and transmission pipelines activities;
- Presence of construction/ installation and support vessels/ helicopters;
- Construction/ installation and support vessel discharges;
- Ballast discharges;
- Subsea control valve operations; and
- Bio-fouling of pipeline.

Pre-commissioning and Commissioning

Following cleaning and gauging the flowlines/ pipelines will then be hydrostatically tested and as part of the commissioning process, dewatered and dried (and made free of oxygen) with nitrogen gas in preparation for first gas.

Gas pipelines are normally hydro-tested by filling the test section of pipe with water which is often treated with biocides and oxygen scavengers. MEG will be used to flush subsea connectors and tie-in spools following installation. During this operation some MEG will be released into the surrounding marine environment. In addition to chemicals, when discharged the hydrotest fluid will also contain any particulate residues from reactions occurring within the pipe.

Potential impacts associated with treated water discharges will be limited to within the mixing zone of the effluent plume at the point of discharge. This discharge is temporary and will occur twice during the pre-commissioning/ commissioning phase (once during cleaning/gauging and once following hydrotesting). Therefore impacts upon water quality and marine organisms will be short lived and limited to a localized area. The discharge will occur at the seafloor and will be directed upwards to ensure the plume does not come into contact with the seafloor, thus minimizing the impact on the benthic community. Where avoidance by fish is not possible, the sensitivity to turbidity varies greatly between species and their life stage (Newcombe, C.P. & Jensen, J.O.T, 1996). Fish gills, the major organ for respiration and osmoregulation, are directly exposed to and can be blocked by suspended solids in the water, which can lead to oxygen deprivation. Juvenile fish are most vulnerable to this, as they have smaller, more easily clogged gills, and a higher oxygen demand (FeBEC, 2013).

Ecotoxicity tests have demonstrated that phytoplankton are the most susceptible organisms to biocides. However, such tests also demonstrated that healthy phytoplankton populations were recorded within one week following hydrotest discharge activities (Boulton, B. and Roddie, B.D., 2008), showing the capacity of ecosystems to rapidly recover from temporary impacts associated with subsea chemical discharges. The majority of hydrotest discharges will occur in the deepwater infield area which precludes the presence of phytoplankton, as such the impact of these discharges is expected to be less than an equivalent shallow water discharge due to decreased susceptibility of species at this depth.

Construction, Installation and Support Vessel/ Helicopter Presence Impacts

All marine mammal and sea turtle species have the potential to be impacted by vessel movement and presence as they spend time at the surface in order to breathe. The time spent at the surface and the mobile agility of the species denotes the degree of sensitivity to this aspect.

Most dolphin species are agile swimmers and are unlikely to collide with vessels. Of the 11 marine mammal species known to have been hit by vessels in the eastern Mediterranean Sea, fin whales and sperm whales, which are both considered vagrants in the Levantine Basin (refer to CSA Ocean Sciences Inc. 2016a), are among the species that are struck most frequently (Laist *et al*., 2001). Although all sizes and types of vessels can collide with whales, the most lethal or severe injuries are caused by ships 80 m or longer and traveling 14 knots or faster (Laist *et al*., 2001). During pipelay and flexible lay operations, the installation vessels will be travelling well below this threshold (0.2 knots for umbilical lay and 0.06 knots for pipelay).

There is a remote possibility of vessels striking a sea turtle during routine operations. Leatherback turtles are the most pelagic of all marine turtles, spending a large amount of time in the open ocean (Bjorndal in Lutz and Musick, 1997). Due to the speed at which the support vessels will be traveling and the relatively low levels of both vessels and marine mammals present in the application, the impact significance is considered to be low.

Helicopter traffic also has the potential to disturb marine mammals (Richardson *et al.,* 1995). Reported behavioral responses of marine mammals are highly variable, ranging from no observable reaction to diving or rapid changes in swimming speed or direction (Efroymson *et al.,* 2000; Smultea *et al*., 2008). Similarly, sea turtles may experience behavioral disturbance from helicopter noise. Sea turtles will hear the sound source prior to any exposure to these source levels; they may respond by changing course or diving to avoid further exposure. Smultea *et al.,* (2008) concluded that behavioral responses to brief overflights by aircrafts are short-term and probably of no long-term biological significance.

