

Part IV: Potential Impacts

The following sections discuss the potential pollution sources and environmental consequences associated with the Project in the Zaamar region. The potential impacts described in **Section 2.0** do not consider the use of mitigation measures designed to reduce or eliminate Project impacts. The mitigation measures are presented in **Part V**. Net Project impacts, as a result of the use of the proposed mitigation measures, are presented in **Part VI**.

1.0 Pollution Sources

1.1 Air Pollution Sources

A small number of air pollution sources will be associated with the Project. These sources and their potential impacts to the environment are outlined in this section. Potential impacts from the various air pollutants to all major receptors are summarized in **Section 2.0**.

The three main sources of air emissions are stationary point sources, mobile point sources, and fugitive dust sources.

1.1.1 Fugitive Dust and Particulates

The primary air emissions of concern are fugitive dust particulates that will be generated by mining operations. Sources of fugitive dust include: excavators and bulldozers used during mining and construction activities that strip native vegetation and soil cover; overburden and tailings piles subject to wind erosion; and, vehicle travel over unpaved, dry, dusty roads.

Dredge operations will not generate significant quantities of dust as they operate in the water, but overburden and tailings mounds will be subjected to wind erosion and dust until they are successfully reclaimed. Bulldozers and excavators will also produce overburden mounds and pits subjected to wind erosion and dust until reclaimed.

The mine camps will also generate small amounts of fugitive dust from localized disturbed areas and service vehicles.

The quantity of fugitive dust generated by these sources in the Project area is anticipated to be relatively small due to reclamation activities that will be conducted concurrently with placer mining operations.

There are some signs of minor accelerated desertification in the Project area, principally associated with vehicle traffic and localized overgrazing that is unrelated to the current Project.

1.1.2 Point Sources

1.1.2.1 Stationary Sources

The mine camps will generate stationary sources of emissions from boilers for heating. This source is a minor emissions source of SO₂, NO_x, CO, particulates and soot.

Ger camps also utilize biofuel as a heat source which can produce emissions from point sources if vented through stacks.

1.1.2.2 Mobile Sources

Mobile sources include dredges, the floating process plant, excavators, bulldozers and vehicles.

An estimated 10,400 liters (2,747 gallons) of diesel fuel will be consumed each day by the two cutter suction dredges and the process plant during proposed mining operation. An estimation of emissions of CO, NO_x, SO_x, PM and TOC from the dredges and the process plant is presented in **Table IV-1** which is based on US EPA-recommended emission factors (US EPA A-42; SCC2-02-004-01). As shown in the table, the maximum annual load of emissions is not expected to cause significant air quality impacts to the region.

Table IV-1 Maximum Daily, Monthly, and Annual Emissions

Parameter	Emission Factors (lb/MMBtu)	MMBtu Generated Per Day*	Emission (lb/day)	Emission (ton/month)	Emission (ton/year)
CO	0.85	376	319.60	4.35	52.19
NO ₂ **	2.4	376	902.40	12.28	147.36
PM	0.1	376	37.60	0.51	6.14
SO _x ***	0.0505	376	18.99	0.26	3.10
TOC (as CH ₄)	0.09	376	33.84	0.46	5.53

* 2,747 gallons of diesel will produce 376.4 million British thermal units (MMBtu) (based on 137,030 British thermal units [Btu]/gallon formula)

** NO₂ was calculated based on the ambient ratio method (ARM) of NO₂/NO_x=0.75 suggested by US EPA

*** Standard Diesel contains 500 parts per million (ppm) of sulfur (thus S1=0.05 and 1.01 * S1=0.0505)

Additional diesel fuel will be consumed by excavators, bulldozers and transport vehicles. Emissions from these sources are relatively minor compared with the cutter suction dredge and process plant operations.

1.2 Liquid Wastes

1.2.1 Domestic Wastewater

It is conservatively estimated that 3.9 tons of domestic sewage (65 people at 60 kg/day/person) will be generated each day when the Project is at full-scale development. An engineered septic system will be established at the mine camp with enough capacity to treat all incoming wastes and used as the major treatment facility for domestic sewage for the mine camp and on-board dredges. Operation of the treatment facilities will be monitored on a regular basis to ensure the efficiency of the system.

1.2.2 Industrial Liquid Wastes

A large amount of process water is required to recover placer gold. It is estimated that seven cubic meters of water is required to process one cubic meter of placer ore. This water will come mainly from the local alluvial aquifer. There will be no chemical processing of placers; it is strictly a physical separation process. Almost all process water will be recycled in dredge and sediment ponds. There will be no discharge of process water to the Tuul River.

A certain amount of spent oils will be generated from operations of dredges, IHC mineral jigs, trucks and other machinery. All waste oil will be collected,

temporarily stored at the maintenance shop and either incinerated on-site or shipped to a licensed disposal / recycle facility in Ulaanbaatar. Since there are no chemicals added in the placer recovery process, other than possible use of clay dispersants, no other types of chemical waste will be generated in the mineral separation process. Mercury will not be used in the mining process for environmental and legal reasons.

Apart from waste oils, materials such as batteries, paints, solvents, antifreeze and hydraulic fluids should all be considered hazardous waste. One of the key factors in effective waste management is comprehensive classification and identification of hazardous wastes so that appropriate waste management procedures can be followed. All containers with hazardous waste will be clearly marked and posted with warning signs. Hazardous wastes will be properly segregated, labeled and stored in a properly secured location. There are no public or private hazardous waste disposal facilities in Mongolia. Hazardous materials will be stored, then disposed of by incineration as may be permissible under Mongolian Law on-site, or transported to a future site for permissible disposal. Some potential may exist for disposal of hazardous wastes in high temperature kilns, asphalt and/or paving plants, power plants, boilers, or other facilities as may be in alignment with international best practices and approved by Mongolian authorities.

1.2.3 Surface Water and Groundwater Quality

The potential impacts of placer mining operations on surface water quality in the Tuul River Valley in the Zaamar Goldfield have been documented by Farrington (2000), Dallas (1999), Jadamba and Doolonbayar (1998), and others. There are some historical surface and groundwater quality data in a document by Jadamba and Doolonbayar (1998). In addition, hydrogeologic investigations have been conducted in this region by the Soviet Geological Exploration Unit in 1986 to 1988 and by the Darkhan Geological Exploration Unit in 1988 to 1990.

Land disturbances from the Project will result mostly from stripping of alluvial vegetation, topsoil, and overburden. Potential activities for increasing sediment loads and turbidity in the Tuul River include excavation of placer materials and, processing and disposal of tailings and overburden. Stormwater and snowmelt runoff may substantially increase sediment loadings from disturbed areas in the Tuul River watershed. Improper environmental management of placer operations could further contribute to sediment and turbidity loadings in the Tuul River. Besides degrading water quality, an increase in sediment loading can present serious negative environmental consequences for riverine geomorphology and aquatic life.

In addition to a potential increase in TSS and turbidity from mining operations in surface waters, there is also the potential increase in nutrients (nitrogen,

phosphorus) and microbiological contamination from wastewater discharges from mine camps. Fuel and lubricant spills from mine camps, mine equipment, and vehicles have the potential to further degrade surface water quality in the Tuul River.

Accidental spillage of pollutants could contaminate soils and vegetation and could also migrate through the soil column to groundwater. After reaching the groundwater, due to the relatively high hydraulic conductivity, the spilled contaminants could possibly impact surface water quality as well. The extent of impacts would depend on the size and location of spill and the response time involved in initiating containment cleanup. The mine process involves only physical separation of the gold and, as a result, there will be no process chemicals in the Project area. As discussed above, there will be some fuels and oils, as well as minor amounts of miscellaneous chemical production on the Project site. Impacts associated with catastrophic structural failure of mine facilities, such as fuel storage tanks and other facilities containing chemicals, could have potential water quality impacts. However, the utilization of engineered safety features and control technology, discussed in **Part V**, significantly lowers the risk of such failures.

With good management practices and the standard engineering process controls discussed in **Part V**, the risk of adverse impacts to surface water and groundwater quality from accidental spills is considered to be low to moderate.

1.2.3.1 Potential Sources of Impact to Surface Waters

There are several Project activities and facilities which pose a low to medium level of potential impact to the surface water system and surrounding watershed throughout the life of the mine such as:

- surface runoff from disturbed areas such as overburden, tailings, pits, roads and camps;
- sediment ponds;
- sewage treatment and disposal; and
- potential spills of fuel and lubricants, during storage, transport or transfers.

Water quality impacts related to catastrophic structural failure of mining facilities such as sediment /dredge ponds could have significant surface water impacts. These events and potential impacts to water quality are discussed in **Sections 2.1.1 and 2.4.2**.

1.2.3.2 Potential Sources of Impact to Groundwater

There are several Project activities and facilities that pose a minimal potential impact to groundwater quality throughout the life of the mine.

- Mining Operations: Dredging operations and sediment ponds will potentially disturb the flow pattern in the alluvial aquifer for the duration of the activity.
- General infrastructure: Minimal impacts are anticipated from other mine services such as the camp facilities, aggregate and concrete production sites, and/or stormwater management structures.
- Sewage treatment and disposal: Sewage will be treated prior to being discharged to the leach fields, thus minimizing potential impacts to groundwater quality.
- Water consumption: A well will supply water to the camp and mining infrastructure. Drinking water may also be transported to the site.

Potential groundwater quality impacts associated with mining activities are discussed in **Sections 2.1.1** and **2.4.2**.

1.3 Solid Wastes

About 0.3 tons of domestic trash will be generated each day at the mine camps in the Project area (65 people at 5 kg/day/person). Domestic trash disposal options being considered include on-site incineration of combustible fraction, and on-site burial in a small landfill.

A large amount of overburden estimated at 30.7 million cubic meters will be removed before all of the placer gold can be recovered from the Project area. Furthermore, over 10.3 million cubic meters of placer ore will have to be processed and the tailings disposed. Since chemicals will not be used in the entire mining process (except for possible flocculants for TSS sedimentation from water and the possible use of clay dispersants), overburden and tailings are considered to be natural byproducts.

A certain amount of solid, non-hazardous industrial wastes (such as wood, scrap metal, etc.) will be generated by the Project, especially during the construction phase. Wood waste will be reused to its maximum and the rest will be incinerated. Scrap metal will be recycled as much as possible and the rest disposed of at the field camp landfill.

2.0 Potential Impacts

The following sections discuss the potential environmental consequences associated with placer gold mining of the Project area in the Zaamar Goldfield. The potential impacts described herein do not consider the use of mitigation measures designed to reduce or eliminate Project impacts. The proposed preventative and mitigation measures for the Project are presented in **Part V**. Net Project impacts, as a result of the use of the proposed mitigation measures, are presented in **Part VI**.

Potential impacts were based upon evaluation of the potential for on-site, local, regional, cumulative, acute, and chronic impacts. Review and evaluation of available quantitative and qualitative data collected from a variety of sources was performed where possible. For many of the Project / environmental interactions, specific quantitative data useful for measurement or evaluation did not exist. Best professional judgment was used on all evaluations taking into consideration the documented primary and secondary impacts of the interaction; comparison with analogous sites and projects; compliance with regulatory requirements; impacts of historical, present, and future activities; frequency and duration of impacts; intensity and persistence of pollution sources; and, irreversibility.

Environmental impacts associated with potential accidents, spills, and emergencies are treated in **Part V**. Associated and indirect environmental impacts associated with the Project in relation to development activities in the Zaamar Goldfield are presented in **Part VI**.

2.1 Physical

2.1.1 Surface Water and Groundwater Hydrology

The potential impacts of placer mining operations on surface water and groundwater hydrology in the Tuul River Valley in the Zaamar Goldfield have been documented in a number of environmental assessments conducted in the area, listed in other sections of this report.

Development of the Project will potentially cause adverse impacts to the surface water system and surrounding watershed, including:

- increased sedimentation;
- alteration of flow patterns; and
- changes in sediment size distribution in channels and floodplains.

Potential physical impacts to the groundwater hydrology include:

- changes in recharge-discharge relationships;
- declines in floodplain groundwater levels;
- possible groundwater mounding under the dredge ponds; and
- changes in groundwater flow direction.

The main sources of impacts to surface water and groundwater hydrology include the following:

- stripping topsoil and overburden;
- dredging operations extracting gold-bearing gravels and sands;
- constructing and operating settling ponds;
- installation of water supply wells/groundwater extraction; and mine closure and reclamation.

2.1.1.1 Stripping Topsoil and Overburden/Surface Runoff from Disturbed Areas

Land disturbance will occur as a result of stripping topsoil and overburden; and, constructing tailings piles, access roads, mine camps, etc. The removal of topsoil and vegetation which can cause sedimentation of the river channel, may impact soil infiltration characteristics and, consequently the groundwater recharge and flow pattern in the Tuul River alluvial aquifer. It may also alter the local hydraulic relationship between the Tuul River and the alluvial aquifer.

Stripping overburden and topsoil can alter percolation capacity under the areas stripped and can also result in some alteration of groundwater flow direction. Increased fines deposition in stream basins may reduce the communication between surface water and alluvial groundwater, altering “gaining-losing” relationship between the river and the alluvial aquifer. This alteration, however, will be localized and not significant.

Runoff intensity is highest during spring and summer time due to snowmelt and intense rainfall events. Erosion potential in the Project area and sediment transport is relatively high and may result in gully formation and river sedimentation without proper mitigation measures during stripping overburden and various construction activities. Structural failure of mining facilities, including construction of tailings piles, dredge and settling ponds may cause significant impacts on the river hydrology. Mitigation measures will be implemented to prevent or minimize impacts.

2.1.1.2 Dredging Operations

Dredging operations separate gold from the gold-bearing sands by a series of washing operations. The mined-out area will result in a network of permanent deep and shallow ponds, islands and wetlands as part of a comprehensive reclamation program at the site.

Water for mine operations will be sourced from groundwater in the alluvial gravels or from the Tuul River. At times, water may need to be pumped from the Tuul River to reach or maintain the required water level in the dredge pond. The pumping may lower water levels in the river. This would most likely happen during the first two weeks of a new dredge pond construction, when water demand is highest. As the dredge pond becomes enlarged, more water will be recycled from the dredge pond and less water will be required from the alluvial groundwater. Eventually, the dredge pond will provide nearly all of the water requirements from the alluvial groundwater and recycling. Water use will be recycled at an estimated 93- to 95-percent efficiency to minimize water withdrawn from groundwater or the Tuul River.

Mining will occur from April through November, which will limit disturbance during low- to no-flow conditions. The maximum amount of water withdrawn from the Tuul River is not considered significant under these conditions. The local water use fee(s) will be obtained from the local government.

Removal of gold-bearing sands from the bottom of dredge ponds may impact percolation capacity at the bottom of the dredge ponds that may consequently alter the groundwater recharge and flow pattern in the Tuul River alluvial aquifer. Some localized groundwater mounds are likely to occur under the dredge ponds.

2.1.1.3 Constructing and Operating Dredging and Settling Ponds

Dredge ponds for alluvial mining operations will be excavated in the floodplain areas adjacent to the river. Overburden will be removed and pumped as slurry-containing water mixed with gravel, sand, silt, and clay. Sedimentation on the bottom of settling ponds may reduce infiltration, which could potentially cause overflow. After cleaning settling ponds, it is likely that some localized groundwater mounds and alteration of groundwater flow direction could occur. These impacts, however, are deemed insignificant.

2.1.1.4 Installation of Water Supply Wells/Groundwater Extraction

There is one water supply well on-site which may be utilized for camp drinking water. Other wells may be installed on-site to supply water during the initial phases of the Project. Results from several pumping tests conducted in the past by the Soviet and Mongolian specialists indicated that the Tuul River alluvial aquifer is characterized by high hydraulic conductivity and transmissivity values. Therefore, potential impact on the alluvial aquifer from groundwater extraction should be insignificant. It is possible that localized cones of depression and possible induced infiltration from the Tuul River can result from excessive pumping.

Mitigation measures will be implemented by WMMC to prevent or minimize surface water and groundwater impacts, as discussed in **Part V**.

2.1.1.5 Mine Closure and Reclamation

Mining activities will remain 100 m from the river channel per the Mongolian Water Law. Because of this, the impact on surface water upon closure is expected to be minimal. With proper erosion controls, recontouring, revegetation, and timing, the surface water will not be impacted by closure and reclamation activities.

Upon closure and reclamation, dredge blocks and sediment ponds will be filled and re-contoured to the natural landscape. The closure of the mining operations and backfilling of disturbed areas is likely to have a short-term impact on groundwater by introducing sediment and temporarily altering the natural groundwater flow.

2.1.2 Geology and Geomorphology

The scale of disturbance of natural topographic features by placer mining and related activities is small compared with typical open pit hard rock mining (USEPA, 1989). Such disturbance is confined principally to redistribution of unconsolidated geologic materials, which is amenable to subsequent reclamation.

The 3,170-hectare Project area includes a prognosis block area and reserve block area. The prognosis block area may be converted to mined after exploration drilling. Operations in the prognosis block area will have minimal impact on geology and topography during exploration. Portions of the current Tuul River floodplain and riparian areas in the areas of the mining license will be subject to intensive short-term disturbance. Direct effects may be significant during actual mining due to disturbance and redistribution of gravel, overburden, and related

materials. Indirect effects include the possibility of increased erosion of these materials during and after such disturbance, although concurrent and continuous reclamation will minimize the extent of these potential impacts.

Long-term impacts could be prevented or mitigated with responsible substantive reclamation efforts. A principal objective of effective reclamation is to return the landscape to an accepted usable or natural condition.

WMMC will design and implement a comprehensive concurrent and continuous reclamation program based on Mongolian regulations and OPIC guidelines. Advanced sediment control technologies will be employed to include comprehensive sediment fencing and use of such materials as filter fabric and geotextiles. Efforts will be made to restore landforms in mined areas. Riverbank stabilization will be enforced with planting of willows and other types of vegetation.

Previous mining activities in the Project region, unrelated to this current Project, have created many overburden piles (near 10 million m³) within the Zaamar Goldfield. Little reclamation work has been done on these “spoil piles”. One valley which was mined has been reclaimed under Mongolian requirements. Soil loss from erosion off these spoil piles has the potential to cause significant TSS in the surface water. For example, water quality measurements taken during the 2008 active mining season showed over a 10-fold increase in TSS beyond background levels measured during December 2002 (non-mining winter conditions).

WMMC intends to reclaim the pre-existing disturbed landscape in the Project area to the extent possible by contouring spoil piles, filling in excavated pits, and planting grass and willows in appropriate areas to minimize their impacts on surface water quality as well as geomorphology.

Impacts from anthropogenic disturbances can be controlled, yet uncontrolled potential impacts from natural disasters such as earthquakes must also be considered. The Project area is located in the Intensity Zone VI (based on the Modified Mercalli intensity scale), indicating that there is a 20 percent chance for a strong earthquake (though may not be destructive) to occur in the Project area within 50 years as shown on Figure III.2-18 earthquake intensity Zones in Mongolia. If it does occur, an intensity VI earthquake could potentially impact the Project. During earthquakes, buildings and structures may be damaged or collapse. Storage tanks of diesel may rupture and release diesel fuel into the environment. There is a risk of fire, with damage to gas lines and or the presence of other flammable material. There is also a risk that the spoils pile may become unstable and slide, potentially entering the river.

2.1.3 Soil

The proposed Project development will result in short-term and some long-term unavoidable impacts to the soil resources in areas disturbed by mining. Accounting for the reserve blocks, the prognosis blocks, and the mine camp, no more than 15 percent of the Project area is anticipated to be disturbed from Project activities. The initial direct impact to soils from placer mining is the alteration of the soil profile in the mining area. Generally, placer mining completely destroys the structure of the existing soil profile through the stripping of overburden and processing of gold-bearing sediments. Under natural processes, recovery from such disturbance occurs gradually over what may be a considerable period. Given the weather conditions and soil composition of the Project area, soil development and revegetation of disturbed areas may require decades. Preserving the topsoil and spreading it back during reclamation will minimize the impact and significantly reduce the time required to develop a new soil profile and reestablish vegetation. WMMC will designate locations for topsoil conservation; and, control measures will be taken to prevent erosion and degradation of the soil.

