SECTION 7.0

ENVIRONMENTAL MANAGEMENT SYSTEM

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7.0 SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT SYSTEM

This Section describes the Safety, Health and Environmental Management System ('SHEMS') proposed for the Star-Orion South Diamond Project (the 'Project'). The SHEMS is based on prevention, mitigation and management of impacts identified by the effects assessments for the environmental and social disciplines for the Project. The SHEMS is the fundamental way Shore's Safety, Health and Environmental Policy will be implemented throughout the Project.

Shore has developed its initial SHEMS, Environmental Protection Plans and environmental protocols to support its exploration activities. These existing programs are the basis of Shore's SHEMS for the Project.

7.1 INTRODUCTION

The purpose of the SHEMS is to organize and guide all activities during all phases of the Project to ensure orderly, safe, compliant, and environmentally and socially responsible operations at the Project. The SHEMS aims to manage significant aspects to control or reduce the effect of the Project on the environment (biophysical and human).

Shore's SHEMS is structured as follows:

- Health, Safety and Environmental Policies;
- planning;
- implementation and operation;
- checking and corrective action; and
- management review and that feeds back to the policies to recommend and implement changes to the SHEMS.

The aim of this structure is to promote continual improvement through a planning-execution-checking-improvement cycle. Key aspects of checking and corrective action include:

- monitoring and measurement;
- incident and non-conformance reporting, corrective and preventive action;
- safety, health and environmental records; and
- SHEMS audits.

Shore will carry out periodic, documented reviews of the SHEMS to ensure the continuing relevance and effectiveness of the SHEMS and to address opportunities for improvement.

Reviews will take into account changing circumstances and will include consideration of:

- results of internal and external audits;
- compliance records;
- safety records;
- environmental incident and response records;
- concerns of stakeholders, including complaints;
- Shore's commitments to continual improvement and pollution prevention; and
- environmental performance including progress towards achievement of objectives and targets.

7.2 ENVIRONMENTAL RISK MANAGEMENT

This Section describes the physical aspects of the Project setting that could be affected by Project development. The management of environmental risk for the Project was assessed from two perspectives:

- evaluation of failure modes of major components of the Project using risk assessment methods; and
- consideration of potential accidents and malfunctions primarily related to spills or failure of mitigation measures.

7.2.1 Risk Assessment

The risk assessment process is described below in terms of methodology and framework.

7.2.1.1 Methodology

Risk is defined as the product of:

- the likelihood of an event; and
- the adverse effects (consequences) produced by the event, should it occur.

Risk assessment is the process to identify potential events that could result in effects and assign likelihoods and levels of consequences. Risk management involves reviewing the results of the risk assessment, developing approaches to reduce the risk (likelihood or consequence or both) and establishing monitoring and contingency plans, particularly for the higher risk events.

Shore conducted a risk evaluation to evaluate the likelihood of occurrence and the likely environmental consequences (in a qualitative fashion) for the Project, related to identified

accidental, failure or malfunction events. The defensive measures and contingencies included were considered when evaluating the likelihoods and the consequences.

The risk assessment was used in project design to identify potential environmental events requiring project modifications or further study.

7.2.1.2 Framework

The environmental risks of each of the Project components were assessed and rated for both likelihood and potential consequence. Likelihood and consequences were assessed on a four point scale ranging from negligible to high as shown in Tables 7.2-1 and 7.2-2.

Table 7.2-1: Definition of Potential of Occurrence

Category	Annual Potential (chance of occurrence per year)	Life of Project Potential	Description
N – Negligible	$< 10^{-6}$	< 1%	Doubt it could happen
L – Low	10^{-6} to 10^{-4}	5 to 25%	Unlikely to happen
M – Moderate	10^{-4} to 10^{-2}	50%	It could happen
H – High	10^{-2} to 10^{-1}	75 to 100%	Has or probably will happen

Table 7.2-2: Definition of Impact on Facility Category

Category	Description
N – Negligible	- No measurable effect to the receiving environment - Non-reportable incident - Minor spill retained on site - <$10,000
L – Low	- Reportable incident - Minor effect on habitat - Significant spill on site, no discharge violation - <$100,000
M – Moderate	- Reportable incident that may have some significant longer term implications - Off-site spill or release - Effect can be remediated but at a cost - Permit violation - Significant reversible impact on habitat - <$1,000,000
H – High	- Significant incident (real or perceived) with effect that may not be completely remediated at any cost - Critical, large, irreversible effect on habitat - Reportable and long-term environmental impact that is not readily remediated - >$1,000,000

An event is considered critical if it has a large, irreversible effect upon habitat and exposes Shore to liabilities in excess of $1,000,000. Critical events are catastrophic and considered separately to ensure they are appropriately taken into account.