The effects of low flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Flight paths should be coordinated and planned to avoid population centers and wildlife areas including bird colonies and set minimum cruise altitudes when traversing the coast in order to minimize physical presence impacts. It is expected, however, that some trips will occur at lower altitudes due to bad weather conditions but these incidents are expected to be very

short-term in duration and sporadic in frequency. Birds in flight over water are expected to avoid helicopters; giving rise only to temporary disruption of feeding or flight paths when encountering low flying helicopters.

Artificial light (i.e. light emitted from an artificial source such as construction, installation, commissioning and support vessels) which is visible in the open environment, can alter the behavior or disorientate marine organisms and seabirds that use light for natural responses.

Artificial light has several effects on female turtles searching for locations for nests and on hatchlings finding the sea. Given the duration of construction, installation and commissioning activities and the distance between these activities and coastal nesting sites in the eastern Mediterranean, any light sources are unlikely to have a significant impact upon those species most vulnerable to changes in natural light patterns.

Marine mammals are less likely to be sensitive to light emissions as they do not rely on light for natural responses. Indirect effects on marine mammals may occur as a result of changes in behavior of their prey, such as temporary aggregations of fish in the vicinity of the construction activities due to light.

Birds are also attracted to sources of light, particularly those on migratory paths during the hours of darkness. Birds tend to circle around light sources reducing their energy reserves and making them unable to reach the next shore or decreasing their ability to survive the winter or reproduce effectively (Deda *et al.,* 2007). However, due to the limited duration of construction, installation and commissioning activities and the low abundance of seabirds present in the Application Area, the impacts of artificial light on seabirds are considered to be low.

As is typically observed across the offshore oil and gas industry, certain fish species will be attracted towards vessels due to artificial light sources projected onto the sea surface. Other fish species will exhibit avoidance behavior from artificial light sources. The effects of this change in behavior of affected fish species is typically localized and minor.

Construction, Installation and Support Vessel Discharge

Routine discharges from installation and support vessels are unlikely to affect most marine mammals, sea turtles and birds since the concentrations discharged are considered to be non-lethal and if the environment is non-favorable, such organisms are likely to adopt avoidance behavior. Plankton and fish species present in the installation areas however, may be impacted.

In the upper portion of the water column, the turbidity plume caused by routine discharges will reduce light penetration for a short period of time in close proximity to the discharge, with limited impacts on phytoplankton. Whilst increased turbidity is not expected to physically affect fish (interference with gill function), turbidity increases may alter the foraging success of some fish when they are present within a plume (De Robertis *et al*., 2003). Given that the total area affected by these discharges is very small, foraging fish are expected to either avoid or move out of the discharge plume and overall, turbidity effects will be localized.

Ballast Water Discharge

Ballast water is water used to maintain the stability of vessels during operations. Ballast water is typically seawater or freshwater that can be added or removed from defined ballast compartments in order to maintain the draft of a vessel within the proper limits. Since a vessel takes up ballast at its point of origin, the water may contain plants and animals that are not present in the environment where the ballast is discharged. Species that survive the transit and are able to become established in the new environment are termed non-native (or alien) invasive aquatic species and are typically defined as species which are agents of change and which may threaten native biological diversity (IUCN, 2002). In general non-native invasive species pose a threat to biodiversity by impacting on native (or endemic) species directly (e.g. predation) or indirectly by causing changes to ecosystem structure and function.

Subsea Control Valve Operations Impacts

During operations, there will be occasions that necessitate actuation of subsea valves in order to maintain safe operations and test their functionality. During actuation, hydraulic fluid will be released into the marine environment.

Modelling of this discharge was performed using the Dose-related Risk and Effect Assessment Model (DREAM) also showed that the hydraulic fluid disperses rapidly to below the toxicity threshold, upon release into the environment. The modelled scenario focusses on valve discharges at the Infield Gathering Manifold as this location will see the largest discharge of all infield sites in the event of simultaneous closure of all subsea actuated valves. Total discharge in the event of all Infield Gathering Manifold valves being simultaneously closed is 117 litres.