There are abundant existing roads in the Project region and only a limited number of new roads will be constructed. Therefore, soil disturbance and compaction from new road construction is considered insignificant. Off-road traffic will be strictly prohibited to minimize soil disturbance. A Bailey bridge may be used to cross the Tuul River. Some temporary soil impacts (compaction, erosion) along the stream bank will occur. These areas will be reclaimed upon removal of the bridge.

2.2 Biological

Potential Project-related impacts to floral and faunal components of terrestrial and aquatic ecology are numerous and diverse; additionally, impacts can be both direct and indirect in nature. Direct impacts include changes that occur as a result of actual mining operations, while indirect impacts describe changes that occur resulting from non-mining activities in and immediately adjacent to, the Project area. An impact matrix is presented in **Table IV-2** to categorize potential Project-related impacts.

Farrington (2000) cites impacts to the steppe grassland and riparian wetland communities as the largest environmental problems in the Zaamar Goldfield. Impacts to terrestrial ecology are expected to be greatest in wetland and riparian areas, where mining activity is greatest.

2.2.1 Terrestrial Ecology

2.2.1.1 Flora

Steppe

In terms of vegetation, seven direct and indirect impacts are identified (see below). Impacts are also classed as actual (existing) or potential; and, are identified as related to the Project area activities. Impacts to vegetation are summarized in **Table IV-2**. Most potential impacts relate to significant landscape level changes in vegetation as follows.

Table IV-2 Potential Impacts and Causal Factors – Terrestrial and Aquatic Ecology

Key Causal Factors Impacts	Direct					Indirect			
	Tails	Sediment ponds	Dredging	Roads	Waste	Settlement Construction	Settlement Activities	Roads	Waste
Vegetation									
- Steppe									
Loss of Vegetation Cover	-	-		-	-	-		-	-
Loss of Species	-			-	-	-	-	-	-
Chronic erosion	-	-	-						
Loss of habitat for T&E species	-	-		-	-	-		-	-
Introduction of invasive species							-		
- Wetland/Riparian									
Loss of willow (<i>Salix</i>) thickets	-	-	-	-		-	-	-	
Chronic river bank erosion	-	-	-	-			-	-	
Loss of habitat for T&E species	-	-	-	-		-		-	
Fauna									
Habitat loss	-	-	-			-			
Reduction in population sizes of species			-	-			-	-	
Increase in population sizes of native species					+		+		+
Decline in individual health due to stress	-		-			-	-		
Introduction of new and alien species						-	-		-

(- negative impact, + positive impact)

Direct and Indirect:

- Loss of vegetation cover/removal of native steppe vegetation from roads, lay-down areas, construction and other field-related activities (actual).
- Loss of species (potential).
- Chronic and self-perpetuating erosion-prone areas owing to embankment and slope disturbance, lay-down areas, roads, and deposition of overburden and tailings (actual).
- Removal of critical habitat of potentially existing Threatened and Endangered (T&E) species (potential).

Indirect:

- Introduction of invasive species from affiliated settlements and agriculture (potential).
- Increased human activity, pets, hunting, and gathering (actual).
- Change in vegetation structure/composition (potential).

Wetlands

Impacts to riparian vegetation along the Tuul River and associated drainages in the Project area are also considered potentially significant on a landscape level. Four principal potential and actual impacts include:

Direct and Indirect:

- Cutting and removal of willow (*Salix*) thickets in field operations (i.e., deposition of overburden and tailings) and for firewood by local residents associated with the goldfield (actual).
- Chronic river bank erosion and bare areas caused by dredging and operation disturbance, settling ponds and lay-down of tailings and overburden (actual).
- Removal of habitat of potentially existing T&E species (potential).

Indirect:

- Increased disturbance through livestock grazing pressure and settlement activity in willow thickets (actual).

Direct and indirect impacts to willow (*Salix* spp.) thickets along the Tuul River and drainages are considered to be among the most significant with respect to vegetation. Farrington (2000) reports that the loss of the willow stands are among the most significant impacts in the Zaamar Goldfield. Overgrazing has contributed extensively to the reduction in riparian willows in this region as well.

The Project plans to establish a riparian protection zone where mining will not occur in riparian areas protected by a buffer zone which will be established for the entire mining area.

Desertification in Mongolia

In Mongolia, 90 percent of the total land area is prone to desertification (FAO, 2000). During the late 1990s, several key efforts were initiated to combat desertification in the country, beginning with the Mongolian Environmental Action Plan (1995) together with the National Action Program to Combat Desertification (NAPCD). In 1996, Mongolia signed the UN convention on desertification and put into motion many key initiatives to combat desertification by the MNE. In collaboration with the UN, the National Committee for Combating Desertification (NCCD) was established at the MNE, which in turn also coordinated with the Centre for Combating Desertification at the Institute of Geo-ecology at the Academy of Sciences (NEAP, 2000). Several key collective goals of these institutions include the following:

- Support to local institutions in the NAPCD, sponsoring studies of the causes and consequences of land degradation;
- Development of methodology to combat desertification;
- Reception of international co-operation to combat desertification
- Strengthening of legal institutions toward sustainable management of rangeland in mitigating overgrazing;
- Increase of regional hydrological management, which include construction of water distribution systems and reservoirs;
- Creation of a fee program and economic incentives for rangeland to promote sustainable usage;
- Establishment of restoration programs for damaged and abandoned rangeland;
- Stimulation and incentives for integrated crop and livestock farming;
- Stimulation of crop rotation practices; and
- Support of sustainable crop protection practices, including fallow-strip, contour plowing, vegetation protection green belts.

Anthropogenic and Climatic Causes of Desertification

It is estimated that five to nine percent of all pasture land is currently degraded in Mongolia from inappropriate land uses practices combined with natural disasters, such as drought and steppe fires (World Bank, 2002). These anthropogenic and climatic factors account for the desertification problem in Mongolia (FAO, 2000), which together have caused a significant increase in countrywide desertification rates over the past 30 years (Batjargal, 1997). Batjargal (1997) focuses on and discusses five principal anthropogenic factors for desertification, including:

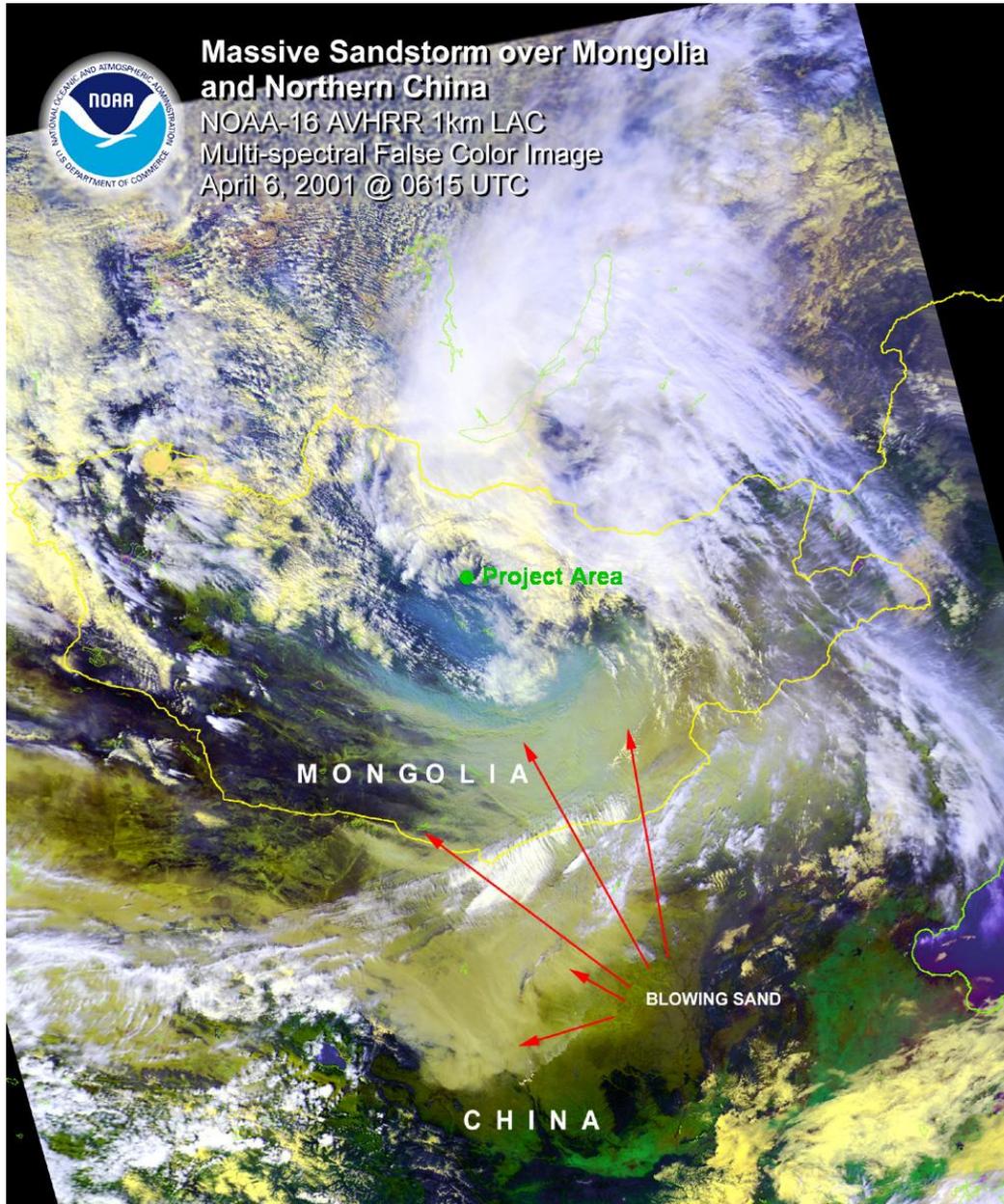
- cropping;
- vehicle induced degradation;
- mining and inadequate waste management;
- construction (domestic and industrial); and
- animal husbandry, overgrazing.

Of these factors, animal husbandry, specifically livestock grazing, is considered the most important and widespread cause of rangeland degradation and desertification in Mongolia (Batjargal, 1997). A mandate to provide solutions to the overgrazing problem is considered the most important priority by the NCCD (NEAP, 2000).

Climatic factors also play an important role in the desertification process, with chronic drought, low levels of precipitation, increases in temperature, dust storms and other climatic phenomena contributing with increasing frequency to land degradation and the desertification process in Mongolia (NEAP, 2000). Although essentially outside the main impact area, the significant 2001 dust storm, (**Figure IV-1**), indicates the massive scale on which this important causal factor of desertification in Mongolia can occur.

All of these anthropogenic and climatic factors already exist and contribute to risk of desertification processes in the Tuul River Valley and regionally, in the Selenge River Basin. Any mining and non-mining activity deleteriously impacting the steppe and riparian vegetation cover can potentially contribute to desertification processes.

Figure IV-1 NOAA-16AVHRR Image of a Large Dust Storm Over Mongolia, 2000



* Project area at center of image (green)

2.2.1.2 Fauna

General

Several potential impacts to fauna at the Project area may come directly from mining activities, as well as, indirectly from non-mining-related activities. These are described in terms of potential key causal factors and are summarized in **Table IV-2**. Potential impacts to fauna include:

- reduction in population sizes across an undetermined number of species;
- increase in population sizes of an undetermined number of species;
- decline in individual health due to stress; and
- introduction of new and alien species.

Potential causal factors of impacts to fauna are described with respect to direct Project activities and indirect activities in the Zaamar Goldfield. Six key direct and indirect potential causal factors are described below, including:

Direct and Indirect:

- Habitat loss in steppe and wetland areas;
- Noise; and
- Vehicle/road kills.

Indirect:

- Illegal hunting and dogs;
- Decline in individual health due to stress as a result of disturbance as well as increased competition for resources; and
- Change in population size or community structure on a local level for an undetermined number of species.

Three of the likely causal factors of impacts (habitat loss, noise, and vehicle accidents) are considered to have the most significant impact from mining activities and Project-related settlements and support services. In contrast, potential impacts caused by illicit hunting and dogs from settlements in the Zaamar Goldfield are anticipated to be sporadic and insignificant.

Mammals

Potential impacts to mammal species in the Project area are anticipated to be both negative and positive. Among the most significant causal factors that could cause negative impacts are construction/habitat destruction and noise associated with

tailings/overburden deposition, sediment pond construction, dredging and settlement construction/activities. Direct and indirect causal factors that could potentially produce positive impacts include abandoned and derelict structures that may provide shelter and organic waste that may provide food. Dredge spoils are often utilized by ground squirrels, and contribute to large increases in local populations by providing much more habitat than occurs naturally. Impacts and causal factors are summarized in **Table IV-2**.

Birds

Potential impacts to bird species in the Project area are also anticipated to be both negative and positive. Significant causal factors that would cause negative impacts to bird species include habitat disturbance/destruction, decline in population of species and decline in individual health from stress. Factors associated with these impacts are considered to include tails/overburden deposition, sediment pond construction, dredging and settlement construction/activities and general noise. Positive impacts will occur for some species of wetland and aquatic birds due to increased habitat from dredge pond and wetland creation. Impacts and causal factors are summarized in **Table IV-2**.

Reptiles and Amphibians

Herpetofaunal species that may be subject to potential impacts are expected to occur mostly in the wetland/riparian habitat of the Project area, including the Tuul River and drainages. Major potential impacts include loss of habitat and decline in population sizes of species as a result of factors directly related to the Project operations.

Invertebrates

Impacts to invertebrates are expected to show considerable variability amongst species groups. The most significant impacts are anticipated to occur with wetland/riparian species, associated with some habitat loss and decline in some population sizes. Aquatic taxa, such as mollusk species in the Tuul River, are subjected to existing habitat degradation through potential and episodic increases in sediment loading of the channel and floodplain. Project mitigation measures will prevent, or minimize sediment loading into the Tuul River.

2.2.2 Aquatic Ecology

2.2.2.1 Fish

Potential impacts to fish species relate to potential increased sedimentation of the Tuul River from mining related activities (see **Part III**). High sediment loads can

have an adverse effect on fish habitats by causing changes in channel morphology, producing deposition of fine sediment on spawning beds and reducing biological productivity and diversity (Platts et al., 1989). High sediment concentrations may interfere with feeding for sight-feeding fishes and can cause gill abrasion. Pentz and Kostaschuk (1999) found that erosion of previously mined disturbed areas had a pronounced effect on suspended sediment during spring snowmelt and summer rainstorms in Haggart Creek, Yukon Territory, Canada. Salmonids such as the Taimen (*Hucho taimen*) are particularly sensitive to high suspended sediment concentrations. These impacts are expected to occur through factors directly associated with overgrazing and poor erosion, sediment control, and current mining practices. WMMC will implement an effective sediment and erosion control plan to protect fish from sediment impacts in the Tuul River.

2.2.2.2 Macroinvertebrates

Although macroinvertebrates are relatively poorly known from the Tuul River and drainages, species populations are expected to be subjected to the same kinds of impacts associated with fish. Potential impacts to macroinvertebrate faunal communities include habitat degradation/loss in the Tuul River and tributaries, reduction of populations of species, loss of species and decline in individual health from stress associated with habitat degradation (i.e., sedimentation). As with fish species, these impacts are anticipated to occur directly from factors associated with existing poor environmental management practices in the regional goldfield operations.

2.2.2.3 Summary of Impacts to Aquatic Ecology

1. Natural (climate change) and anthropogenic impacts during the last 20 years have resulted in considerable changes in the fish fauna of most waters (both rivers and lakes) of the Mongolian part of the Selenge River drainage. The Tuul River is with no doubt the most impacted river within the drainage, affected by urban waste discharges, sedimentation from mining, and extensive erosion caused by overgrazing in the watershed.
2. In the rivers with mining impact, the layer of deposited sediment may be as much as 70 cm thick. This makes the rivers unsuitable for spawning of lithophilic fish species, including important species such as taimen, lenok, and grayling.
3. The fish fauna of the Tuul River currently consists of at least 17 species of fish. The fish community has changed significantly over the last 15 to 20 years. The dominant and subdominant species have

all changed and the species assemblage is no longer typical of a piedmont steppe stream.

4. Sampling in the Tuul River in the vicinity of the Project area in July 2008 yielded ten species of fish, all of which are well-adapted to high concentrations of suspended sediments in the water. Siberian dace were most abundant in the baseline study collections and Prussian carp, Amur carp, ide, roach, Amur catfish, and yellow perch were common.
5. According to IUCN Red List criteria, the only “Critically Endangered” fish species that might occur in the Project area, or downstream of it, is the Siberian sturgeon. The downstream-most section of the Tuul River used to be part of the Siberian sturgeon’s range, but the species is no longer found there because of historical and contemporaneous pollution. It is unlikely that the species ever occurred in the Project area due to the lack of deep pools required for overwintering.
6. The IUCN Red List assigns Siberian taimen a status of “Endangered”. This species does not occur anywhere near the Project area. Taimen have not been found on the Tuul River downstream of Ulaanbaatar for many years.
7. Of the ten fish species which were found in the Project area of the Tuul River, three are non-native (Prussian carp, Amur carp, and Amur catfish). All of these fish are common species that have high resistance to increased sediment loading from mining or other impacting activities. The Selenge River, with 29 percent non-native species (7 of 24) is one of the more important invasion corridors for non-native fish in central Asia.
8. The macroinvertebrate community in the Project area has been impacted by sediment deposition from past mining activities and erosion from overgrazing. Areas of cobble/gravel, however, remain in higher current areas, and these areas support a relatively diverse macroinvertebrate community.
9. A high value limnetic ecosystem has developed within the pit lake, which formed when a former mining pit filled with groundwater. The water in this lake is clear and of good quality. Extensive beds of submerged aquatic vegetation have developed within the lake, which, in turn, support a relatively diverse macroinvertebrate community. The lake also contains two fish species, Amur catfish and yellow perch. Numerous tadpoles of the Mongolian toad were observed

along the shoreline of the lake. Islands within the lake are used as nesting sites by gulls and terns. Artificial water bodies within a dry steppe landscape can form areas of high biodiversity. This type of ecosystem will be created as part of the reclamation program for the Project. The ecosystem within these artificial water lakes can be enhanced by stocking of suitable fish species from nearby lakes and rivers.

2.2.3 Threatened and Endangered Species

A total of approximately 39 T&E species potentially could occur in the Project area based on habitat requirements and distributions. This includes both faunal and floral species.

Potential sources of direct, indirect, and cumulative impacts to sensitive species of flora and fauna may include:

1. Loss of Habitat (Direct loss);
 - a. Habitat conversion;
 - b. Encroachment;
2. Disturbance from noise and general activity;
3. Hunting, illegal capture or collection;
4. Direct predation or competition by exotic or invasive species; and
5. Pollution.

2.2.3.1 Flora

A total of 12 T&E Red Book plant species are listed that “potentially could occur in the Project area,” with approximately one-half of these associated with wetland or riparian habitat typical of the Tuul River and tributaries. Thus impacts to floral species are expected to be potentially most significant in these areas. Expected impacts include loss of steppe and wetland habitat, habitat degradation, loss of species and reduction in population size of some species. Causal factors of potential impacts are expected to be both direct (tails/overburden deposition and sediment pond construction) and indirect (settlement activities such as wood cutting of willow thickets and wild collection of showy species (**Section 4.3.2**) by residents in the Zaamar Goldfield.

2.2.3.2 Fauna

Approximately 25 T&E Red Book faunal species potentially could occur in the Project area based on their habitat requirements and distribution. These include two mammal, twelve bird, nine invertebrate and two fish species.