The combination of likelihood and consequences results in a four by four matrix (see Figure 7.2-1) where nine levels of risk (I to IX) can be defined by diagonal lines through the matrix. These diagonal lines represent approximately equal levels of risk and allow higher risk events to be readily identified.

7.2.2 Assessment of Hazards

The draft Emergency Response Plan (ERP) (Appendix 7-A) contains an initial assessment of hazards as described in the following tables, and an emergency response procedure to respond to these events. These assessments will be updated prior to construction. The relatively high ranking (medium potential and high impact) of forest fire (both natural and man-made) necessitates the development of a specific wildfire management plan, which will be based on the Fire Control Plan provided in Appendix 7-D. Note that these potential rankings are based on large or out of control wild fires in the immediate area of the Project. Small, controllable wild fires within the FalC (but outside of the LSA) would have a high potential of occurrence, but would have low impacts on the facility.

Table 7.2-3: Naturally Occurring Hazard Assessment

Hazard	Potential of Occurrence	Impact on Facility
Lightning	Medium	Medium
Ice Storm	Low	High
Tornado	Low	High
Earthquake	Negligible	High
Forest Fire	Medium	High

Table 7.2-4: On Site Anthropogenic Hazard Assessment

Hazard	Potential of Occurrence	Impact on Facility
Chemical Vapour Release	Low	Low
Chemical Liquid Release Hydrocarbons	Medium	Medium
Structural Collapse	Negligible	High
Fire	Low	Medium to High
Radiation Release (Sorting equipment)	Negligible	Low
Explosion	Low	Medium to High

Hazard	Potential of Occurrence	Impact on Facility
Transportation Accident On Site	Negligible	Medium
Bomb Threat	Low	Low
Workplace Violence	Low	Low
Pit Flooding	Low	High

Table 7.2-5: Off Site Anthropogenic Hazard Assessment

Hazard	Potential of Occurrence	Impact on Facility
Access Impairment	Medium	Low
Forest Fire	Medium	High
Transportation Accident Off Site	Medium	Low

7.2.3 Critical Events

Critical events are typically those with extremely low probability of occurrence, but which consequences may be very large on the Project or on the environment. The following critical events are considered for each identified phase of the Project (Table 7.2-6), and discussed below.

Table 7.2-6: Critical Events

Event	Construction	Operations	Closure
Large Wild Fire	X	X	X
Hazardous Goods Spill	X	X	X
Slope Failure – South Wall, Star Pit		X	X
Slope Failure – Other Walls, Star Pit		X	X
Slope Failure – Orion South Pit		X	X
Slope Failure – Overburden Pile	X	X	X
Slope Failure – Coarse PK Pile		X	X
Berm Failure – PKCF		X	X
Collapse of Underground Works during Mining		X	
Explosives Magazine Fire		X	

7.2.3.1 Wildfire

Large wildfires are in the area of the Project are considered to have a medium likelihood, and are listed here because of the potential long term interruption of operations and potential effect on health and safety. Wildfires are addressed specifically in a separate wildfire management plan, which will be incorporated into the draft ERP (Appendix 7-A) based on the Fire Control Plan presented in Appendix 7-D.

7.2.3.2 Hazardous Goods Spill

Hazardous goods spills that are not immediately containable and enter fish-bearing water bodies as a result of accidental release or pose irreversible hazards to the terrestrial environment (e.g., vehicular accident involving a truck full of diesel fuel) have the potential to cause a high environmental impact. These possibilities are specifically addressed in the ERP and in the Hazardous Substances Wastes and Dangerous Goods (HSWDG) Management Plans (Appendix 7-B).

7.2.3.3 Slope Failure- Southern Wall of Star Pit

Slope failure of the southern wall of the Star pit, adjacent to the Saskatchewan River, is the most catastrophic event considered in the EIS. The potential for slope failure between the pit and the river could potentially result in the river being diverted into the pit. This would create unacceptable environmental changes, including changes to the path of the river, creating an unauthorized harmful alteration, disruption and destruction of fish habitat, and preclude mine operations.