Results of the DREAM model show that the hydraulic fluid will initially sink towards the seabed following release (due to its density) and the resultant plume will drift in accordance to the prevailing current conditions. Due to the water depth at the infield location the seabed currents are low and as a result the plumes will not traverse the seabed at a significant rate, thus giving mobile species significant time to relocate away from the advancing plume. Although, immotile species will not be able to move away from the plume, the hydraulic fluid is water based and of low toxicity and therefore will not pose a significant impact on a population level. Further analysis shows that, due to the significant depths at which this fluid is released, and the very small quantities that will be released it poses a low risk to the surrounding marine environment.

The limited discharge frequency associated with the subsea controls systems (nominally twice per annum) further reduces the potential for environmental harm.

Bio-fouling of Pipeline

Organisms with relatively immobile life stages, including marine invertebrates, colonize and grow upon such infrastructure and as a result will represent biomass production. Macroalgae and nearly all major invertebrate taxa, including corals, anemones, hydroids, sponges, sessile bivalves, mollusks and polychaetes have been observed on oil and gas infrastructure (Reed *et al,* 2004; Bulleri *et al,* 2005; Chapman, 2006; Page *et al,* 2008).

It is not considered likely that biofouling of the pipeline will result in any significant impacts, either to the surrounding environment or to the integrity of the pipelines. The Background Monitoring Survey conducted and described in Chapter A did not identify any hard structures during the survey therefore potential settlement from such organisms is not likely to be at a significant scale.

There will likely be an increased abundance in invertebrate species in proximity to the subsea infrastructure which may result in an increased level of predator abundance in the vicinity of Application Area. Due to the depths at which the majority of the subsea infrastructure is located however, it is not considered likely that this will result in a significant change on a population level.

Cumulative Impacts

There may be cumulative effects if other similar work is taking place within the region. Noble Energy, however, is not aware of any other work programs that will run concurrently. The planned Tamar south expansion project is expected to be completed prior to the commencement of the installation phase of the Leviathan project.

There may also be inputs from other anthropogenic sources that are unrelated to the oil and gas industry including shipping, fishing vessels, helicopter flights and military exercises. The Leviathan Field Development Project will add additional sound to background noise levels, but the nature of the anticipated noise sources, the distance location from shore and the fact that the area is not busy in terms of shipping and fishing suggest that significant cumulative noise effects are unlikely.

Emissions from vessel activities, also have the potential to contribute to a variety of cumulative environmental effects, including local air pollution, acidification (acid rain) and on a wider scale will contribute to global warming (greenhouse gases).

Localized impacts may include elevated levels of atmospheric emissions in the immediate area. However, it is considered that these elevated concentrations will be short lived and it is unlikely to be detectable within a short distance of the vessels due to the dispersive nature of the offshore environment and the fact that vessels are mobile thus preventing emissions being concentrated at a single location.

Mitigation measures to be employed and impact significance ranking for all aspects associated with Nature and Ecology are summarized above in Table E-5.

Cultural and Heritage Sites

As the cradle of civilization, it is little surprise that the Fertile Crescent (the Levant and Mesopotamia) contains some of the oldest evidence of seafaring in the world. The shipwrecks and submerged cultural heritage that lie on the seafloor of the eastern Mediterranean Sea often include intact ship remains and cargo. The maritime trade routes of ancient seafaring cultures such as the Greeks, Phoenicians, and Romans indicate heavy traffic in the region. The hull remains and artifacts from wreck sites represent an enormous wealth of knowledge on ancient seafaring history, culture, and technology.

Mitigation measures to be employed and impact significance ranking is summarized above in Table E-5.

Hazardous Materials

Noble Energy is committed to reducing waste production and to managing all produced waste by applying approved and practical methods. Waste should only be disposed of if it cannot be prevented, reclaimed or recovered. A Waste Management Plan will be developed for the Project and will identify (1) the types of waste generated and (2) management procedures for each waste stream. The Plan will detail appropriate waste contractors to be used to ensure the waste is correctly documented, transported, processed and disposed of in accordance with applicable legislation. Regular audits will be carried out to verify correct implementation of the plan.