Mammals

The two mammals species that may occur in the Project area, the Daurian hedgehog (*Erinaceus dauricus*) and the Elk (*Alces alces pfizenmayeri*), are both species that are associated with moist/wetland willow thickets. Both of these species are considered “Low Risk – Near Threatened” (IUCN, 2001; 2007).

If these mammals are found to occur in the Project area, impacts would be associated with the habitat along the Tuul River and associated tributaries. Potential impacts would include some habitat loss/degradation (from tails/overburden stock piling, sediment pond construction and dredging), decline in individual health (stress from general increased noise levels and human activity associated with goldfield and settlement activities), and potential eventual loss of either species from the Project area. Currently, noise and human activity has kept these species away from the Project Area.

Birds

A total of 12 T&E Red Book bird species may potentially occur in the Project area across seven diverse major groups (falcons/hawks/eagles, geese, storks/cranes, pipits, bustards, penduline tits and sandpipers). All of the potentially occurring T&E species are strongly associated with wetland/riparian habitat for feeding and breeding; and, approximately one-half of these birds are resident year-round in the Selenge River Basin. The remainders are migrant species present only in the summer months. Owing to the variation in migratory versus resident status, impacts to these potentially occurring species is expected to show significant variation. Eight of these species are considered rare, two very rare, and two rare/very rare with globally threatened status (**Part III**).

Potential negative impacts to these T&E bird species are similar to those listed for all birds, including habitat disturbance/destruction, decline in populations of species and decline in individual health. Causal factors for these impacts are considered to include tails/overburden deposition, sediment pond construction, dredging, settlement construction/activities and general noise disturbance.

The Project will create additional wetland and aquatic habitat from dredge ponds and Project reclamation activities along the Tuul River floodplain. The increase in habitat is expected to have a positive impact on some T&E bird species.

Reptiles and Amphibians

The rare Siberian salamander (*Salamandrella keyserlingii*) and the Japanese tree frog (*Hyla japonica*) are both species that occur in wetland/riparian habitat associated with willow thickets in the region. Impacts to these potentially present

species are thus expected to be associated with direct and indirect factors from activities along the Tuul River and tributaries. Potential impacts expected include habitat loss, decline in species populations and loss of species. Causal factors could include tailings/overburden deposition, sediment pond construction, dredging, and settlement construction/activities.

The Project will create additional wetland and aquatic habitat, including willows, from dredge ponds along the Tuul River floodplain. The increase in habitat may have a positive impact on these rare species.

Invertebrates

The number of invertebrate species in the region is unknown, but expected to be very large. Some rare species potentially occurring in the Zaamar Goldfield are associated with the upland steppe grassland, including the largest group in this category, five butterfly and moth species. A T&E invertebrate species, the musk beetle (*Aromia moschata orientalis*), potentially occurs in willow thickets and, another, the river mussel (*Anodonta sedakovi*) is associated with the immediate area of the Tuul River and drainages. Overall potential impacts to T&E invertebrate species could thus occur in both steppe grassland and wetland/riparian/aquatic habitats. Potential impacts that could occur include some habitat loss, decline in species populations and potential loss of species if severe. Causal factors could include tails/overburden deposition, sediment pond construction, dredging and settlement construction/activities.

Fish

Seven red listed species are thought to be present or have historically been present in the greater Selenge River Basin. The very rare Siberian Sturgeon (*Acipenser baeri baicalensis*) and the Taimen (*Hucho taimen*), a rare salmonid currently do not occur locally in this region of the Tuul River.

2.2.4 Environmentally Sensitive Areas

Impacts to environmentally sensitive areas (see **Part III**), relate to the degradation of three major natural zones in the Project area, including upland steppe grasslands, forest patches and the Tuul River and floodplain.

Disturbed areas experiencing chronic erosion, such as road shoulders, tails/overburden stockpiles, riverbanks and disturbed slope areas, are also considered environmentally sensitive in that they are difficult to reclaim.

2.3 Human Environment

As the Project commences construction in late 2008 and moves towards production in 2009, there will be increased socioeconomic impacts. Evaluation of the impacts associated with the Project must consider the current social and economic environment of the local area. The Project-related impacts, both temporary and permanent, must also be related to changes in the overall economic picture of the area, including continued mining exploration, potential expansion, and development. Cumulative impacts of other neighboring projects (for instance, environmental impacts, employment issues, legacy and reputational risks) have an impact on the Big Bend Placer Gold Mining Project. These cumulative impacts may compound or offset one another, and may vary through different phases of development. Future changes in employment and phasing of other projects may result in changes to the impacts presented.

The impacts of current activities (drilling, operating an exploration camp) are limited in scope and scale, and relate largely to direct impacts on a limited number of families. However, the Project area is in the middle of approximately 13 other active mining projects in operation along the Tuul River Valley. As such, many impacts of the Project are likely inseparable from the impacts of other mining operations.

The socioeconomic impacts discussed here focus mainly on grazing, because all of the households close to the Project area are engaged in herding for their livelihoods.

2.3.1 Positive Potential Social Impacts

Potential social benefits from the Project include, but are not limited to:

- employment opportunities;
- purchase and/or utilization of Mongolian supplies and services;
- increased tax base;
- land improvements; and,
- social program and budgetary contributions.

The short-term benefits of the Project will generally be economic. Project operations will require both skilled and unskilled labor, supplies, equipment, and support services. The economic benefit from these expenditures and associated taxes will magnify as funds are dispersed locally and nationally.

In the long term, the Project will improve the land for grazing and wildlife uses. The Project area will be reclaimed with successful vegetation and improved livestock and wildlife watering areas and habitat.

2.3.1.1 Employment Opportunities

The additional gold production and employment generated from the Project will generate additional income to the mineral extracting industry and government within Mongolia. Approximately 65 individuals will be employed during the Project. About 50 employees will be directly involved in the mining operations, and another 15 employees are anticipated for mining support functions (e.g., procurement officers, cooks, etc.). A total of 24 to 28 workers will be required to perform the cutter suction dredge mining operations, operating in two shifts per day (two 12-hour shifts of 12 to 14 people). These workers will be trained by supervisory staff with the necessary skills to perform their job duties. The workers will live at the mine camp during Project operations, typically from April through November, depending on the climate. Employees will be transported to and from the Project area between rotations.

The Project will employ local and national Mongolian workers to operate the dredges. Through supervisory training, these workers will acquire technical skills that will be applicable at other mines when mining operations at this Project are complete. This improves the skilled labor available in Mongolia.

Salaried workers will be paid on a monthly basis throughout the year. Estimated employment and labor costs are provided in **Table IV-3**.

2.3.1.2 Supplies, Equipment and Services

The Project will require supplies, diesel fuel, and other materials that will come primarily from urban areas within proximity of the Project area. Additionally, WMMC is committed to procuring local meat and dairy products.

2.3.1.3 Increased Tax Base

The improvement of the local and national tax base will benefit other local and national jobs, businesses, and infrastructure. WMMC estimates 61 million USD in capital expenditures over the ten-year life of the Project. These expenditures include labor, equipment leasing, fuel, and maintenance as well as general and administrative expenses. The planned capital expenditures are shown in **Table IV-4**.

Table IV-3 Estimated Employment and Labor Costs

Positions	Number of Individuals	Monthly Income (USD)	Annual Income (USD)
OPERATIONS			
Supervision	6	58,000	696,000
General Manager	1	15,000	180,000
Operations Advisor	1	10,000	120,000
Maintenance Advisor	1	10,000	120,000
Electrical – Mechanical Advisor	1	3,000	36,000
Dredge Master	2	20,000	240,000
Mongolian Operating Personnel	28	25,600	307,200
Operations Manager	1	5,000	60,000
On-Site Project Manager	1	2,000	24,000
Engineer	1	1,700	20,400
Electrician	1	1,700	20,400
Dredge Master	2	3,000	36,000
Dredge Process Operators	12	6,000	72,000
Maintenance	4	3,200	38,400
Dozer Operators	2	1,000	12,000
Backhoe/Front End Loader Operators	2	1,000	12,000
Excavator Operators	2	1,000	12,000
Income/Social Taxes		25,080	300,960
Total Labor Operations	34	108,680	1,304,160
ADMINISTRATIVE			
General Director	1	50,000	600,000
Office Manager	1	700	8,400
Accountant	1	700	8,400
Assistant Accountant	1	500	6,000
Secretary	1	300	3,600
Field Warehouse Manager	1	300	3,600
Supply Coordinator	1	300	3,600
Drivers	4	2,000	24,000
Income/Social Taxes		1,440	17,280
Total Labor Administrative	12	56,240	674,880

Table IV-4 WMMC Planned Expenditures

Category	Annual Capital Expenditures (million USD)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Labor	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	13.00
Equipment Leasing	0.75	0.75	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0	2.20
Fuel	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	36.00
Maintenance	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.00
General and Administrative	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	6.70
Total	6.63	6.63	5.98	5.88	60.90						

Taxes are additional to these planned capital expenditures. The taxes applicable to the Project include corporate income taxes, social taxes/personal income taxes, and royalties on production sales; these annual taxes are estimated as 3 million USD. Other taxes may include windfall profit taxes, value added taxes, excise taxes, and local taxes (for resource use, water use, and land use). The expected annual gold production is approximately 16,200 ounces on average.

2.3.1.4 Land Improvements

Following reclamation, the land will be improved for wildlife purposes. Disturbed areas will be contoured to match the existing landscape, and successfully revegetated through the replacement of topsoil and selection of appropriate plant species. This beneficiation also extends to creating wetlands, marshlands and un-grazed rangelands to promote biodiversity, which in turn benefits grazing areas in the long-term.

2.3.1.5 Social Program and Budgetary Contributions

The Project currently has a voluntary social program in place in addition to the mandatory direct budgetary contributions made to the soums for resource use (especially land use). These two contributions will have a positive impact on the Zaamar Soum and Buregkhangai Soum.

Direct Budgetary Contributions

The Project makes direct budgetary contributions to the two soums in the Project area (Zaamar and Buregkhangai). These payments are negotiated in advance for the use of land, in accordance with the law. These funds are transferred into the soum budgets and spent by the soum governors as they see fit. This should enable the soums to better manage their budgets and to deal with the social issues created by mining in their regions.

Voluntary Social Contribution

The social program of the Project presently focuses on the Buregkhangai Soum. This program focuses on providing hospital supplies to the hospital in the soum center, a positive contribution to the local community.

2.3.2 Negative Potential Social Impacts

Potential adverse social impacts from the Project include:

- decreased grazing area;
- relocation of herders;
- short-term increased land disturbance; and
- short-term increased risk to human health and safety.

2.3.2.1 Grazing

From 1998 onwards, the Tuul River Valley has experienced increased pressure on grazing areas. This is due to historically low levels of rainfall compounded by historically high grazing numbers and subsequent pressure on pasturelands. These have been compounded by the growth of mining in the area during the same time – putting more pressure on grazing areas and shifting some herders into the Project area that had not previously grazed there (further discussed below). The scale of this impact cannot be underestimated, with a total of 135 mining and exploration licenses issued (covering 87,000 hectares) in the Zaamar Soum alone. Locally perceived impacts of mining from the underlying problems of overgrazing and drought are difficult to disaggregate.

The Project will have an impact on grazing. As much as 3,170 hectares (equivalent to the Project area) will be excluded from grazing pastures. WMMC will install a gate at the Project area's point of access/egress and may fence the mine camp for health and safety reasons. On-site security will ensure that reclamation areas are not disturbed in order for successful revegetation. Reclamation activities will be performed contemporaneously with operational activities. In order to compensate for this impact, WMMC paid the soum governments for the land-use right of the Project area. In the long term, the reclaimed areas will benefit wildlife with its successful revegetation in a region experiencing much overgrazing.

Relocation of Herders

Surface management of leased mining areas often involves the displacement of seasonal ger occupants who historically may have occupied locations directly or indirectly in the mining area. The traditional ger lifestyle in Mongolia is one which is mobile and seeks out resources – especially grazing and water resources for livestock. Seasonal ger units associated with the Project area normally move from overwintering locations in mountain valleys in the north to summer grazing in the Project area. A total of five local seasonal ger dwelling individuals comprised of four family units have been identified in the Project area.

Five ger units are situated in the Project area. The land-use fee allows for direct management and relocation of seasonal occupants, and a resettlement action plan (RAP) is needed to make a smooth transition for the displaced seasonal herders that will result in a better situation than they currently maintain.

The economic pressures in the past ten years have led to increased grazing pressure on the Tuul River Valley. There has evolved an interdigitation of ger units and mining activities along both banks of the Tuul River Valley. Some ger units have year-round occupancy, but most are seasonal. All five ger units of the Project area are seasonal. Sheep and goats graze over the entire mining area, including areas where natural revegetation is occurring. The impact of this process is that larger grazing numbers are leading to unsustainable land use practices – and the Project wishes for one of its lasting impacts on the environment to be a re-introduction of sustainable land use practices within the Project area.

Two principal herds of sheep and goats, along with a few horses and yaks graze the area. The total number of sheep and goats currently grazing the Project area has grown only recently (the last four years) to nearly 2,000 animal units. This level of livestock grazing has significantly impacted the area over the past four years. In 2003, the level of grazing was much less, involving only a few horses and yaks.

Because sheep and goats eat more aggressively and impact root structures of some plants, it is the intention of the Project to reduce grazing impacts by reducing grazing pressure. Ultimately, the Project's goal is to preserve local biodiversity by implementing sustainable land-use practices and reclaiming the Project area as a wildlife sanctuary and refuge. However, the current land use is incompatible with this goal, so grazing pressure must be reduced significantly.

No grazing will be allowed within the Project area. The Project area will exclude livestock grazing from the Project area primarily with on-site security personnel. The Project facilities will be fenced for health and safety purposes.

Interviews have been held with each of the ger units. It has been determined that these individuals have occupied the general area in the summertime months and that they have de facto claims to compensation. The voluntary relocation of the local ger herding units will be accomplished through negotiated cash settlement and with care to locate more suitable steppe habitat nearer to their original winter residences.

Where economic displacement will occur, and to fit in with overall company plan to establish a wildlife sanctuary and refuge, compensation will be negotiated directly with herder households. In July 2008, meetings with each ger unit were held and the general project and project timeline explained. There was concern

expressed by the families that mining would have an impact on their preferred location for seasonal ger use. It was reported that some of the older children have been employed by local mining companies and had moved away. One of the ger units was supplying meat to their extended family (and occasionally to the Big Bend Project), but there was no organized plan for marketing of meat, milk, wool, cashmere, or live animals. Total annual income from grazing of 900 sheep and goats was estimated by WMMC at approximately 1,000 USD. Resettlement will involve the negotiation of cash settlements and relocation assistance for the five ger units who were located in the Project area in 2008.

2.3.2.2 Land Disturbance

Natural resources of the Project area (soil, vegetation, hydrology, wildlife, and wildlife habitat) will be temporarily disturbed during the Project. These resources will be reclaimed to support wildlife use. The Project will perform reclamation activities contemporaneously with operation activities to minimize land disturbance and expedite the reclamation process.

2.3.2.3 Health and Safety

Potential impacts may occur from accidents during construction and operation activities. Accidents and emergencies are inevitable consequences of human error and unpredictable / uncontrollable natural events even where there is an awareness of their occurrence and where response procedures are in place. Given the remoteness of the Project area and the general lack of industrial accident and emergency awareness in Mongolia, the consequences of such events could be more acute.

Other potential impacts relate to the effects of oil spillage on terrestrial and aquatic biota and potential losses to herders from drowning of animals in ponds.

2.4 Environment Quality

2.4.1 Air Quality

Potential air quality impacts from the Project include direct emissions from stationary and mobile sources, as well as, fugitive dust generated from mining operations (excavators, road travel, reclamation, etc.).

Air pollution results from point (permanent stationary discharges, stacks, exhausts) and non-point or fugitive sources (wind erosion, vehicle movement on roadways, etc.). Air pollutants can be further classified by chemical composition

(SO₂, NO_x, CO, etc.) or physical attributes (particulates, gaseous, etc.). The air quality impact assessment is divided into an evaluation of fugitive and point-source emissions that may potentially result from placer mining operations.

2.4.1.1 Fugitive Emissions

A potential source of impact to air quality will be due to increases in the emissions of fugitive dust (particulates) as a result of mining activities, which can result from the following:

- Stripping of overburden by excavators;
- Wind erosion from overburden and tailings piles, roads, camps, and soils exposed during construction /restoration/ reclamation activities; and,
- Vehicle traffic.

The amount of fugitive particulate emissions generated from the proposed mining operations has not been quantified, but is estimated to be small compared to background levels. Most of the fugitive dust will be generated from excavator operations; and, from overburden mounds prior to reclamation, particularly during windy days (especially in the spring). For cutter suction dredges operating in the Project area, no significant dust will be generated due to wet mining methods. Placer mining will proceed by blocks, with concurrent reclamation, so that only a small portion of overburden and tailings will be disturbed and exposed to wind erosion at any one time. In addition, the actual placer operations are wet operations, which reduce fugitive dust in the process. Some fugitive dust could be associated with overburden stripping above the water table.

Potential impacts from fugitive dust generated from these sites include a reduction in air quality for human and wildlife health immediately downwind of the site. The health significance of fugitive dust to people and wildlife depends on many factors including wind direction, proximity to the source, concentration of particulates, size of particulates, frequency and duration of exposure, etc. Some disturbed areas that are particularly vulnerable to wind erosion may serve as chronic sources of fugitive dust, and, if left unclaimed, could result in some level of desertification. These potential impacts generated by the Project will be temporary and reversible; and, are judged to be relatively small in magnitude.

Fugitive particulate emissions from travel over roads will potentially be distributed over the entire length of the roads and should be dispersed effectively and rapidly by the local wind conditions. Because of these dispersion factors, low traffic volume, and other parameters, impacts to wildlife, vegetation, human health and quality of life are judged to be negligible.

2.4.1.2 Point-Source Emissions

The potential sources of point-source emissions from the Project operations that could impact local air quality are the following mobile and fixed sources:

- Diesel-operated equipment, including cutter dredges, floating process plant, excavators, bulldozers and transport vehicles;
- Coal-fired boilers for heating; and
- Diesel generators, used as a source of back-up power.

These sources generate SO₂, NO_x, CO, hydrocarbons and particulates that can potentially degrade local air quality for humans, wildlife, and vegetation. Potential impacts depend on the gas concentrations, duration and frequency of exposure, among other factors.

Air quality emissions of SO₂, NO_x, CO, and particulates from all of the diesel engines that will be used in the development were calculated and presented in **Table IV-1**. Potential air quality impacts from these sources are not significant due to the generally excellent dispersion characteristics of the region, low human population, lack of other significant emission sources in the Project area, and the small amount of emissions generated.

To quantitatively evaluate potential air quality impacts from point-sources in the Project region, the US EPA Screen 3 air quality modeling was conducted for one cutter suction dredge (1,200 to 1,500 horsepower [hp]), which will consume 4,000 liters (1,057 gallons) of diesel each day (20 hours of operation per day), making it the largest single emission source in the field. Four parameters (CO, NO₂, PM and SO_x) were examined. The entire cutter suction dredge was modeled as a single “Point Source” with “Elevated Terrain” (increased elevation with further distance) and “Full Meteorology” (all wind speed and valid stability class combinations). Among all available choices in the Screen 3 model, these conditions are considered to be more conservative.

Emission factors were based on US EPA’s Compilation of Air Pollutant Emission Factors (AP-42 5th Edition Vol. 1, Chapter 3.4; SCC 2-02-004-01). The calculated emissions of the four parameters are listed in **Table IV-5**.