Integrated waste management is an important component of Israel's environmental policy. To address the challenges of both solid and hazardous waste, the MoEP has formulated policies founded on reduction at source, reuse and recycling, with disposal as the last priority.

Mitigation measures to be employed and impact significance ranking is summarized above in Table E-5.

Measures for Reduction of Geological and Seismic Risks

Noble Energy has considered seismic risk (including potential earthquakes) when developing the proposed pipelay and subsea infrastructure program. The design and engineering of the pipelines and associated subsea infrastructure takes into account identified seismic risk as well as seafloor and shallow geo-hazards.

There has been one recorded earthquake (magnitude 4.0) within approximately 40 km of the Leviathan Field since 1979. There have been no strong (magnitude 5.6 or greater) regional earthquakes recorded since 1983 within 200 km of the proposed drill sites.

Mitigation measures to be employed and impact significance ranking is summarized above in Table E-5.

Fishing and Marine Farming

Impacts to the fishing industry may occur through interference with fishing activities during installation, particularly pipelaying activities and the presence of exclusion zone during these activities will lead to a removal of available fishing grounds.

Fish farming (aquaculture and mariculture) is the main producer of fish in Israel, accounting for 84 percent of domestic fish production in 2005 (UNFAO, 2007). Aquaculture is usually undertaken onshore using traditional earthen ponds, such activities onshore will not be impacted by development operations offshore. Mariculture is generally focused in the nearshore environment therefore the physical presence of vessels will not impact the nearshore environment within the scope of this EIA.

Offshore marine fishing within the scope of this EIA is relatively sparse as a result of water depths and the oligotrophic nature of the environment (UNFAO, 2007). In total, marine fishing only contributed 10 % towards the total domestic fish production in Israel in 2005 (UNFAO, 2007). Fishing is concentrated along the narrow continental shelf, which, though 50 km wide in the south (along Gaza) narrows to only 10 km in the north (Haifa–Carmel Mountains).

Due to the distance from shore, recreational fishing is not expected in the Application Area.

Oil and Gas infrastructure (pipelines and platforms) in other global locations have been observed to attract significant levels of marine species (including fish) to their vicinity. This is primarily a result of two key features:

- Pipelines and platforms provide a hard substrate within the seabed environment for settlement of organisms such as hard corals and bivalves; and
- Production fluids are generally produced at temperatures above ambient seabed temperature as a result of the elevated temperatures found in subsurface reservoirs. As heat is conducted across pipeline walls this has a warming effect on the surrounding environment which is known to attract fish species and infaunal communities.

The impacts associated with fish populations being attracted to such facilities however is difficult to assess, if fish populations are limited by the amount of available habitat, then the addition of suitable artificial habitat increases the environmental carrying capacity, resulting in a sustained increase in population biomass. This phenomenon is known as the ‘production hypothesis’ (Bohnsack, 1989). However, fish observed on artificial reefs may simply have been attracted to those locations from surrounding habitats, this is termed the ‘attraction hypothesis’ (Bohnsack, 1989). Initial attraction, however, does not preclude the possibility of later production which may occur over several decades (Macreadie *et al.*, 2011).

The ‘attraction’ hypothesis can be considered detrimental to fish populations as otherwise sparsely distributed resources can be concentrated making them easier to exploit (Bohnsack, 1989). However, the depths at which the majority of the subsea infrastructure within the scope of this Production EIA precludes it being located in areas where the seabed may be considered a fishery. Within territorial waters water depth decreases such that fishing activity may occur (< 500 m) at the seabed, however, fish abundance is generally low due to the oligotrophic nature of the Eastern Mediterranean Basin. As a result, the fishing effort is generally lower.

Since the Leviathan Field Development is reliant on continuous thermal hydrate inhibitor injection the subsea production system will not be thermally insulated. As such the production pipelines will be at approximately ambient temperature in the midwater / shallow water areas (> 105 km from the wellheads). Therefore the pipelines would not be expected to result in significant colonisation (by fish) of the waters immediately surrounding them.

Mitigation measures to be employed and impact significance ranking is summarized above in Table E-5.

Safety and Protection

Consistent with international industry practice, Noble Energy will establish a 500 m radius safety exclusion zone around the pipelay vessel and the OCV while it is operating, this will be patrolled by the standby vessel and kept clear of all unauthorized vessels. A standby vessel (capable of housing the entire workforce of the largest vessel) will be dedicated to supporting the pipelay and OCV vessels in order to both enforce the exclusion zone and provide rapid response in the event of an emergency situation occur.

Numerous shipping lanes cross Israel's territorial waters, although the Leviathan Field, pipeline route and the proposed platform location are not located within any shipping lanes. However, shipping lanes do extend westward from Haifa in the direction of the Leviathan Field. Therefore, it is possible that shipping traffic may pass through the area en-route to or from various Mediterranean ports.

Mitigation measures to be employed and impact significance ranking is summarized above in Table ES-2.

Monitoring and Control Program

Monitoring procedures are an integral element of Noble Energy's operations and help to ensure that the mitigation measures identified for the project are implemented. Some monitoring is prescribed in the various regulations and plans; other monitoring is directed by Noble Energy's EHS procedures.

Noble Energy conducted a Background Monitoring Survey of the marine environment as required by the Ministry of Environmental Protection and the Ministry of National Infrastructures, Energy and Water Resources which is required in order to characterize the environment encompassing the development areas before any Field Development.

These survey reports are entitled Leviathan Field Development Background Monitoring Survey: Drilling Component, March 2016 and Leviathan Field Development Background Monitoring Survey: Pipeline Component, March 2016.

Abandonment and Dismantling of the Infrastructure

Given the water depths at the proposed infield flowline locations (>1,500 meters) and for a large proportion of the transmission pipelines locations, removal would be difficult and costly. Currently it is anticipated that these will be left in situ following flushing/cleaning operations to remove contaminated fluids which may have a detrimental impact on the marine environment.

Removal of infrastructure at the end of field life would disturb the seabed sediments and cause an increase in local turbidity which could lead to smothering of benthic communities. The effects of smothering would be greater in deeper waters which are subjected less to seabed disturbances caused by oceanographic or meteorological processes. Often, any positive environmental impact of removing deep-water pipelines is considered to be outweighed by the negative increases in turbidity and seabed disturbance associated with the removal operation.

Additionally, deepwater pipelines often offer an alternative hard substrate habitat which may act to increase biodiversity in the region, subsequent removal of this habitat may result in the loss of any increased biodiversity that has developed over the project life cycle.
Prior to decommissioning a detailed impact assessment will be undertaken to review and assess decommissioning options. The comparative assessment will be based on technical feasibility, complexity and risk, safety, environmental impacts, effects on other sea users and cost. The aspects that will be covered in detail in the plan will include:

- Plans to plug and abandon/ suspend the wells;
- Methods to clean and/ or remove subsea trees/ manifold;
- De-oiling of pipeline, flowlines and risers; and
- Any pipeline/ flowline removal or burial.

The Decommissioning Plan will also address any mitigation measures to minimize environmental impacts as well as post restoration and monitoring activities that may be required following completion of facilities suspension and removal.

Although it is too early at this stage to assess the significance of the impacts expected to arise as a result of decommissioning activities, a dedicated Decommissioning EIA shall be prepared to ensure that residual impact significance is considered to be low prior to conducting any decommissioning activities.

ES.5 Proposed Instructions for a Plan for Preservation and Prevention of Harm to the Application Environment

This section outlines Noble Energy's Environmental management practices, followed by a review of the mitigation and abatement actions to be implemented and followed to reduce potential impacts on the environment during the Leviathan Field Development Project execution, production and decommissioning activities.

Noble is responsible for ensuring that Project commitments, including those within this EIA, are implemented and that the Project's performance complies with applicable environmental, legal, regulatory, and corporate requirements.

Environmental, health, and safety management of Noble Energy activities is implemented through a hierarchy of policies, plans, and procedures that cascade from the corporate level to the business units and their individual operations. Based upon these high level policies, Noble Energy Israel is developing an Operations Management System (OMS) that provides specific procedures and guidelines for implementing its EHS systems.