Table IV-5 Emissions from the Cutter Suction Dredge

Parameter	Emission factors (pounds per MMBtu)	MMBtu Generated Per Day*	Emission (pounds per day)	Emission (g/sec)
CO	0.85	144.84	123.11	0.7756
NO ₂ **	2.4	144.84	347.62	2.1899
PM	0.1	144.84	14.48	0.0912
SOx***	0.0505	144.84	7.31	0.0461

* 1,057 gallons of diesel will produce 144.84 MMBtu (based on 137,030 Btu/gallon formula)

** NO₂ was calculated based on the ARM of NO₂/NOx=0.75 suggested by US EPA

*** Standard Diesel contains 500 ppm of sulfur (thus S1=0.05 and 1.01 * S1=0.0505)

Table IV-6 shows the summary of the modeling results at 100 meters, 500 meters, 1,000 meters, and 5,000 meters from the source. Mongolian and WHO recommended air quality standards (daily maximum) were also listed for reference. Because the results from this Screen 3 modeling are 1-hour maximum concentrations, a conversion was conducted in order to compare modeling results with Mongolian (permissible) and IFC standards, both of which are daily mean values. As listed in Screen 3 documentation, a multiplying factor of 0.4 should be used when converting 1-hour maximum concentrations to 24-hour maximum concentrations (US EPA Screen 3 Documentation- Appendix D).

Table IV-6 Screen 3 Modeling Results (24-Hour Maximum) of Cutter Suction Dredge

Parameter	100 m	500m	1,000 m	5,000 m	Mongolian Air Emission Standard	WHO Guideline
CO	38.82	16.16	9.47	8.60	8,000	
NO ₂	109.60	45.60	31.50	26.74	40	80
PM	4.56	1.90	1.11	1.01	150	25 (PM _{2.5}) 50 (PM ₁₀)
SOx	2.30	0.96	0.55	0.51	30	20

*All concentrations are in µg/m³

The data presented in the tables above shows that the highest concentrations of the parameters (occurring at about 100 meters from the source) are below both Mongolian and WHO standards, with the exception of nitrogen dioxide (Nitrogen dioxide exceeds both the Mongolian and WHO standards at a distance of 100 m, and exceeds the Mongolian standard at 500 m). Furthermore, it should be pointed out that the cutter suction dredge was considered as a single “point-source”; while in reality, emissions may come from more than one point on the dredge, which makes the initial dispersion much more efficient than the model predicts, and thus the maximum concentrations should be lower than the model predicted. When operating two dredges at different locations (which will be separated by more than 100 meters), these sources shall be considered as individual sources.

2.4.2 Surface Water and Groundwater Quality

2.4.2.1 Potential Sources of Impact to Surface Water

The main sources of impacts to the surface water system of the surrounding watershed include the following:

- Surface runoff from disturbed areas such as overburden, tailings, pits, roads and camps;
- Sediment ponds;
- Sewage treatment and disposal; and,
- Potential spills of fuel and lubricants.

Water quality impacts related to catastrophic structural failure of mining facilities such as sediment / dredge ponds could have more significant surface water impacts.

The components of the proposed Project that are considered to have potential impacts on the groundwater quality include those listed above for surface water. This is a result of the strong hydraulic connection between the surface drainage and the Tuul River alluvial aquifer.

2.4.2.2 Surface Runoff from Disturbed Areas

The potential for erosion and surface water sedimentation from surface disturbances will vary, depending on the spatial extent of disturbed areas, drainage, and rainfall/snowmelt intensity.

Meteorological characteristics of the Zaamar Goldfield are such that runoff intensity (and therefore erosion potential) is highest in the spring during snowmelt; and, in the summer during intense rainfall events. The topography and fine soil textures of the area do make it susceptible to soil loss and gully formation. The potential for sediment transport into the Tuul River is high without mitigation. Soil loss, gully formation, and removal of vegetation increase infiltration characteristics through the soil column and, consequently, increase vulnerability of the underlying alluvial aquifer. Therefore, there is a possibility of some localized increases in turbidity and TSS levels in the alluvial aquifer.

Without proper mitigation and reclamation, effects of surface water runoff across barren, un-reclaimed overburden, tailings piles, and pits can be a significant, long-term potential source of sediment loading into the Tuul River and the alluvial aquifer. Camps and roads contribute to additional sediment loading in the Tuul

River during runoff events and could impact the groundwater. These sources of sediment are not as significant as the overburden and tailings piles.

2.4.2.3 Sediment Ponds

Improper maintenance of sediment ponds used in mining operations may result in a significant source of sediment in the Tuul River. Potential impact to groundwater from sediment ponds are rather significant as groundwater levels in the alluvial aquifer are relatively high, mostly ranging from one to six meters below land surface, so most sediment ponds are below groundwater. Active sediment ponds will need to be periodically cleaned of sediments; otherwise they fill up and water may overtop the pond and carry suspended sediments to the river.

Effluent will be directed to tailings ponds in which the coarse sand materials will fall out of suspension; and, the water will then be recycled back to the wash plant. The tailings pond will be adequately designed to minimize potential for pond failure and will have a properly designed emergency spillway.

A catastrophic failure of a dredge pond or sediment ponds could potentially cause significant, short-term impacts to surface water quality in the Tuul River.

2.4.2.4 Sewage Treatment and Disposal

Sewage generated at the Project area (mine camp and on-board dredges) will be collected and properly treated. A septic system will be established at the mine camp with enough capacity to treat all incoming wastes and used as the major treatment facility for domestic sewage. Sewerage from the dredges will either be collected and transported to the mine camp for treatment or routed through an on-board septic system. Discharge from any such treatment facilities will be monitored on a regular basis.

The Tuul River and the alluvial aquifer are hydraulically connected which was demonstrated during hydrogeologic investigations conducted by the Mongolian and Soviet specialists in the 1980s. Hence, there is a minimal potential that if wastewater is not managed correctly, that it could affect the groundwater quality and, consequently, the surface water quality. However, by employing a proper sewage waste treatment and disposal plan, discussed in **Part V**, potential impacts are considered to be very low.

Settling ponds and dredge ponds will be designed and constructed to ensure that there will be no uncontrolled discharge of any process water even during storm events. Waste management is further discussed in **Part V**.

2.4.2.5 Potential Spills of Fuels and Lubricants

Surface water and groundwater quality impacts from fuel and lubricant spills could occur as a result of an accident during transportation, storage, or use at the camps. A tanker truck accident during fuel transport from Ulaanbaatar to the Project area may result in surface water and groundwater contamination with diesel fuel depending on the location of spill and amount of fuel spilled. Failure of diesel storage tanks at the camps may also result in surface water and groundwater contamination, depending on the proximity of the storage areas to drainages and the Tuul River and percolation capacity of soil in the spill area. Minor fuel spills may occur during routine re-fueling of mine equipment and vehicles. Refueling of the cutter suction dredges within the dredge ponds may result in diesel fuel spillage directly in the ponds, which could contaminate the ponds and the alluvial aquifer with petroleum hydrocarbons.

No chemicals will be used to recover the gold; physical or gravitation methods will be used to sufficiently recover the gold. This reduces the potential impacts of chemical contamination within the Tuul River.

2.4.3 Aesthetics and Noise

The appearance of the current landscape in the Zaamar Goldfield within the Tuul River Valley is of extensive wet placer mining and dry mining activities. Large dredges, draglines, and other mining equipment are evident throughout the area; as well as overburden mounds from dragline activity, dredge ponds, and sculpted masses of dumped oversize (Neogene clay balls). Little or no sign of rehabilitation and lack of vegetation represent the visual scene.

Where mining has not occurred, the alluvial valley displays green pasture to the rivers edge. Undulating dry steppes are adjacent to the alluvial valley, generally with limited vegetation. In the distance, low mountains and hilly dry steppes are evident. In general, the area is stark and expansive in nature. The extreme climate in winter provides a hostile environment for people, plants, and animals.

The existing landscape will not be dramatically changed by the proposed mining activities. However, upon completion of mining, reclamation of the Project site may significantly improve the visual integrity of the mined area at Big Bend.

Noise impacts would not be considered significant to humans, due to the rural nature of the area and the sparse population.

2.4.4 Soil Chemistry

Topsoil will be stripped and stockpiled prior to removal of overburden. Since the topsoil will not be removed or disposed with the overburden, soil chemistry will be minimally impacted, although bio-degradation may occur when large piles of topsoil are stacked together. In addition, topsoil will be utilized in reclamation that will be conducted concurrently with mining operations. The impacts of topsoil removal, if any, will be short-term and reversible.

Some of the shallow placer gold deposits are present in the topsoil. In this case, processing of the placer will significantly change the chemistry of soil in that many of the nutrients (organic matter, K, P, N and other salts) will be washed away. This change is unavoidable and permanent. However, since most of the placer deposits in the Project area are at depths below the topsoil (greater than two meters), there will be insignificant chemical impacts to the topsoil in total. Since topsoil is the most critical portion for reclamation and revegetation of the mined areas, WMMC will utilize topsoil in reclamation, so impacts on soil chemistry will be minimized.

There are some existing areas in the Zaamar Goldfield where drainage patterns have been altered, forming playas where salt concentrations have increased due to natural evaporation of shallow standing water. These impacts are not anticipated in the Project area since modern mining techniques and continuous reclamation operations will be employed.

2.5 Archaeological, Historical, and Cultural Resources

A potential operational constraint is the likelihood of encountering archaeological features that require excavation and site resolution before the Project area may be mined. In certain circumstances, which are likely in the Zaamar region, this could result in development delay or in total exclusion from the area.

A risk of historic and archaeological feature damage may result from topsoil and overburden removal.

WMMC conducted an archeological field study of the Project area as part of this SEIA development. The Archaeological Report of this study is contained in **Attachment 2 of Appendix E**; a summary of this study is contained in **Part III**; and, mitigation measures related to the study findings are discussed in **Part V**.

3.0 Regional and Cumulative Impact Assessment

The analysis of cumulative, associated, and indirect impacts of the WMMC Big Bend Placer Mining Gold Project is a general requirement of OPIC when dealing with projects that may have direct or indirect linkages to other projects or activities within a region. Although a comprehensive detailed analysis of the entire Zaamar Goldfield is beyond the scope of this SEIA, an analysis of the relative contribution of the Project to the regional social and environmental situation was performed. This analysis was based upon social and environmental reviews of the proposed Project mining plans; field inspection of the Project area and surrounding region; remote sensing analysis; and, review of existing environmental information for the region. In order to understand the cumulative impacts from the proposed Project to the surrounding region, it is important to review the current environment in the region.

Large-scale development of placer gold mining in the Zaamar region of Mongolia began around 1990 (Dallas, 1999). Currently a total of 135 mining and exploration licenses have been issued (covering 87,000 hectares) in the Zaamar Soum. The Project covers approximately 3,170 hectares.

In the early 1960's, there were no significant mining activities occurring in the Zaamar region as shown by the air photo mosaic (see **Figure III.4-8, Section 4.2.5 of Part III**). An IKONOS satellite image of the Project area taken in July 2008 is presented in **Attachment 4 of Appendix E**. This image shows the current cumulative and regional environmental impact of mine operations on land surfaces in the region. A classification of the IKONOS image was performed to classify the different habitats, vegetation communities, and disturbed areas. A total of 930.7 hectares of mine-related disturbance (unreclaimed overburden and tailings piles, pits, roads and camps) was calculated based on the classification of the region as of July 2008 (see **Figure III.4-7, Section 4.2.5 of Part III**). The image shows that past mining activities not related to this Project have had a significant and cumulative impact on the environment in the Zaamar region of the Tuul River Valley.

Farrington (2000), Dallas (1999), and Jadamba and C. Doolonbayar (1998) have documented the environmental problems with some of the previous and current operations associated with placer mining in the Zaamar Goldfield which include:

- Destruction to riparian, riverine, aquatic and grassland habitats along the Tuul River by mine extraction activities;
- Introduction of large amounts of silt and sediment in the Tuul River from poorly operated wash plants and settling ponds;

- Sediment laden runoff from improperly designed open mine pits, mine roads, and unreclaimed or poorly reclaimed areas when mining is finished;
- High levels of airborne dust from open mine pits, roads, camps and overburden piles;
- Hydrocarbon spills;
- Sewage and solid waste disposal;
- Coal and woodsmoke emissions from mine camps; and
- Possible historical mercury use.

Most of these environmental problems relate to poor environmental management practices, inefficient gold recovery from old placer technologies, and lack of enforcement of existing environmental regulations.

WMMC intends to introduce modern, environmentally sensitive placer mining operations that utilize GIIP, as defined by IFC; and, modern international environmental management practices to minimize short-term impacts and reduce or eliminate long-term environmental impacts.

WMMC plans to demonstrate that placer mining can be a relatively clean industry by conducting it properly. The proposed mining operations will not use chemicals (i.e., mercury or cyanide) to process the ore, will not result in acid mine drainage, nor will have smelter emissions common to mining and processing of other metal deposits. WMMC intends to employ modern, placer mining methods in this Project with full concurrent reclamation of mined lands. WMMC will also reclaim historical mine disturbances to the extent practical on its mineral leases.

There are not anticipated to be any significant adverse cumulative effects of placer mining on surface water or groundwater resources due to the Project. Water for mine operations will be sourced from groundwater in the alluvial gravels or from the Tuul River. Water use will be recycled at an estimated 93- to 95-percent efficiency to minimize water withdrawn from groundwater or the Tuul River.

Wet mining operations to be conducted at the Project area will occur in dredge ponds physically isolated from, and protected from the Tuul River. Suspended sediments created in the dredge pond by mining operations will remain in the pond as a zero discharge, closed system, with no significant impact to surface water in the river.

With no river diversions and the establishment of buffer zones, no impact to the aquatic life in the Tuul River is anticipated.

Stripping of vegetation, topsoil and removal of overburden and processing of placer will result in changes in the local topography and landscape in the

floodplain and terraces that are mined in the Project area. Dredge ponds will be contoured with appropriate slopes and will be revegetated with willow cuttings to establish wetland vegetation. Wet placer mining will result in a net increase in aquatic and wetland habitats with a potential for positive net wildlife gain. The overburden piles will be recontoured to gentle rolling hills away from the riverbanks and will be reclaimed and revegetated with native grasses, as practical. This is in stark contrast to the existing dragline overburden mounds in the region that are excessively steep and high (up to 30 meters in height), and mostly barren.

There are no expected significant cumulative impacts related to camp waste from the Project. Wastewater treatment sludge will be tested regularly to determine whether it may be landfilled in its untreated state or whether it requires lime addition. Non-hazardous wastes will be recycled or disposed without pre-treatment. Solid waste will be disposed of in a mine camp landfill.

Project operations will result in an increase in dust from earth-moving equipment and road transport, but the cumulative effects will be minor due to implementation of a dust control program. Emissions of SO₂, NO_x, CO and particulates are not expected to be significant based on screening modeling results and airshed dispersion characteristics.

Placer mining activities in the Zaamar region have been occurring for many years now. The proposed Project is one of many placer operations in the area. An infrastructure has been developed in the nearby concessions to deal with the types and numbers of personnel, operations, impacts and emergencies associated with this type of development. The workforce for the Project will come primarily from Ulaanbaatar, and to a lesser extent from the towns of Darkhan, Erdenet and Bulgan, and possibly, Russia. There are not anticipated to be any relocation of any local residents associated with development of this Project.

The mine camp will be the largest permanent settlement within the region. There are no permanent settlements directly within the Project area; however, there remain a few artisanal miners in the region that primarily rework the tailings to extract fine gold left over from previous inefficient gold recovery. Historical placer mining operations in the Zaamar region were inefficient in using older, Russian dredges and mineral separation units such as sluice boxes, which failed to recover the fine gold fraction, often representing up to 40 percent of the gold reserve. As a result, the historical tailings still contain sizeable amounts of gold, which attract artisanal miners.

Indirect environmental impacts associated with the artisanal miners include improper location of gers, cutting riparian willows and mountain forests for fuel, lack of sanitation and potable water; and, water quality impacts to the Tuul River from washing the ore and human waste, etc.

Since WMMC will use modern methods to extract 95 percent of the gold from the placer, and perform concurrent reclamation while mining operations are ongoing, there will not be enough gold left over in tailings worth mining by the artisanal miners, or it will be buried by overburden and reclaimed. Historically disturbed areas will be reclaimed last. This will not significantly affect the artisanal miners livelihood as there are several other historically mined areas in the Zaamar region (i.e., Erel, Hailaast Valley, etc.) to accommodate their activities. Artisanal mining has been reduced and controlled by Mongolian authorities.

There are not anticipated to be any adverse socioeconomic or socio-cultural impacts. On the contrary, the benefits to the local community and Mongolia should be significant based upon increased employment and taxes. It is unknown what the economic multiplier effect will be for the Project, but secondary services and support should be significant based on the number of jobs created by the Project.

A conclusion of the regional and cumulative impact assessment is that the basic physical, chemical, biological and social impacts as a result of this Project are judged to be manageable and not significant. Cumulative contributions of air and water pollutants, waste, etc. are of such volumes and in such locations that their cumulative effects are judged to be not significant. Internationally accepted social and environmental management and reclamation practices will minimize any long-term impacts from the Project.

Part V: Mitigation Measures

The proposed preventive and mitigative measures for placer gold mining operations at Big Bend are presented in this chapter. A SEMMP has been developed to assure that any negative social and environmental impacts are minimized or mitigated during construction and operation of this Project; and, that the site can be reclaimed to stable conditions following final decommissioning and closure. Implementation of environmental protection measures will enhance the capability of the Project to operate in an environmentally sound manner. The preventative and mitigation measures will be incorporated into the final design, construction, and operation and closure of the Project.

WMMC is committed to conformance with IFC Performance Standards and relevant EHS Guidelines in the design, operation and eventual closure of the Big Bend Project. This includes the adoption of GIIP, as defined and evaluated in the IFC General EHS Guidelines and EHS guidelines for mining, for preventative and mitigative measures to be employed, as well as management practices. The proposed mitigation measures are subject to change during the life of the mine Project based on management requirements, regulatory requirements, and experience gained while implementing the various phases of the Project, which can result in improved performance of these measures.

Modern mining programs must consider mitigative measures during the earliest phases of mine planning, including access roads, project footprint, engineering alternatives, processing alternatives, and general project development scenarios. Mitigation is defined as steps taken to avoid or minimize negative environmental impacts. Mitigation can include: avoiding the impact by not taking a certain action; minimizing impacts by limiting the degree or magnitude of the action; rectifying the impact by repairing or restoring the affected environment; reducing the impact by protective steps required with the action; and compensating for the impact by replacing or providing substitute resources. It is the mitigation planning phase which is used to avoid, reduce and offset any negative impacts, however significant they may be, to acceptable levels for consideration by environmental and social experts. The mitigation planning for the Big Bend Placer Gold Mining Project has considered physical, chemical, biological, social, and regulatory aspects of the Project and the risks involved in each of these key areas. It has also considered certain environmental and social offsets which can be used to more than compensate for residual impacts that might occur.

Details regarding social and environmental management and mitigation are presented in the **SEMMP**.

WMMC will employ the prevention and mitigation measures listed below to address the potential impacts (discussed in **Part IV**) of each of the major

components of the surrounding environment and their protection at the Big Bend Project:

- Water Management – Mine process water will be recycled to conserve the water resource, thereby minimizing impacts to the Tuul River and groundwater hydrology. WMMC will work with the MNE to complete a water analysis program that defines the relationship between placer mining, local groundwater levels and the Tuul River. A water permitting procedure will be required to meet Mongolian regulations.
- Water Quality – There will be no mining in the Tuul River and thus no direct impacts to water quality and aquatic life from the mining operations. WMMC will engage modern sediment and erosion control techniques, and will isolate all mining activities from the river proper using sediment fencing and other advanced techniques.
- Land Disturbance – Land disturbance will be minimized by employing erosion and sediment control practices which minimize erosion and maintain a stable environment. Multiple track roads will be consolidated and modern road building standards employed in all areas. The main access road will be maintained to modern standards.
- Land Reclamation - Reclamation will be concurrently performed while mining is progressing to restore land productivity. It is the intent of WMMC to reclaim the entire mining area to a higher land-use, as an ecological reserve with the lowland dredge areas as wetland, marshland, and open water habitats. Upland areas, which constitute the majority of the Permit area, will mostly not be disturbed by mining. However, it is WMMC's intent to utilize modern rangeland management methods and greatly reduce grazing pressure to enhance the biodiversity and improve wildlife values, as these areas and the lowland areas where the dredges will operate are significantly overgrazed. WMMC is committed to continue payment of the land use fees to enable WMMC management of the entire Project area (instead of only the 15 percent of the Project area that may be disturbed from Project activities), although this is not necessary and is an added cost to the Project. This land use payment is one of the few revenues of the soums that may be utilized for soum administrative costs.
- Tuul River / Wetland / Pond Restoration – Wetland and aquatic habitat will be enhanced and increased through proper reclamation of dredge and sediment ponds. The Dutch dredging process that will be employed results in a normally distributed tailings deposit, with coarse materials on bottom and fines on top. The Dutch Cutter Suction Dredges pump the overburden to fill in the dredge pond behind the mining dredging and over the tailings from the

mining. Since no chemical are used in the gold recovery process, there is no change to the water quality due to dredging. The use of this dredging system facilitates the continuous reclamation following mining so only a small area will be actively involved in mining and unreclaimed at any one time.

- Groundwater Management – Ground water quality will be sampled to determine baseline prior to beginning mining in each area. Dredge pond water quality analysis will be made once a month and reported to the MNE. Post-mining groundwater sample points will be installed and monitored in each area after mining. Since there is no introduction of chemicals in the dredging and mineral recovery process, it is not expected that groundwater quality will be impacted. The disturbance and agitation of the sediments (silt and sand) should not result in any decrease in water quality of the groundwater as there will not be any change in the solubilization of soil ions as the equilibrium between ions in solution in the water and soil concentrations is not affected by this process. There is better contact, but the conditions affecting the dissolution rate and the equilibrium will not be changed.
- Waste Management – The amount of solid and liquid wastes generated from the Project will be minimized and the wastes will be disposed of in a manner that has minimal environmental impacts. A sanitary landfill and a controlled incinerator will be at the site. Hazardous wastes will be isolated and stored on-site, and incinerated or transported off-site to an approved treatment/disposal facility when accumulated volumes warrant their removal. MNE is currently defining hazardous waste handling procedures. WMMC will work with the MNE to establish a proper disposal site. Some potential exists for disposal of some qualified hazardous wastes in high temperature kilns, boilers, power plants, asphalt plants, and/or paving plants.
- Fuel/Chemical Storage – Proper design and management practices will be employed in the location, storage, containment and use of fuels and chemicals. Proper lining of the fuel storage depot area and berming, to 110 percent of the volume of all tankage, will be followed. Modern spill prevention, control, and countermeasures (SPCC) plan applies.
- Air Quality – Air emissions will be minimized to reduce impacts to human health, wildlife, vegetation, and general quality of life. Mobile sources will utilize modern engines which are checked and tuned on a regular basis. Fugitive dust will be monitored and a dust control protocol engaged to reduce particulate transport from roadways and disturbed areas.
- Socioeconomics – Socioeconomic benefits of the Project will be maximized and disruptions to traditional livelihoods (i.e., herding) will be minimized. It is anticipated that local herding will be

removed from the property to reduce existing overgrazing impacts, and that transparent, negotiated settlements with local herders will proceed immediately.

- Biodiversity Offset – Wetland and open water habitats will be created which will exceed the current area. In addition, with elimination of grazing, improved sediment controls, and reclamation of riparian areas, all of these activities will represent a significant biodiversity offset to the Project area. The value of wetland, riparian, and open water habitats in Mongolia is very high, and increases in these habitats are considered significant. In addition, the reduced grazing and increased protection of the undisturbed upland areas will enhance the biodiversity and the improvement of desirable rangeland species. This area will serve as a reserve of protected rangeland for reseeded of adjacent areas. WMMC intends to work with the local Soum Governors and Environmental Managers, and other mining companies to introduce modern rangeland management methods in this entire area, and to relocate grazing as needed.

1.0 Waste Minimization

Waste minimization means the reduction, to the extent practical, of the volume or relative toxicity of liquid or solid wastes that are generated and subsequently treated and require disposal. Waste minimization focuses on source reduction, recycling, and treatment to allow for beneficial reuse. Due to the difficulty and cost associated with transporting materials to the site, and potential cost of landfilling unwanted materials, site management will include standard waste minimization practices. Wherever possible, re-use of recoverable material in all operations should be considered. The waste generating potential of all materials to be employed at the site will be assessed prior to ordering or contracting. The evaluation will be directed at waste minimization and control of all hazardous materials that might be required. Oils, lubricants, paints, process chemicals, and other potentially hazardous waste-generating materials will be characterized and more environmentally acceptable alternatives sought where possible.

Re-use of process water at the Project area will be a major application of waste minimization. Because water supply is limited in the Project region and extraction of a large amount of water from the Tuul River could result in significant impacts to the river ecology, every effort will be made to conserve water and re-use process water. It is estimated that 95 percent of the water supply will come from previously used process water. Dredge ponds and settling ponds will be constructed with special engineering design to ensure suitable water quality will be achieved before process water is re-used.

This process does not generate significant volumes of waste water, as the dredging and mining recirculates water from the dredge pond. The process recycles the sediment to the dredge pond. This sediment is the only constituent of what might be considered waste water and is the natural soil, silt, sand and gravel from the dredge pond site. Other opportunities to achieve significant waste volume reduction, however, are limited because waste volumes are primarily a function of activity level and characteristics of the placer deposits to be mined. For example, the volume of overburden and tailings are primarily a function of the depth and the grade of the placer ore bodies. Also, the volume of wastewater is generally a function of the volume of the ore that needs to be processed.

Some opportunities exist for further waste minimization and efforts will be made to exploit them. These include: eliminating unnecessary crating and packaging materials prior to delivery to the site; segregating certain scrap materials from the waste stream for reuse in other aspects of the operation; using combustible materials as a supplemental local heating fuel; and using non-toxic organic wastes as a soil amendment to facilitate reclamation success or as a fertilizer.

2.0 Waste Treatment and Disposal Facilities

2.1 Liquid Wastes

Domestic Sewage

Sewage generated at the Project site (mine camp, and on-board dredges) will be collected and properly treated. A septic system will be established at the mine camp with enough capacity to treat all incoming wastes and used as the major treatment facility for domestic sewage. Periodic pumping of the septic tank may be required on a contract basis. Wastes will be disposed of in a local landfill or on non-edible agricultural pastureland in an MNE-approved manner. WMMC will consider alternatively installing a modern treatment system for biodegrading the human sewage to a sludge that may be used for fertilizer.

The following procedure identifies the information required and responsibility for management of domestic sewage during the development of the Big Bend:

- Document sewage situation at each site;
- Determine the need for other alternatives of treatment;
- Maintain the treatment facilities in good working order;
- Evaluate potential beneficial uses of secondary effluent and septage; and,
- Staff training.

Industrial Liquid Wastes

The most significant liquid in the development of the Big Bend placer deposits is the process water. This will initially be water taken from the Tuul River or from alluvial wells. That will be used to float the dredges; and, then to move overburden and tailings in a slurry stall to deposition areas where reclamation will take place. Under normal operating conditions, however, all process water will be recycled and no discharge to the surface water drainage is expected.

Settling ponds and dredge ponds will be designed and constructed to ensure that there will be no uncontrolled discharge of any process water even during storm events. Turbidity and pH of the process water will be monitored. Other parameters (salts and metals) will be analyzed regularly. Since no chemicals will be added to process water during the entire mining and ore processing procedure, water quality of the process water should not be much different from the source water (higher turbidity is an exception).

Process water in abandoned settling ponds and dredge ponds will be allowed to evaporate and percolate in place. In case discharge to surface water drainage is required, water quality samples will be taken and analyzed before releasing to ensure no impact to natural water quality will occur.

There will be minor amount of other industrial wastewaters from mining operations at Big Bend, which include wastewaters from machinery cleaning / washing at the maintenance shop, dredges and wash plant. These wastewaters will be collected and transported to the treatment facility at the mine camp for treatment and disposal. If required, oil/water separation will be performed to reclaim hydrocarbons which may be incinerated or disposed of in an approved land application area. Land farming of organic wastes at the site is not anticipated.

2.2 Solid Waste

Domestic Solid Wastes

Domestic solid waste management begins with on-site storage. Improperly stored refuse may attract insects and rodents, present a fire hazard, be an unattractive nuisance, produce odors and present a health hazard. Domestic solid wastes will be generated at the mine camp dredges and wash plant. The wastes included in this category are mostly trash from daily life, packaging refuse of glass, tin, aluminum, plastic, cardboard, and light papers, but also include organic wastes such as food scraps generated by the kitchen facilities, and other consumer wastes that are either incinerable or landfillable. A large proportion of typical domestic solid wastes (about 60 to 70 percent) will be combustible and could be disposed of by incineration, although the non-combustible fraction would need to be segregated and buried at landfill site either prior to or after incineration.

Recycling and reusing the refused materials will be a routine practice at all WMMC facilities. An on-site sanitary landfill will be constructed according to MNE requirements, and inspected regularly.

The general procedural requirements for management of domestic solid wastes include:

- Determine the quantity of wastes;
- Characterize the waste materials;
- Establish sanitary landfill disposal site;
- Utilize incineration with landfilling of incinerator residuals;
- Develop and install waste collection system;
- Encourage recycling; and
- Mandate use of waste receptacles by all employees.

Industrial Solid Wastes

Overburden and tailings are the most significant solid wastes generated from placer mining. Since no chemicals will be added in the placer mining operations and no any other chemical processes (such as oxidization) are expected to occur, the composition of the overburden and tailings are almost identical to their natural unmined counterparts. Concurrent reclamation of the overburden and tailings stockpiles will be conducted by WMMC to eliminate long-term impacts. Detailed description on erosion and sedimentation control was presented in the previous section.

Industrial wastes generated during the mining operations will include empty paint cans, scrap metals, trash and debris (packing materials), empty drums, used tires, drum rinsate, and retired equipment.

The management of industrial wastes includes minimization, recycling and source separation between non-hazardous solid wastes and hazardous chemical wastes. Scrap metal and packing materials will be collected and stored for recycling. A handling procedure for used drums and oil filters will be established to prevent spillage, loss or damage. All used containers, construction materials, and equipment will be returned to the suppliers, if possible. Other non-hazardous solid wastes will be separated and disposed of by incineration or landfill.

2.3 Hazardous Wastes

Hazardous wastes associated with the Project could include used equipment lubrication oils, automobile batteries, paints, solvents, caustic or acid cleaners, used oil filters, hydraulic fluids (coolant), and miscellaneous chemicals and solid wastes. Apart from waste oils, materials such as batteries, paints, solvents, antifreeze and hydraulic fluids should all be considered hazardous waste. One of

the key factors in effective waste management is comprehensive classification and identification of hazardous wastes so that appropriate waste management procedures can be followed. All containers with hazardous waste will be clearly marked and posted with warning signs. The procedure for correct use, handling and disposal of hazardous wastes will be established according to Mongolian regulations and World Bank/OPIC guidelines, and best international practices taking into consideration the remote location of the site.

A special bermed area with an impervious liner will be used for segregation of all hazardous wastes including oily debris, cleaning rags, waste oil and lubricants (recyclable), containers for paint, and other materials. Hazardous wastes will be characterized and stored in a designated area remote from surface water and groundwater, and human habitation.

There are no public or private hazardous waste disposal facilities in Mongolia. Hazardous materials will be disposed of by incineration as may be permissible under Mongolian Law on-site, or transported to a future site for permissible disposal. Some potential may exist for disposal of hazardous wastes in high temperature kilns, asphalt and/or paving plants, power plants, boilers, or other facilities as may be in alignment with international best practices and approved by Mongolian authorities.

MNE has not identified or approved any modern hazardous waste management sites in Mongolia. WMMC is currently consulting with the MNE and various other mining companies in Mongolia to establish a proactive hazardous waste management procedure which can be established to protect public health, workers and the environment. If required, an on-site hazardous waste bunker, lined and fenced, will be established, to hold all hazardous wastes until such time as long-term disposal options develop in Mongolia.

3.0 Sustainable Natural Resource Management

3.1 Air Quality

The sources of air emissions include:

- Fugitive dust from mine operations, topsoil stockpiles, overburden and tailings piles, roads and camps; and,
- Mobile and fixed sources with exhaust gases from diesel combustion to power certain mining equipment (e.g., cutter suction dredges, excavators, bulldozers, back-up generators, and vehicles).

There will be no process air emissions from the operations.

A fugitive dust control plan will be implemented during the life of the Project. Fugitive dust will be periodically monitored to ensure compliance with Mongolian and international standards.

Mitigative measures will include the following:

- Use of haul routes which minimize hauling distances.
- All mining equipment and vehicles will be kept in good mechanical order and will be tuned-up regularly to maximize efficiencies and minimize fuel consumption and exhaust emissions.
- Periodic application of water to the roads as necessary to reduce dust. The source of the water will be from groundwater or from pits.
- Reclamation and revegetation of overburden, tailings, pits, and other disturbed areas will be conducted as soon as mine activities in that area are finished, with appropriate grading and contouring of soil material, and potential application of water sprays as necessary to minimize the amount of disturbed land exposed to wind.

3.2 Water Quality

3.2.1 Surface Water and Groundwater

The largest sources of potential impacts to surface water and groundwater quality include:

- Surface runoff from disturbed areas such as overburden, tailings, pits, roads and camps;
- Sediment ponds;
- Sewage treatment and disposal; and,
- Potential spills of fuel and lubricants.

The Project will incorporate appropriate mitigation measures designed to prevent, or minimize alteration of surface water and groundwater hydrology, and degradation of water quality in the Tuul River and in the alluvial aquifer. These mitigation measures are addressed in detail in the following sections:

- Section 3.1.3, Reclamation and Revegetation;
- Section 3.1.4, Erosion and Sediment Control;
- Section 5.1.6, General Health Features; and,
- Section 6.1.3, Accident Prevention, Control and Countermeasures.

General Water Use

Management of the water supply in the Project area will be an important component in minimizing the probability that water used in placer mine activities will enter the Tuul River or groundwater or that the alluvial aquifer will be severely depleted.

Process water from alluvial mining will be sourced from the dredge ponds. Water supply for the dredge ponds will be from the copious groundwater in the floodplain alluvial deposits that will be dredged. Occasionally, additional water will be needed to maintain water levels in the dredge pond for operations, especially during the early phases of mining. This water will be pumped from groundwater wells installed in the alluvial aquifer, and/or from the Tuul River. Two principal goals of mitigation are: (1) zero discharges of process water to the Tuul River and (2) water recycling. WMMC will obtain a water use permit for either surface or groundwater will be required.

Dredge ponds will be isolated from the Tuul River by an embankment that prevents mixing of these waters. Dredge and sediment ponds will be maintained as a zero-discharge, closed circuit system. No surface water discharges to the Tuul River from mine operations is anticipated.

Recycling of mine process water will be a key mitigation measure for Project operations. For dredging operations, wash water will be discharged directly back into the dredge pond for reuse by the dredges. The cutter suction dredge will pump overburden as a slurry from the dredge pond to the slurry settling areas. The dredge will pump placer slurry from the dredge pond to the floating wash plants that will separate out the gold by physical means only; and, then the tailings will be pumped as a slurry to the slurry settling areas initially and then later, the tailings will be pumped back to the dredge pond to cover the oversized fraction of tailings. Water from the slurry settling areas (containing some fine components of overburden and tailings) will be recycled back to the dredge pond.

Surface runoff from disturbed areas such as overburden, tailings, pits, roads and camps

The principal non-point source of potential impacts to water quality will be associated with sediment input into the aquatic ecosystem. Appropriate preventative and mitigation measures to control this potential impact are discussed in **Section 3.1.4**.

Good international industry practices, which will be used to control surface erosion and suspended solids in stormwater runoff, will include structural (e.g., sediment ponds) and non-structural (e.g., maintenance and management measures) approaches. These practices will be employed wherever soils are disturbed and construction activities occur.

Sediment ponds

Project site water management will be an important component of Project impact prevention and mitigation. Sediment pond design is discussed in detail in **Section 3.1.4**. The Tuul River (which is a low gradient stream) is the major hydraulic control in the Project area. Large rainfall events and snowmelt in the spring frequently cause water levels of the main streams to increase, and backwater conditions propagate upstream in adjacent tributaries. Therefore, adequately managing large volumes of water (rainfall and flooding), and mitigating any flooding and erosion issues on-site and downstream, are key site water management issues.

Potential spills of fuel and lubricants

The primary mechanism to mitigate potential impacts from accidental spills to the environment is prevention. Preventive measures are outlined in the Accident Prevention, Control, and Countermeasures (APCC) Plan in **Section 6.1.3**. In the event of unforeseen accidental spills, the protocol outlined in the Emergency Response Plan that relate to spills will be implemented. Appropriate SPCC equipment, materials and protocols will be available on-site.

3.3 Reclamation and Re-vegetation

3.3.1 General

Reclamation and revegetation is one of the most important parts of the general decommissioning and closure program (see the Reclamation and Closure Plan in the SEMMP). In general, the overall goals for reclamation and revegetation in the Project area are to provide both short- and long-term erosion control; ensure land-use compatibility with surrounding lands; and to leave the reclaimed areas at least as a self-supporting ecosystem. There will be potential enhancement of wildlife habitat in constructed wetland system that will be integrated with the greater Tuul River Valley as a result of reclamation of former dredge/sediment ponds and spoils stockpile areas. The goal is to return the mining area to a higher level of environmental integrity, as an ecological preserve with enhanced riparian, wetland, and open water values. Increases in wetland, riparian, and open water habitats represent a significant biodiversity offset for the Project. Protection of the undisturbed upland areas from excessive grazing will enhance the biodiversity and wildlife values as well as the productivity of the rangeland.

Direct activities of the operations that will require reclamation include mining sites and overburden/tails stockpile areas; indirect activities include settlement/contractor services, waste dumps and willow thickets.

In spite of the many complex direct and indirect impacts that will require a reclamation/re-vegetation program, mining activities also present a high potential for habitat enhancement of the Tuul River floodplain system for both wildlife and vegetation through the creation of a wetland system in former dredged areas. The areas of wetland, riparian, and open water habitats will increase biodiversity of the area, and represent a significant biodiversity offset. Elimination and management of grazing also supports the biodiversity offset by increasing vegetation species, and viable terrestrial habitats of the entire Project area. It will be necessary to greatly reduce or eliminate grazing to restore the reclaimed areas and the adjacent areas that are now seriously overgrazed.

3.3.2 Reclamation Planning Strategy

In the pre-planning overview for an entire reclamation project, Jensen and Platts (1989) recommend the following management considerations:

- Planning in identifying preliminary goals and the general approach;
- Assessment of the baseline conditions;
- Assessment of feasibility of accomplishing set reclamation goals;
- Development of a reclamation Health, Safety and Environment (HSE) checklist;
- Evaluation for assurance in compliance with engineering designs; and
- Monitoring program of variables important to goals and objectives.

WMMC plans to incorporate these planning activities into the company's reclamation program.

3.3.3 Reclamation Goals for Big Bend

Some limited artisanal, placer, and dry mining has occurred in the Project area in the past, unrelated to the proposed WMMC Big Bend Placer Gold Mining Project.

Placer mining at the Big Bend operations will result in an extensive system of dredge ponds and overburden stockpiles on the Tuul River floodplain. The enhancement and creation of wetlands, riparian, and open water habitats are considered a significant biodiversity offset, coupled with the reduced grazing pressure on the entire Project area.