The OMS provides a framework for establishing performance goals and incorporates Noble Energy's legal requirements and best practices into an umbrella framework within a model that integrates elements from both Safety and Health Management Systems and Environmental Management Systems. The OMS provides the framework for implementing a program designed to make offshore gas development safe for workers and protective of the environment.

The OMS will be implemented across offshore operations and is applied to third-party contractors involved in drilling and other support activities. This ensures that all levels of operations are performed in a consistent manner such that safety and environmental protection are consistently achieved. The integration of the Noble Energy OMS and contractor operations will be implemented through bridging documents that identify common processes and approaches to address any differences in procedures between Noble Energy and the contractor as well as any site-specific hazards of the Leviathan Field drilling and completion activities. Noble Energy will conduct an extensive comparison and review of vessel plans, processes, and procedures relative to the Noble Energy OMS to ensure that the contractor's plans are acceptable for use as the primary system during the Leviathan Field drilling and completion activities.

Following this EIA process, instructions have been made in order reduce and prevent hazards for those actions that give rise to environmental impacts that are considered to be undesirable. Any impacts that are identified as unacceptable during the impact assessment process were prevented permanently or reduced to acceptable levels.

Mitigation measures surrounding the environmental aspects are used to inform the Noble Safety and Environmental Management System (SEMS) and have been detailed in Chapter E for the following instructions:

Instructions for the Various Stages of Performance of the Application

Instructions to ensure that all execution, operation and decommissioning activities will be conducted in compliance with a series of operational procedures and instructions and employing Best Industry Practice procedures.

Handling of Hazardous Materials

Handling of hazardous material is likely during construction and installation of the Leviathan Production Development, however during operations, with this portion of the project being entirely subsea, there will be no requirement for use of hazardous materials except at the LPP, which will be developing its own Environmental Management and Monitoring Plan in line with Israeli requirements and as such is considered outside the scope of this EIA. This section therefore references activities related to construction and installation hazardous waste management and handling.

Reduction and Prevention of Harm to the Seafloor, Seawater and the Coastline

Instructions for pipeline and subsea infrastructure installation to reduce and prevent harm to the seafloor, seawater and coastline. It also includes consideration of harm to marine ecology, heritage and cultural sites, fishing and fish farming.

Preservation of Fauna and Flora, including Pelagic Species

Instructions for the preservation of fauna and flora in the Application Area including the prevention of harm to habitats, to pelagic species whose presence might be increased such as sharks, marine mammals and birds.

Monitoring

Instructions for monitoring procedures, an integral element of Noble Energy's operations to ensure that the mitigation measures identified for the project are implemented.

Preventing or Reducing Noise Impacts

Underwater noise will be most significant during construction, installation and commissioning of the Leviathan Production Facilities and therefore instructions highlighted in this Section focuses on these phase of the project development.

Management of Safety and Protection Zones

Instructions related to the management of Safety and Protection Zones will apply to both installation and operational phases of the Production Development.

Emergency Procedures:

Instructions related to the Emergency Procedures will apply to both installation and operational phases of the Production Development.

Geological and Seismic Risks

Noble Energy has considered seismic risk (including potential earthquakes) when developing the proposed pipelay and subsea infrastructure program. The design and engineering of the pipelines and associated subsea infrastructure will take into account any identified seismic risk as well as seafloor and shallow geo-hazards.

Protection and Maintenance of Transmission / Supply Pipelines

Instructions for the protection and maintenance of transmission and supply pipelines to ensure that they do not suffer any damage which could potentially result in an impact to the surrounding environment.

Decommissioning

Instructions to prepare a Decommissioning Plan which will address any mitigation measures to minimize environmental impacts as well as post restoration and monitoring activities that may be required following completion of facilities suspension and removal.

Periodical Reporting and Incident Reporting

Periodical reporting shall be done according to the specific requirements laid out in the relevant discharge permit and incident notification shall be done according to Noble Energy's incident notification procedure.

Changes in Development Plan

Noble Energy will report any changes in the Construction, Execution and Production plan, including the impact of such changes on the environment.

Implementation of SEMS

Specific to Israel, Noble Energy is implementing a Safety and Environmental Management System (SEMS) that builds upon the elements that make up its Global Management System. The SEMS provides the framework to make offshore gas development safe for workers and protective of the environment.