Support to mining activities in the Project area includes roads, a mine camp, and waste disposal areas. All of these facilities and operational activities will require some reclamation measures. The most significant reclamation will involve the mining features, which will be modified to create an artificial wetland complex with a view to enhancing wildlife habitat and terrestrial/aquatic ecology in general. In addition, reclamation of the previous mining and exploration impacts within the Project will be implemented to the extent practical.

Reclamation will proceed concurrently with mining, similar to what is depicted in **Figure V-1**, which is a placer operation in northern Mongolia. **Figure V-2** presents a schematic generic drawing of the continuous reclamation process. WMMC will modify this process by using the double-dredge method instead of excavators to remove the overburden and placer; and, will slurry the overburden away from the immediate floodplain to a tailings deposition area, leaving more open water habitat.

Figure V-1 Placer Mining with Concurrent Reclamation



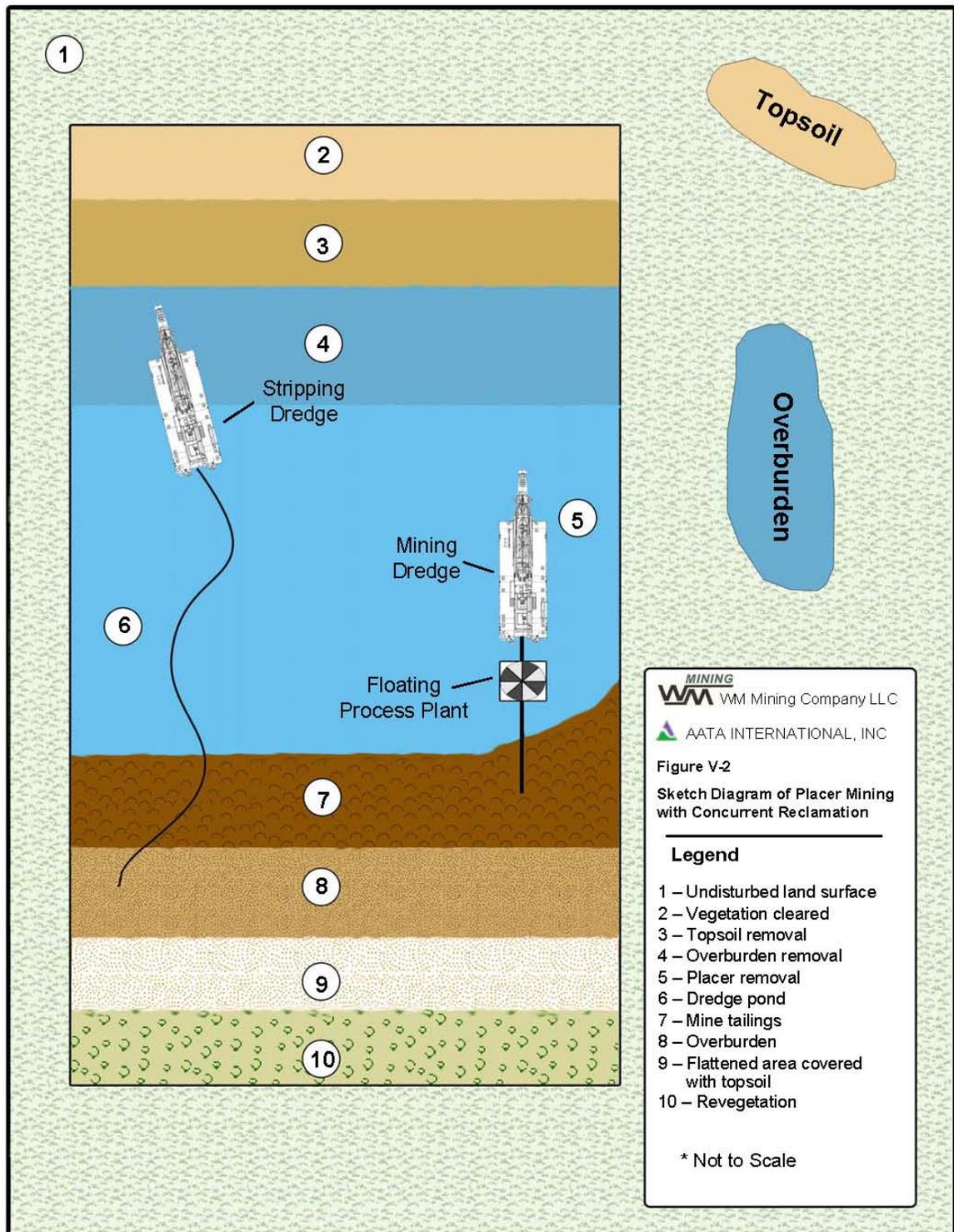
(Note: Reclamation proceeding from left to right following mining operations. Topsoil is stockpiled and spread over newly reclaimed areas with new vegetation evident on the far left of the photograph.)

Draglines will no longer be required, which, first, eliminates environmental problems associated with large overburden mounds created by draglines; and, secondly, solves the problem of draglines being unable to remove overburden that lies beneath the water table (dredges then have to remove the overburden below the water table, reducing productivity). Furthermore, instead of leaving a “reversed” tailings profile as with the Russian dredges currently in use in the Zaamar Goldfield area (i.e., fine grained tailings at the bottom and coarse grained tailings at the top), the double dredge system produces a more natural tailings profile (i.e., coarse grained fraction on the bottom and fine grained tailings on top), which makes reclamation and revegetation much easier and more effective. Topsoil will be stockpiled and used to reclaim these slurry spoil areas. The slurry spoil areas will be contoured to have gentle slopes and will be revegetated. The “double dredge” method proposed for this Project is operationally more efficient and flexible, and environmentally more sensitive than the “dragline with single dredge” method currently used in Mongolia.

Mining will proceed in a series of dredge blocks. When a dredge block is completed, the dredge pond will be contoured and reclaimed with willow cuttings and grasses, and left as open water habitat for wetland and aquatic wildlife gain. This represents valuable habitat similar to oxbow lakes, sloughs, and marshes.



Figure V-2 Sketch Diagram of Placer Mining with Concurrent Reclamation



3.3.4 Areas of Direct Impacts - Placer Mining

Extensive literature is available with respect to placer mining reclamation. In the past decade, reclamation of many placer mines in North America have shown a high success rate, including Indian River (Alberta, Canada) and Kennedy, Elk and Indian Creeks (Montana, USA), (INAC, 2002; MBMG, 1993). Reclamation design protocols will follow standard recognized practices adaptable to Big Bend site conditions as outlined in the Placer Mining Reclamation Handbook (Interfluve, 1990).

Riverine/riparian habitat (RRH) represents a dynamic system of interdependent aquatic (riverine) and wetland (riparian) resources which are especially valuable in terms of fish, wildlife, nutrient cycling, water quality and “flood storage” (Jensen and Platts, 1989). The creation of functional wetland habitats through enhancement of dredged areas in the Tuul River floodplain is a general reclamation goal of the Big Bend Project.

Reclamation Planning for Direct Impacts

Planning of the reclamation phase of the mine site areas in the Project area involves the restoration of dredge ponds and other disturbed areas. A key element of this reclamation program is that reclamation will be performed concurrently while mining progresses. This minimizes the areal extent of disturbance at any one time and spreads the cost of reclamation over the life of the producing mine.

Enhancing Wildlife Habitat

An opportunity exists to enhance wildlife habitat compared to pre-mining conditions on the Tuul River floodplain, by using the dredge ponds and contoured overburden stockpiles to this advantage to create a complex wetland mosaic. This will serve as a potential refuge for wildlife and as flood storage, enhancing the flood buffering capacity of the river.

In planning for restoration of the floodplain areas disturbed by mining activities, the following nine initiatives will be used in drafting the master reclamation plan:

- Pre-site assessment;
- Reestablishment of wetlands planning;
- Dirtwork planning;
- Bank stabilization considerations;
- Assessment for subsurface dams;
- Grading plans;
- Geotextile and sediment fencing installation and usage;

- Revegetation; and,
- Cost estimation.

Pre-Site Assessment and Inventory

The first phase of design of the reclamation plan is review of survey charts and maps of the Project area in the process of locating, characterizing and inventorying sites to be reclaimed, including dredge ponds and areas of erosion.

Reestablishment of Wetlands Planning

The reestablishment of wetlands, specifically restoration of willow thickets, is an important initiative both in supporting the re-creation of important wildlife habitat and as an important step in soil conservation. An inventory of cut willow thickets and eroded riverbanks will be conducted and considered for reclamation.

Dirtwork Planning

Dirtwork planning is the estimation of land area coverage of sites to be reclaimed, cut-and-fill volumes of fill which will be moved and heavy machine hours required to complete the reclamation job.

Bank Stabilization Considerations

Bank stabilization issues involve erosion control and establishment of riparian vegetation. A scope of work will be outlined for moderately disturbed bank sites, which have been impacted by non-point pollution and previous mining and exploration activities.

Assessment for Subsurface Dams and Dredge Ponds

Subsurface dams involve floodplain subsurface barriers (“checkpoints”) to control flow of water and prevent undermining of riverbanks and washout of floodplain materials. Two important considerations to be focused on with regard to subsurface check dams include effective placement along the Tuul River and cost issues.

Dredge ponds will be armored against washout and runoff of floodplain material with placement of coarse tails material on the pond bottom to mitigate erosion. During placement of material on pond bottoms discharging water will be diverted to the settling ponds to prevent elevated TSS in the main Tuul River channel.

The use of sand/gravel pumps will also be considered to facilitate floodplain reclamation activities, especially during the installation of subsurface dams.

Grading Plans

In restoration of the Tuul River floodplain grading will be necessary to disperse and contour various stockpiles types, especially those significantly conical ones (sand/gravel, oversize and overburden types) that are difficult to reclaim, in addition to sediment ponds and levees. A case-by-case feasibility review of stockpiles and levees will be necessary as some though not all of the stockpiles will be accessible to land based earth moving equipment. A sedimentation control plan will also be designed into the grading plan to prevent downstream sediment loading during grading operations.

Geotextile/Sediment Fencing/Filter Fabric

The use of geotextile, natural or artificial fiber, and the use of sediment fencing are key components of a reclamation program. These measures are important in erosion control, stream sedimentation control and in revegetation of eroded stream banks and gulleys (**Section 3.1.4**, Sedimentation and Erosion Control). Sediment fencing will be installed between all active mining areas and the Tuul River.

Natural versus Artificial Geotextiles/Sediment Fencing Material

Both natural and artificial fiber type geotextiles are acceptable; however, both have their advantages and disadvantages.

Natural fiber based geotextile is preferable especially from both an economic and biodegradability perspective. In contrast, artificial geotextile, typically woven from environmentally inert polypropylene, is a more durable fabric capable of resisting washout and with a greater holding ability of soil materials. Artificial geotextile is, however, considerably more expensive than natural fiber textile, does not biodegrade readily, and presents a higher risk of theft (as a locally useful and durable material); **Table V-1** summarizes these characteristics.

Table V-1 Comparisons of Geotextile Types

Geotextile Type	Natural	Artificial
Relative Advantages/disadvantages		
Advantages		
Low Cost	Yes	No
In-country acquisition	Yes (verify)	No
Biodegradable	Yes	No
Durability and material holding	Low	High
Disadvantages		
High Cost	No	Yes
Not biodegradable	No	Yes
Theft risk of installed product?	Low	High

Revegetation

Replacing willow stands through a standard replanting program in riparian areas will be important in reestablishing wildlife habitat and in being proactive in controlling erosion. The current mine plan does not involve any operations within 100 m of the channel, which will protect the current willow habitat; however previous mining activities, firewood cutting, and overgrazing has reduced the willow populations along the Tuul River. A program for revegetation planting of willows in areas where willow thickets have been disturbed or removed is a low-cost program and “cuttings” from existing willow stands will be used. Restoration of willow thickets is especially important in creation of habitat for wildlife and in soil conservation. Willow is especially easy to propagate in this manner in individual “poles” or in collective twig bundles or “wattles” (Hennessy et al., 2000).

Establishing a willow revegetation program requires the consideration of several aspects in setting up a revegetation project for riparian areas including, source of planting stock to be used, volume/prioritization of areas for planting, overall cost and scheduling.

Source of planting stock - The source of planting stock is local and will use existing willow patches (*Salix cf. ledebourina*) from the riparian/wetland zone of the Project area. A slurring program should be used to maintain stock in good condition during the program, so as to ensure successful planting.

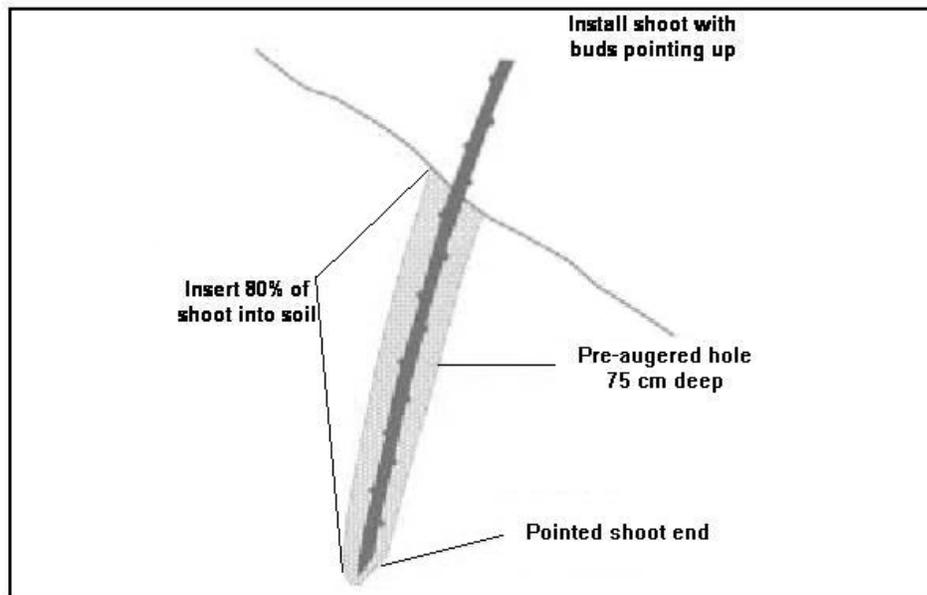
Volume and Prioritization of Areas - An inventory of riparian/wetland areas where willow stands are to be disturbed during mine development activities is needed for estimating areas of priority for replanting (i.e. with high erosion potential) and to estimate planting volume for each site anticipated to be covered in the program and overall volume.

Cost - Assigning a cost estimate to a willow replanting program is covered under the general overall cost assessment for the reclamation program. Willow replanting is one of the most important and cost effective re-vegetation methodologies suitable for the Project area.

Scheduling - Season scheduling for replanting the willow thickets is an important factor in the overall success of this Project. The optimum planting timeframe is early spring immediately following the snowmelt and before bud-break of willow branches. If feasible, it is important also that scheduling of willow planting be as close as possible to cessation of operational work, in order to re-establish vegetation cover on bare soil surfaces as quickly as possible and thereby help in mitigating erosion.

Pole Cuttings of Willows - The use of willow pole cuttings is a common form of vegetative propagation of this species in site restoration projects with year-round moisture. Willow poles (1.5 to 4.0 cm in diameter and 1.5 m long) are planted in 30 to 90 cm deep holes (**Figure V-3**). Cut willow poles should be planted within 24 hours unless they are kept in water; at the time of cutting, poles should be dormant. Poles can also be kept moist and cool (wrapped in plastic and refrigerated) to extend the holding time to 72 hours before planting.

Figure V-3 Willow Pole Planting

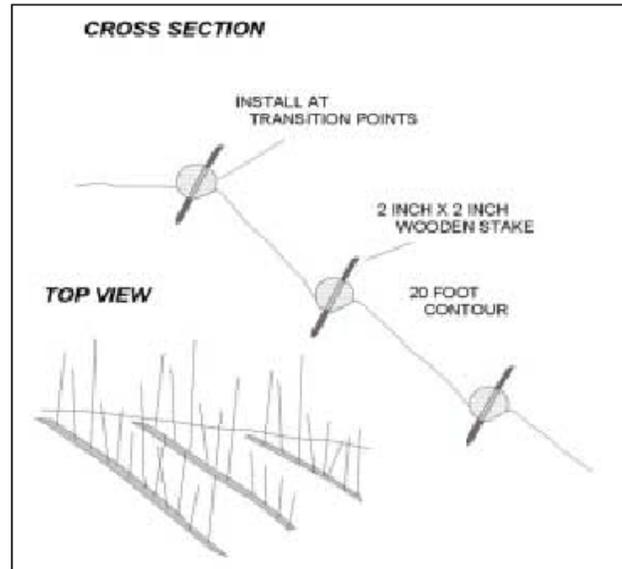


Adapted from: The Watershed Institute, 2000

Willow Wattles - Willow wattles are pole cuttings of willow bundled together that are 1.5 to 2.5 m in length. Wattles are anchored to slope areas in trenches (**Figure V-4**). Only dormant poles should be used for wattles that are held together with

twine. The wattle is installed in an excavated trench/furrow and pegged into place by 5 cm long spikes.

Figure V-4 Willow Wattle on Slope



Adapted from: The Watershed Institute, 2000

Cost Estimation

Cost estimation is one of the most important considerations in the design of a reclamation program. In choosing between different engineering solutions, careful analysis of the cost/benefit factor will be carried out in designing a reclamation program.

3.3.5 Areas of Indirect Impacts – Mine Camp and Mine Services

The mine camp and associated operational facilities represent an important part of the overall impact footprint of the Project.

Settlements and Contractor Services

From a reclamation standpoint there are four relevant impacts associated with the mine camp, these include roads, derelict buildings, waste dumping areas and riverbank erosion. A reclamation plan, engaging the following pre-planning steps, will be carried out to reclaim these site aspects:

- Pre-site assessment;
- Grading planning;
- Waste;

- Geotextile usage;
- Revegetation; and
- Cost estimation.

Pre-site Assessment

A pre-site assessment will include an inventory of sites to be included in a reclamation program. Inventory of Project area roads and dirt tracks should focus on localities with erosion problems and disused rogue tracks off of established roads.

An initiative should be encouraged to remove or reuse any derelict camp/contractor services buildings as they represent a safety hazard and maybe significantly visually degrading to the landscape in the Project area.

An inventory of poorly managed and illicit waste dumps associated with previous camps/contractor services should be conducted in planning for the disposal of waste in a government/aimag approved facility. Removal (and recycling of some waste materials) will be done in coordination with similar materials produced from minefield activities (see the **SEMMP**).

Some riverbank erosion associated with camp activities in the Project area may occur. These areas should be documented and assessed for reclamation.

Grading Planning

Grading and soil decompaction activities need to be determined and include localities of roads, waste and building sites. During the reclamation phase, grading and soil decompaction will be necessary to prepare some sites for revegetation and erosion control measures.

Geotextile Usage

Minimal geotextile usage is considered needed at settlement/contractor services sites to be reclaimed and need only be applied to slope areas of $\leq 20\%$ to keep overall costs down. Such localities would be relatively limited in size of area extension.

Revegetation

Revegetation of sites would use accepted technologies in the interest of a cost effective and efficient program. Application of a revegetation program should focus on the following sites:

- Erosion prone sections of road shoulders;
- Slope areas of greater than 20 percent;



- Former waste sites; and
- Former building sites.

Cost estimation

The framework of cost estimation will need to consider three key parameters: scope of responsibility for Project impacts, regulatory requirements and cost/benefit of all reclamation options.

3.4 Erosion and Sedimentation Control

Since placer deposits are mostly located near surface water drainages, a major environmental issue involves potential turbid runoff from erosion of overburden stockpiles and unsettled process waters that could flow into receiving waters. This can increase the turbidity of the river and produce excessive amount of sedimentation, which could severely impact the eco-system of the river. It has been reported that turbidity of the Tuul River in the Project region increased significantly (up to 37 times; World Bank, 1998) during the active placer mining season (see Water Quality section). Monitoring of turbidity during summer 2008 showed increases of turbidity (5 to 13 times) from nonpoint source inputs. Erosion from the overburden stockpiles and uncontrolled process water discharge are believed to be the major cause. Proper design, construction and maintenance and operation of the settling ponds and overburden stockpiles are therefore, the keys for erosion and sedimentation control.

Planning for erosion and sedimentation control will start together with mine design in the early phase of development of the Big Bend Project.

A 50-m buffer strip of undisturbed land surface with vegetation will be maintained between the soil stockpiles and the active stream channel to capture and trap escaped sediments, with no mining occurring without MNE approval within 100 m of the active stream channel. Sediment fencing will be installed between all mining activity and the Tuul River proper.

A minimum of five meters will be kept between settling ponds and any surface water drainage.

3.5 Protection of Flora and Fauna

Protection of flora and fauna and mitigation of terrestrial and aquatic ecology systems will be important initiatives for the Project. These initiatives may include establishing a voluntary conservation zone for the Project area, eliminating and/or minimizing grazing in Project area, and support of a periodic environmental monitoring program for certain key organism groups.

Baseline investigations for vegetation and wildlife have shown that the primary high biodiversity terrestrial habitat is the riparian and island areas of the Tuul River. Islands are especially high in biodiversity due to their isolation from grazing impacts. Most riparian areas demonstrated some degree of grazing impact. Fisheries investigations have shown that the Tuul River has devolved into a warmwater fishery dominated by sediment tolerant species (carp, catfish, cyprinids) with occasional perch and pike. This has been caused by significant increases in the sediment loading to the river ecosystem related to agricultural and mining activities (overgrazing and ineffective sediment controls). Siberian taimen and sturgeon have, for all practical purposes, been extirpated from this section of the Tuul River.

The Project area represents a small percentage of the Tuul River watershed in this area. Optimal sediment control over the entire Project area will probably not result in significant improvements to the ecology of the Tuul River due to the upstream watershed conditions and resultant sediment loadings, especially during high flow events. WMMC wishes to demonstrate modern sediment control which could be used as a model for other Mongolian mining operations. Such sediment control, if widely adopted and coupled with broadbased prescriptive grazing practices, has the potential to improve water quality in the Tuul River.

To accomplish an effective program aimed at the protection of the flora and fauna of the Project area, an ecosystem-based approach is to be adopted. This approach assumes that interaction of the physical and biological environment, in addition to the human component, is essential on a local and regional scale to the successful maintenance of biodiversity within the Project area and immediate surroundings.

Given that there are some trade-offs with economic and social development, it is still possible to maintain biodiversity if the underlying ecosystem level mechanisms remain functional. With this perspective, WMMC has adopted a strategy to account for these important components of environmental integrity throughout the design, implementation, operational and closure phases of the Project.

WMMC has committed to follow accepted international practices and required national environmental standards to ensure the successful inclusion of methods and techniques that will produce a sound biodiversity management program,

which is aimed at minimizing environmental degradation. WMMC also has taken all reasonable steps to gather and develop substantial baseline information that incorporate non-protected species, as well as organisms with special conservation status, into a functioning ecosystem framework. The following mitigation and protection measures will serve as a framework under which WMMC can measure its progress toward ensuring that biodiversity challenges are met.

3.5.1 Updating the Baseline - Standardized Inventory/Census Methodology

A baseline provides inventories/census for organisms of the Project area. A baseline is important for several reasons, including:

- Accurate evaluation of impacts to biodiversity, across vegetation and fauna components of terrestrial and aquatic ecology;
- Determining actual presence/absence of Red Book listed T&E species;
- Use of repeatable, standardized methodologies for inventory of organisms;
- Identification of sensitive areas potentially worthy of conservation; and
- Providing an accurate and standardized report card for the biological systems of the Project area.

The baseline conditions of the Project area were updated (from the 2003 study of the area) with sampling and data collection of relevant environmental and social components in July, August, and October 2008.

In addition to updating the baseline environmental data, a number of measures for mitigating impacts to terrestrial and aquatic ecosystems are being considered for the Project area, including: establishing voluntary conservation zones and biological corridors within the Project area; supporting terrestrial and aquatic refuges in the vicinity of the Project; the application of a comprehensive and effective reclamation and re-vegetation plan; and, support of a periodic environmental monitoring program for certain key groups of organisms to make ongoing adjustments to the biodiversity management and mitigation strategy, if needed.

Voluntary Conservation Area

The Project area licenses are currently designated rangeland conservation areas with grazing livestock. This activity will be limited to the extent possible. Protecting the Project rangeland areas against livestock grazing will help mitigate erosion significantly through protection of the grassland cover. WMMC will develop a modern rangeland management system in consultation with local

herders, local Soumon Governments and local mining companies. The primary goal of WMMC is to protect, preserve and enhance the terrestrial habitat by limiting and/or eliminating the grazing from much of the Permit area and work to secure alternative, more desirable and economically beneficial locations, activities, management training, and other economic opportunities for onsite herders.. WMMC recognizes the cultural context of nomadic herding, including the general Mongolian interest in open range and freedom of movement throughout the steppe. Proper and thorough documentation of all discussions, negotiations, settlements, expectations, contracts, and other aspects of social mitigation will be formally recorded and conform to IFC Performance Standards.

WMMC will identify areas within the Project area that are worthy of conservation designation. This will include representative habitat for wildlife and aquatic organisms. These areas will be dedicated to conservation and preservation, and efforts will be made to limit or eliminate direct and indirect impacts associated with the gold mining operation within these zones.

Impacts Addressed:

- Loss of vegetation;
- Fragmentation of habitat;
- All impacts to fauna; and
- All impacts to ichthyofauna.

Inventories of Biodiversity

The baseline information for terrestrial and aquatic ecology will be evaluated to incorporate a strategy to provide comprehensive assessment of the flora and fauna, including typical annual variation in the natural environment and changes over the life of the Project. Previous environmental research and monitoring in the Project area provide an excellent framework to add upon with additional surveys of the terrestrial and aquatic environments.

The updated baseline information from the July 2008 study was important for several reasons, including the fact that it expanded upon the current understanding of ecosystem structure and function and will allow for monitoring changes in the species composition of the Project area. The July 2008 study resulted in:

- A comprehensive review and study of the biodiversity of the specific areas to be cleared for the major infrastructures of the Project area.
- An accurate evaluation of potential impacts to biodiversity from the Project.
- An assessment of actual presence/absence of IUCN listed T&E species, or species that have a special protection status in

Mongolia, including information of migratory or wide-ranging species.

- The use of repeatable, standardized methodologies for inventory of organisms to track and monitor future changes in species composition, presence or absence.
- An identification of areas high in biodiversity within the Project area that are potentially worthy of conservation, and selection and monitoring of biological corridors within the Project area.
- Providing an accurate and standardized report card for the biological systems of the Project area.

Impacts Addressed:

- Loss of vegetation;
- Loss of habitat;
- Fragmentation of habitat;
- Loss or reduction in number of animals; and
- Change in community structure of animals.

Re-vegetation Strategy

Re-vegetation of sites would use accepted technology in the interest of a cost effective and efficient program. A comprehensive reclamation and revegetation strategy is outlined in **Section 3.1.3**. Good international industry practices will be used to facilitate and shorten the time period necessary to stabilize the soils and potential sources of sediment input to the aquatic ecosystem. The topsoil will be removed and stored using appropriate and proven techniques to facilitate revegetation. In addition, efforts will be made to improve habitat, such as retaining wetland areas for wildlife refuge for waterfowl and mammals, and, planting willows for bank stabilization.

Monitoring / Environmental Audits Incorporating IUCN Criteria for Biodiversity Issues - Biodiversity Management Plan

The essential features of the monitoring agenda provide for the flexible assessment of ongoing environmental impacts, accounting for connectivity, fragmentation, disturbance, and hydrologic processes of aquatic and terrestrial ecosystems. The plan considers a strategy aimed at providing an ongoing evaluation of a full range of impacts that include direct, indirect, cumulative, and induced impacts. The management strategy includes participation of outside stakeholders, institutions, NGOs and the government; and, also includes a way to incorporate the importance of indigenous knowledge of local biodiversity aspects into the management and monitoring strategy.

Impacts Addressed

- Floral: loss of vegetation.
- Faunal: movement from area; decline in numbers; change in community structure; disturbance by noise; predation, competition, disease; localized decline in numbers; loss of habitat.
- Ichthyofaunal: habitat loss; fragmentation of habitat; increased sediment; decreased water quality.
- Sensitive Species: decline in numbers.
- Benthic Invertebrates: localized decline in numbers; change in species composition.

4.0 Mitigation of Human Impacts

As part of the AATA baseline study for this SEIA, a socioeconomic study was conducted in July 2008, in and near the Project area, in accordance with national requirements and international guidelines of OPIC and IFC. **Attachment 1 of Appendix E** contains the full, detailed report of this study, which is briefly described below.

WMMC believes that the high need to achieve and maintain a social license to operate also requires considerable understanding, knowledge and coordination with local, national and international stakeholders. Broad community support not only facilitates the mine operation, but it also serves as the social license to operate as required by OPIC, IFC Performance Standards and EPFIs (as discussed in **Part II**).

The socioeconomic report (**Attachment 1 of Appendix E**) was prepared through desktop research and one-on-one interviews conducted in the field during the AATA July 2008 baseline study for this SEIA. The desktop research involved the review of Project documents, legislation, and socioeconomic references. Interviews and surveys of stakeholders were conducted within and near the Project area. These stakeholders included residents, NGOs, and government representatives.

The socioeconomic report in **Attachment 1 of Appendix E** discusses the cultural background as well as the human environment and legal framework in which the Project will operate. In addition, the potential impacts from the Project and the proposed mitigation measures are identified. In compliance with IFC Performance Standards, a Social Engagement Program is defined and will be implemented by WMMC in order to efficiently involve stakeholders on issues potentially affecting them.

As noted, mitigation measures are included in the full socioeconomic report. A summary of these measures is included below.

4.1 Grazing

The Tuul River Valley is experiencing increased pressure on grazing areas due to natural events (i.e., drought), overgrazing, and increased mining. The Project intends to reduce pressure on grazing areas by eliminating or relocating livestock grazing and successfully reclaiming the Project area. Ultimately, the Project's goal is to preserve local biodiversity by implementing sustainable land-use practices and reclaiming the Project area as a wildlife sanctuary and refuge. However, the current land use is incompatible with this goal.

The exclusion of the Project area (3,170 hectares) from livestock grazing will impact local herders. The voluntary relocation and economic displacement of the local ger herding units will be accomplished through negotiated cash settlement and with care to locate more suitable steppe habitat nearer to their original winter residences. In addition, WMMC paid and will continue to pay the soum governments for the land-use right of the Project area. WMMC will work with the local herders, local Soumon Governments, and local mining companies to institute modern scientifically-based range management in the Zaamar Goldfield. Grazing at the Project area will be greatly reduced by relocation of some of the herders and by reducing the number of animals by providing alternative income-generating activities. WMMC recognizes the cultural context of Mongolian nomadic herding and the open range concept. WMMC will work with the affected stakeholders to improve economic opportunity for the onsite herding stakeholders, including proper range management of the area.

The Project area will exclude livestock grazing from the area of active mining primarily with on-site security personnel. A gate will be installed at the Project area's point of access/egress for health and safety purposes. Project facilities may be fenced if deemed necessary.

Performed in conjunction with operational activities, reclamation will provide land suitable for wildlife purposes. Disturbed areas will be contoured to match the existing landscape, and successfully revegetated through the replacement of topsoil and selection of appropriate plant species. This beneficiation will also extend to creating wetlands, marshlands and rangelands to promote biodiversity, which in turn benefits grazing areas in the long-term.

4.2 Land Disturbance

Natural resources of the Project area (soil, vegetation, hydrology, wildlife and wildlife habitat) will be temporarily disturbed during the Project. These resources

will be reclaimed to support wildlife use. The Project will perform reclamation activities contemporaneously with operation activities to minimize land disturbance and expedite the reclamation process.

Of the 3,170 hectares within the Project area, no more than 15 percent may be disturbed during the Project. However, only a portion of this area will be disturbed at any one time because reclamation will be ongoing after the initial operations. Details of the specific mitigation measures related to soil, vegetation, hydrology, and wildlife are discussed elsewhere in this section.

4.3 Health and Safety

WMMC will eliminate or minimize risks to health and safety by implementing the following (more details are provided in the **SEMMP**):

- Provide 40 hours of MSHA-based general and site-specific safety training to all employees, including proper storage and transport of materials (e.g., petroleum products), the necessity for excluding livestock from operational areas, and emergency response;
- Frequently conduct and maintain records on health and safety meetings;
- Provide on-site access to medical personnel, supplies, communications, and vehicle transport in case of accidents;
- Perform Occupational Health and Safety (OHS) Investigations, Incident Reports, Inspections, Audits, and compliance monitoring;
- Provide monthly OHS statistical reports;
- Establish and enforce an employee code of conduct as well as OHS policies and procedures; and
- Compensate herders for accidental animal injuries or fatalities related to Project activities.

4.4 Archaeological, Historical, and Cultural Resources

Archaeological Resources

As part of the AATA baseline study in July 2008, a detailed Archeological Study of the Big Bend Project site was conducted. Some 13 archaeological sites were found in this study within and near the Project area. Detailed records of these sites are provided in **Attachment 2** of **Appendix E**.

WMMC will endeavor to eliminate or minimize impacts to these sites during the Project development and operation. Should the Project disturb these areas, the appropriate regulators and/or institutes will be contacted in order to implement mitigation measures in accordance with local and national regulations. A cultural

resources mitigation planning process is being engaged with MNE and the Institute of History of the Mongolian Academy of Sciences.

Cultural resources

To protect cultural resources, WMMC will:

- Request the Institute of History of the Mongolian Academy of Science to identify and designate potentially sensitive areas within which particular care should be taken to avoid disturbance of valuable sites.
- Propose and enforce regulations prepared under the Mongolian Law on Protection of Cultural Heritage, which will ensure the proper protection of cultural and historic sites.
- Prepare documentation that no significant sites or artifacts would be disturbed prior to exploration or mining in a designated area.
- Implement a cultural resources management program.

5.0 Occupational Health and Safety Measures

5.1 Mongolian Safety and Health Regulations

The primary responsibility for the safety and health of workers will lie with WMMC and its workers. The Government of Mongolia has laws and regulations that cover safety, health and working conditions. Provisions on occupational health and safety are included in the Mongolian Law on Labor (MLL), which was first introduced in 1991 and was last amended in 1999. There are many other laws, standards, regulations and rules in the field of occupational health and safety that are currently in effect.

The Labor and Social Welfare Inspection Agency is in charge of supervising matters regarding occupational health and safety. This Agency was established following Government Resolution No. 257, 22 October 1996, under the Ministry of Health. The responsibilities of this agency are set out in the Rules of the Labor and Social Welfare Inspection Agency; and, are also determined by the Labor Law and the Package of Social Security Laws. The Labor and Social Welfare Inspection Agency conducts its work in close co-operation with the relevant government institutions (such as the Ministry of Infrastructure and Urban Development, Transportation and Tourism, the Agricultural Inspection Agency and the Geology and Mining Inspection Agency) as well as with employers, workers and NGOs.

There are a total of 75 inspectors, where 44 operate in provinces, 18 in districts, three within the Ministry of Defense and Mongolian Railways, and ten at the Labor and Social Welfare Inspection Agency. These inspectors are divided into:

1. Engineers (40) (involved in safety inspection),
2. Hygienists (33) (engaged in occupational hygiene inspection), and
3. Experts (2).

Inspectors at the local level report to the Agency on Occupational Health and Safety (OH&S). These reports are made on a six-monthly and yearly basis and include information on industrial accidents and occupational hygiene.

In 1997, the government conducted a national survey to determine the status of occupational health and safety in the country. The survey covered a total number of 4,953 economic entities, 9,236 shop floors and 191,000 workers. For the mining industry, 119 enterprises were surveyed. Of these, 44 had incidences of industrial accidents (total number of accidents was 182) and 192 workers were exposed to accidents. There were 12 fatalities, and 8 people who lost the ability to work.

The Mongolian Law on Labor details the responsibilities of the company regarding indemnification for industrial accidents, occupational illness and toxic poisonings (Article 97). The MLL also states “work safety and hygiene standards shall be approved in accordance with the directed legislation by an establishment charged with issues of standard upon agreement with the state’s central administrative establishment charged with labor affairs.”

5.2 Company Policy

A sound Health, Safety and Environment (HSE) Program starts with the formation of a company HSE Policy. Such a policy formalizes the focus that HSE matters are important, and are an integral part of the company’s goals. A key objective of an HSE policy is that there should be accountability for performance at each level of management and by the workers themselves. This goal can be achieved through training of management and the workforce in occupational health, safety and environmental matters. Development and adoption of safe work practices and procedures should be done; workforce health should be monitored on a regular basis with annual checkups; and, steps should be taken to make sure that working and living conditions at the mine site are healthy and safe. Key elements of a health and safety policy include:

- Provide a safe and healthy workplace for all employees including employees, contractors and visitors;
- Train and motivate all employees to work in a safe and responsible manner;

- Make health and safety a part of all business decisions;
- Integrate the highest safety standards through exploration, construction, operations and closure;
- Apply "best practices" to ensure that company's health and safety performance is recognized as a world leader;
- Comply with relevant legislation and exceed community expectations
- Strive for continual improvement in the company's health and safety performance by setting and reviewing achievable targets;
- Hold all employees accountable for health and safety; and
- Ensure all employees understand that no task is so important that time cannot be taken to complete work safely.

WMMC will develop a HSE Policy for the Big Bend Project that incorporates these elements, as appropriate.

Fulfillment of a company's HSE objectives starts by an effective employee selection and training procedure. In addition, contract terms for contractors must include environmental protection and accountability clauses. Having environmental protection clauses that contractors must adhere to will ensure that the company's policies will be followed. There should be ongoing visible management participation in the program to ensure that momentum is developed and maintained. At least one person must be responsible for mine occupational health and safety coordination, who has the necessary training and backing from the company to ensure that HSE policies are followed. Hazards that cannot be eliminated and/or removed must be controlled. Emergency procedures to deal with injury, fire, rescue and other situations of risk must be developed and implemented. Proper reporting procedures must also be put in place.

WMMC will prepare and implement a set of Guidelines on Protection of Health and Safety at Work. For each job position, a Program of Safety at Work and a Program of Training at Workplace will be developed. These programs will cover health, safety and environmental protection related to their duties.

The following safety practices will be adopted by WMMC and will be observed by all personnel, contractors, and visitors:

- All visitors will be escorted at all times and will receive a safety briefing before visiting the site.
- All personnel will wear hard-hats and steel-toe boots in the vicinity of the dredge and other operating machinery.
- There will be absolutely no smoking within the perimeter of the dredge, or within 200 m of fuel and lube storage facilities.



- There will be no drinking of alcoholic beverages while on duty. Personnel reporting to work intoxicated will be immediately fired and escorted from the site by security.
- There will be no burial of flammable or hazardous wastes.
- Safety rules will be posted and prominently displayed at all Big Bend Project work areas.

5.3 General Safety Features

General safety features will be incorporated into the construction and operation of all facilities at the Project site. The company will ensure that protective gear and special work clothes (if needed) will be provided, and that the gear will be cleaned and repaired when necessary, following the stipulations in the Mongolian Law on Labor. Other general safety features will include:

- Shield guards or guard railings should be installed on all belts, pulleys, gears, or other machinery with moving parts;
- Elevated platforms should be equipped with guardrails, non-slip surfaces, and toeboards;
- Electrical equipment should be grounded, well insulated and conform with applicable codes;
- Fencing should be provided around all hazardous areas (e.g., fuel loading and unloading areas, open pits, spoil piles); and
- All facilities, equipment, and utilities should be located at a safe distance from each other as dictated by law.

5.4 Employee Training

Employees will have to meet the basic requirements and certifications for the job prior to being hired (e.g. engineering, accounting etc.). In addition, all employees have to go through basic health, safety and first aid training upon employment and regularly thereafter, with the corresponding records duly kept. The topics of training include both general health and safety in the workplace (safety awareness, cardiopulmonary resuscitation, first aid, safe lifting, operating in cold and hot environments, dangerous chemicals, proper clothing and equipment, etc.). Field employees will undergo additional training as required by the job description and may include equipment training, safety briefings and emergency responses. A summary of the training program is for the company to:

- Sponsor and actively participate in a health and safety planning and training program that emphasized education of the workforce;
- Promote safety such that it receives the highest priority and attention in training;

- Provide adequate personnel protection equipment for all employees;
- Implement a training program designed to conform to all applicable Mongolian regulations; and
- Maintain clean and organized working conditions, including adequate ventilation, general good housekeeping, security, and adequate lighting.

Material Safety Data Sheets (MSDS) are information packets provided by the chemical manufacturer that detail reactivity, chemical properties, proper storage methods, necessary safety precautions, and a wide variety of other necessary information regarding the use of that particular chemical or compound. Employee training sessions will include the use of these sheets in spill and accident prevention and control, and the implementation of basic safety procedures. Sheets for fuel and lube will be available at areas where these chemicals are used.

Employees will be educated in the prevention of accidents as well as the procedures to follow if an accident does occur. This training will include emergency identification, response, and notification. Identification training will include the recognition of potential problems (e.g., leaks, structural failure) and the designated chain of command to report such problems to the proper authorities. Response training will include identifying the location and proper use of all emergency equipment, the use of personnel protection equipment, and procedures for raising the alarm and the notifying the emergency response team.

Prior to Project operations, safety training will be conducted and record keeping will be maintained according to Mongolian regulatory procedures. The company will conduct a training program for all new miners hired for the Project. Only after the training course has been completed will the employees be given their work duties. Some topics will include:

- (1) Instruction in the statutory rights of miners under Mongolian law; authority and responsibility of supervisors. The course will include instruction in the statutory rights of miners, an introduction to the Company's rules and the procedures for reporting hazards.
- (2) Transportation controls and communication systems. The course will include instruction on the procedures in effect for riding on and in mine conveyances where applicable; the controls for the transportation of miners and materials; and the use of mine communication systems, warning signals, and directional signs.
- (3) Introduction to work environment. The course will include a visit and tour of the mine, or portions of the mine which are representative of the entire mine. The method of mining or operation utilized will be observed and explained.

- (4) Escape and emergency evacuation plans, fire warning and firefighting. The course will include a review of the dredge and mineral plant escape system, and escape and emergency evacuation plans in effect at the mine site; and, instruction in the fire warning signals and firefighting procedures.
- (5) Ground control; working in areas of highwalls, water hazards, pits and spoil banks; illumination and night work. The course will include an introduction to and instruction on the highwall and ground control plans in effect at the mine; procedures for working safely in areas of highwalls, water hazards, pits and spoil banks; the illumination of work areas; and, safe work procedures during the hours of darkness.
- (6) Health. The course will include instruction on the purpose of taking dust, noise and other health measurements, and any health control plan in effect at the mine will be explained. The health provisions of the Act and warning labels will also be explained.
- (7) Hazard recognition. The course will include the recognition and avoidance of hazards present at the mine.
- (8) Electrical hazards. The course will include recognition and avoidance of electrical hazards.
- (9) First aid. The course will include instruction in first aid methods.
- (10) Health and safety aspects of the tasks to which the new miner will be assigned. The course will include instructions in the health and safety aspects of the tasks to be assigned, including the safe work procedures of such tasks, the mandatory health and safety standards pertinent to such tasks, information about the physical and health hazards of chemicals in the miner's work area, the protective measures a miner can take against these hazards, and the contents of the mine's hazard communication (HazCom) program.

Afterwards, an annual refresher course program will be conducted at the beginning of the mining season.

In addition, employees will receive periodic hazard training on a monthly basis, to include the following topics.

- (1) Hazard recognition and avoidance;
- (2) Emergency and evacuation procedures; and
- (3) Health and safety standards, safety rules and safe working procedures.

5.5 Workplace Noise

Feasible administrative and engineering controls (such as sound insulation, mufflers etc.) will be employed to reduce the average noise levels in normal work areas. Equipment will be properly maintained to minimize noise levels. If personnel are exposed to noise levels above 85 dBA, hearing protection equipment will be provided and mandated.

5.6 General Health Features

Workplace health will be maintained by the company. Sanitary facilities will be properly maintained. Solid waste will be disposed of properly away from population centers to avoid health problems. Hazardous wastes will be properly segregated, labeled and stored in a properly secured location. There are no public or private hazardous waste disposal facilities in Mongolia. Hazardous materials will be stored, then disposed of by incineration as may be permissible under Mongolian Law on-site, or transported to a future site for permissible disposal. Some potential may exist for disposal of hazardous wastes in high temperature kilns, asphalt and/or paving plants, power plants, boilers, or other facilities as may be in alignment with international best practices and approved by Mongolian authorities. Domestic water will be clean quality so it is adequate for household use. Drinking water will meet the drinking water standards. Domestic wastewater will be properly collected and treated.

5.6.1 Drinking Water

In Mongolia, only 33 percent of the rural population has access to safe drinking water (MEM, 2003). At the Project location, water is obtained from a well installed in the alluvial aquifer, already on-site. Steps will be taken to ensure that drinking water standards are met. Routine monthly monitoring of the water quality of the domestic supply well will be conducted for all key parameters including, but not limited to major cations, major anions, heavy metals, coliform bacteria, suspended sediment, conductivity, pH, and total petroleum hydrocarbons (diesel range organics).

5.6.2 Sanitation

An engineered septic system will be installed at the mine camp area to treat all sewage waste. Wastewater from the dredge and floating process plant (if any) will be stored in tanks and periodically emptied and transported to the sewage treatment facility.

5.6.3 Personal Hygiene

Facilities to ensure that employees will be able to meet their personal hygiene needs will be provided. These facilities include bathing facilities, laundry facilities, and toilet facilities.

6.0 Hazard Prevention and Emergency Response

6.1 Preventative Maintenance

Preventative maintenance is an integral part of major hazard prevention, and helps to ensure that small issues do not turn into major environmental problems.

A preventative maintenance schedule will be set up for each facility. Preventative maintenance will be conducted on a regular and frequent basis, and a record of all maintenance procedures will be maintained on-site. Periodic inspections of storage tanks, secondary containment, on-site fuel transporting trucks and diesel powered dredges are necessary to protect against major accidents. During a regular inspection the following items will be verified:

- Valves are in good working order and function correctly;
- Fuel storage tanks show no signs of corrosion or leaks;
- Berms or other secondary containment structures are maintained to specific dimensions for containment and are free of cracks, weeds, and debris;
- Secondary containment areas are free of excess water, oil, or chemical residue;
- Equipments are operating according to engineering specifications; and
- Worn or damaged equipment parts are replaced as needed.

6.2 Fire, Rescue, and Emergency Support

Article 89 of the MLL requires that fire prevention measures be put in place, including installation of a fire alarm system, fire extinguishers and special equipment. In addition, employees shall be trained to use and maintain the equipment. Fire detection equipment will be installed at strategic locations and maintained on a regular basis at Big Bend.

WMMC will establish an emergency response team to handle such incidents as fires and spills in the Project region. Team members will have special training to

deal with all types of emergencies. The team will be equipped with a variety of special gear for dealing with emergencies.

A fire extinguisher will be carried in every mobile diesel-powered transportation mounted at a location easily accessible to the operator and protected by position from external damage.

6.3 Accident Prevention, Control, and Countermeasures (APCC)

As Project development begins, an APCC will be fully developed, detailing the procedures and guidelines to follow in the event of an accidental chemical spill, equipment failure, or other emergencies. This APCC plan will cover emergency identification, response, and notification procedures as well as an emergency preparedness plan covering exploratory drilling, materials hauling, on-site facility construction, dredging, and flood evacuation, etc. The APCC contains all of the elements of the typical Spill, Prevention, Control and Countermeasures Plan (SPCC).

In addition, this plan will address the design standards and engineered safety features required at on-site facilities, including spill containment structures at the storage facilities for diesel fuel, hydraulic fluid and lubricant oil. All materials that pose a potential health hazard in the Project area will be listed, and the applicable MSDS will be provided for each substance. The MSDS will contain information on how to safely handle each substance.

Development of the APCC plan will include the following objectives:

- Identify unplanned scenarios and accidents which would occur given the nature of the proposed facilities;
- Evaluate the probability that such scenarios will occur;
- Predict the environmental consequences of each scenario;
- Identify measures which will reduce the probability that such a scenario will occur (e.g., prevention); and,
- Identify measures which will reduce the environmental impacts of a given scenario should it occur (e.g., control and countermeasures).

The purpose of this plan is to outline policies and procedures for preventing and responding to environmental, health, and safety incidents and emergencies. Some of the general plans will include the following.

Daily inspections will be conducted to ensure that workers are equipped and use adequate Personal Protective Equipment (PPE). Field first-aid kits will also be present with all worker teams and workers will be briefed in the application of



basic first aid. Safety reminders will be posted in prominent locations. Safety briefings will be conducted on a weekly basis and will include planned Project activities and cardiopulmonary resuscitation (CPR) training for all staff.

First-aid kits will also contain snakebite antiserum and epinephrine for reclamation work conducted during the summer months. An on-site paramedic team would be in place, or available for call in addition to a medical evacuation program in the event of serious injuries requiring hospitalization.

The company will follow the MSHA tips and safety ideas, which can be found online at: http://www.msha.gov/Accident_Prevention/appcategories.htm.

A separate SPCC will be developed prior to commencement of field development activities. The purpose of this plan is to outline policies and procedures for preventing and responding to environmental, health, and safety incidents and emergencies.

6.4 Hazardous Material Handling

Materials such as fuel, machinery lubricants, automobile batteries, paints, solvents, and hydraulic fluids can potentially contaminate soil, surface water and groundwater supplies, if they are used and/or stored improperly. WMMC will establish a program with a comprehensive classification and identification of all hazardous materials at each location so that appropriate management procedures can be followed, which include:

- Keep a clear inventory of all hazardous materials, including shipping record, amount on site, storage location;
- Retain an MSDS file for each type of hazardous material;
- Set up an emergency response system to manage accidental spill;
- Clearly mark every storage container with name of the material as well as a warning sign and emergency contact information;
- Regularly check the conditions of containers to ensure no leak will occur (especially during frequent freezing and thawing season);
- Keep hazardous material storage area away (at least 100 m) from streams, wet areas and drainages;
- Secure hazardous material storage area with locks, fence or guards;
- Regularly check for and promptly repair oil and hydraulic leaks on equipment; and
- Collect all used hazardous materials and dispose them accordingly (see the Emergency Response Plan in the SEMMP). Absolutely no draining or burying of any hazardous material (e.g., used oil, oil filters, used batteries, parts and containers) on the ground.

Fuels are the most abundant material that could be hazardous if spilled. Therefore, special attention should be addressed on fuel storage and handling. A fuel depot center, where all of the fuels (diesels mainly) needed to support field mining operations are stored, will be constructed at the main field camp. A group of fuel storage tanks will be installed at this facility. The following precautions will be observed:

- All tanks at the storage site will be underlain with impermeable material and will be surrounded by berms capable of holding 120 percent of the total tank(s) capacity;
- Tank bottoms will be coated with mastic tar or an anti-corrosive agent to prevent tank corrosion. Tank exteriors will be painted with an oxide primer and at least one coat of industrial-grade paint;
- All tanks will be connected with a common venting system controlled by a valve to ensure sufficient top space pressure to restrict release of aromatic gases;
- Tall lightning arresters and a grounding system will be installed to accommodate lightening strikes;
- No storage tank will installed within 100 m to the nearest stream or other water bodies;
- Tank separation will be sufficient to reduce risk of multiple tank fire/explosion;
- No smoking or open fire burning will be allowed within 200 m of the fuel storage tanks; and
- Proper types and amounts of sorbents will be maintained in a dry condition, and available for use.

Part VI: Projected Net Social and Environmental Impacts

The predicted net environmental impacts for the Project presented in this section are based on an impact analysis conducted for this SEIA with the following assumptions.

- Mongolian laws and regulations applicable to the Project will be complied with in the design, construction, operation and closure of the Project.
- Internationally recognized criteria and standards (e.g., OPIC, IFC Performance Standards, Equator Principles, ICM, WHO, etc.) will be adopted in the design, construction, operation and closure phases of the Project;
- Good International Industry Practices (GIIP), as defined by IFC, will be employed to minimize potential social and environmental impacts; and.
- Proper mitigation measures will be implemented during all phases of the Project.

Many adverse effects that could occur from the Project will be eliminated or minimized by proper design, maintenance, management constraints, and mitigation measures. The social and environmental analysis presented in this section assumes that the social and environmental management, monitoring, and reclamation measures will be implemented as discussed in **Part V**, Proposed Prevention and Mitigation Measures, and the SEMMP.

Potential impacts to the environment from placer mining will be generally related to: (1) surface disturbance (i.e., excavations, removal of vegetation, displacement of soil and placer deposits) and (2) air emissions, from the dredges and mobile equipment; and, (3) by disposal of sewage, greywater, and solid wastes.

Surface disturbances will be related primarily to removal of overburden and placers from alluvial mining operations, and disposal of tailings. Additional surface disturbances will be related to construction of a few short access roads, electric power lines and the mine camp infrastructure.

The following emissions, discharges and wastes will be generated as a result of Project development. Air emissions from the diesel-powered cutter suction dredges, excavators, bulldozers, trucks and vehicles and backup diesel generators. Liquid effluent sources from the Project operations will include sewerage and greywater from camps and mine operations. All water from the placer processing (physical separation) will be recycled, hence no discharge is anticipated. The major solid waste sources will be construction wastes (e.g., wood and metal scrap,

packaging); domestic wastes (e.g., putrescent wastes, plastic, glass, paper); and miscellaneous wastes (e.g., used lubricants, oil).

Table VI-1 summarizes the potential net social and environmental impacts of this Project. Net impacts were calculated based on worst-case impact scenarios (i.e., gross impacts), minus the effects of all proposed preventive and mitigative measures. This provides an estimate of the net impacts, both short and long term, that can be anticipated as a result of Project operations. The net impact analysis table is not intended to provide a comprehensive list of all possible impacts, but is designed to highlight those risks and associated impacts that could potentially occur.

This analysis indicates that implementation of the social and environmental management, mitigation, monitoring, and reclamation measures that have been proposed by WMMC, and employment of GIIP that WMMC has committed to, will eliminate or minimize the potential negative social and environmental impacts of the Project; and, will provide economic and social benefits to the region.

Table VI-1 Summary of Net Social and Environmental Impacts from the Project

Environmental Parameter	Potential Gross Impacts	Mitigation Measures	Potential Net Impacts
Topography and Landscape	Excavation of overburden and placer; disposal of overburden and tailings; and new landforms created (ponds and small islands); Topsoil stockpiling. Construction of new roads and field camp. .	Concurrent reclamation of disturbed areas, including overburden and tailings; recontouring of dredge ponds and creation of wetlands for enhanced wildlife habitat; use of geotextile when grade >20 percent; and re-vegetation to stabilize new landforms Utilize existing field camps and roads.	Short-term changes can be significant with newly constructed ponds, topsoil / overburden stockpiles, mine camp and other facilities brought to the site. Long-term changes in topography and landforms with net beneficial habitat for wildlife, especially riparian, wetlands and open water habitats.
Air Quality	Fugitive dust from roads, camps and other disturbed areas; Gaseous emissions of SO _x , NO _x , CO, soot, hydrocarbons from diesel engine dredges and vehicles.	Implementation of fugitive dust control (water spraying) as needed Routine maintenance of equipment.	Short-term: slight increases in dust Long-term: no significant impacts from dust. No significant impact from gaseous emissions.
Surface Water	Increased sedimentation in the Tuul River from dredging operations. Contamination with polluted (diesel fuel, oil) surface runoff; Contamination with improperly treated sewage.	Dredge ponds isolated from Tuul River by protected embankment, concurrent reclamation of dredged materials; Secondary containment of all fuel storage facilities and SPCC program; Mine camp sewage treated in engineered septic system.	No significant impacts anticipated.
Groundwater	Depletion of groundwater if wells used for water supply for dredge ponds; Contamination from fuel / lubricant spills; Contamination from sewage	Monitor cone of depression from groundwater wells. Fuel storage areas have secondary containment and lined bottom to protect groundwater; SPCC program; Mine camp sewage treated in engineered septic system.	No significant impacts anticipated.

Environmental Parameter	Potential Gross Impacts	Mitigation Measures	Potential Net Impacts
Soils	Large areas/volumes of soils removed during mining; Erosion.	Strip topsoil and stockpile, for use in reclamation. Erosion and sediment control plan. Reclamation of soils / overburden while mining progresses (concurrent reclamation) with re-use of topsoil.	Short-term: significant direct impact from soil displacement Long-term: no significant impact due to restoration
Vegetation	Direct vegetation removal from riparian areas that are mined	Revegetation of disturbed areas; sprigging of willows along margins of dredge ponds	Short-term: significant impact to vegetation from removal Long-term: no significant impacts; positive net gain in riparian and wetland vegetation due to an increase in wetland and aquatic habitat from reclaimed dredge ponds.
Wildlife	Removal of some riparian and grassland habitat. Displacement and destruction of some species of terrestrial wildlife	Plan operations to minimize impacts to terrestrial species; Reclamation and revegetation of disturbed habitats;	Short-term: possible reduction in some terrestrial wildlife populations in areas of disturbance; Long-term: no significant impacts; net positive impact for wetland wildlife due to an increase in habitat from the reclaimed dredge ponds.
Aquatic Ecology	Indirect impacts of increase sediment on aquatic life populations	Erosion and sediment control program to eliminate sediment inputs to the Tuul River; Concurrent reclamation of overburden and tailing to prevent sedimentation to the Tuul River. No discharge of process water to the Tuul River (it will be recycled).	No significant impact; net positive impact for aquatic species due to an increase in habitat from the reclaimed dredge ponds;

Environmental Parameter	Potential Gross Impacts	Mitigation Measures	Potential Net Impacts
Socioeconomic Conditions	<p>Increased employment opportunities.</p> <p>Purchase and/or utilization of Mongolian supplies, equipment, and services.</p> <p>Increased tax base.</p> <p>Land improvements.</p> <p>Social program and budgetary contributions.</p> <p>Decreased grazing area.</p> <p>Short-term increased land disturbance.</p> <p>Short-term increased health and safety risk.</p>	<p>Negotiated monetary compensation and careful relocation planning for impacted herders; and continued land-use payments to the soum governors.</p> <p>Reclamation/revegetation of disturbed habitats while mining progresses.</p> <p>Employee safety training; on-site access to medical personnel, supplies, communications, and vehicle transport in case of an accident; and compensation for accidental animal injuries or fatalities related to Project activities.</p>	<p>Short-term: Increased job availability; increased tax revenues; improved medical services; no significant impact to herders; increased land disturbance.</p> <p>Long-term: Promotion and protection of biodiversity; increased wildlife habitat.</p>
Archaeological Resources	Disturbance of archaeological site(s) in the proposed mining area	Cultural Resources Management Plan	<p>Excavation of archaeological site(s) and analysis/curate in Mongolian museum;</p> <p>Improve anthropological understanding of the project region.</p>