Slope design has been conducted to be conservative at a geotechnically stable angle. Overall slopes in the overburden are planned at 16.5 degrees (P&E 2010). This provides a factor of safety of 1.10 or higher on the pit slopes during operations. Additionally, the Saskatchewan River is separated by approximately 300 m of soils (surficial, sands and silts and clay till) at its closest approach and is highly unlikely to experience a failure that would connect the pit to the Saskatchewan River.

Continuous monitoring and state of the art mine survey equipment will monitor pit slopes to detect any slight movements of the pit walls. As slope failures often begin with small movements, early identification of movement will allow Shore to re-direct resources to stabilize the slope.

Additionally, backfilling of the Star pit with Orion South overburden is planned to begin at the south part of the Star pit, as soon as possible (likely in Year 13). This will reduce the slope, further increasing long term stability, and load the toe of the slope, thus further reducing the possibility of failure.

7.2.3.4 Slope failure – Other walls of Star Pit and Orion South Pit

Slope failure in the other areas of the Star pit and in the Orion South pit would lead to an unplanned expansion of the pit footprint, leading to potential loss of dewatering centers and mine infrastructure. This critical event would cause a moderate, permanent change to the project footprint; however, reclamation would be able to return affected areas to a forest ecosystem.

Slope design has been conducted to be conservative at a geotechnically stable angle. Overall slopes in the overburden are planned at 16.5 degrees for the Star pit (P&E 2010). The OS pit utilizes an inter-ramp angle of 16° above the 340 m elevation for overburden and an inter-ramp design slope of 30° below the 340 m elevation for design of the Orion South pit (Figures 2.6-6 and 2.6-7). The 16° inter-ramp angle would consist of a bench height of 15 m with a 22° batter angle, resulting in an average berm width of 15 m. In the till units an inter-ramp angle of 18° would consist of a bench height of 15 m with a 34° batter angle, resulting in a berm width of approximately 15 m. This provides a factor of safety of 1.10 or higher on the pit slopes during operations.

As stated, state of the art mine survey equipment will monitor pit slopes continuously to detect any slight movements of the pit walls. As slope failures are often presaged by small slope movements, monitoring and early identification of movement will allow Shore to re-direct resources to stabilize the slope.

7.2.3.5 Slope failure – Overburden and Rock Storage Pile

Slope failure of the overburden and rock storage pile could mobilize material and lead to impacts on Caution Creek or the 101 Ravine, and/or bury additional terrestrial habitat. This catastrophic event would cause a moderate, permanent change of the Project footprint, however reclamation would be able to return affected areas to a forest ecosystem.

Inspections and surveys will be conducted as the pile is constructed to monitor for potential mass movements. The pile is designed to be geotechnically stable at a height of 60 m. Backfilling into the Star pit has the potential to reduced this height, thus further improving stability. Side slope angles have been designed to be no steeper that 4:1.

7.2.3.6 Slope failure – Coarse PK Pile

Slope failure of the Coarse PK pile could mobilize material and lead to impacts on the Duke Ravine drainage channel, or bury additional terrestrial habitat. The Coarse PK pile will be formed as material is transported by conveyor to the pile, and will be designed to have slope movement as part of the evolution of this facility. Therefore, only a slope failure on an extreme scale would be considered to be a risk. This scale of event would only cause a low

to moderate, permanent change of the Project footprint; however, if necessary, reclamation would be able to return affected areas to a forest ecosystem.

Inspections and surveys will be conducted as the pile is constructed to monitor for potential mass movements, on a large scale. Side slope angles have been designed to be approximately 4:1, or lower than the angle of repose of this material.

7.2.3.7 Berm Failure – PKCF

Slope failure of the PKCF berm could mobilize significant quantities of Fine PK and process water into the environment, towards the Duke Ravine or the English Creek drainage channel, or over terrestrial habitat. The worst case would be if a failure released all contained water and suspened fine PK into a simgle drainage, leading to the release water and sediments into the Saskatchewan River, potentially causing a harmful alteration, disruption and destruction of fish habitat. The sediments could be considered release of a deleterious substance into the river. This catastrophic event would cause a major, but short term effect on the Saskatchewan River due to the non-acutely toxic nature of the Fine PK and process water.

PKCF berms are designed to rest at a 4:1 slope angle, and due to the centerline construction of the berms using dewatered tailings, are lower than the angle of repose of the material. This reduces the possibility of failure.

In addition, regular inspections and surveys of the PKCF are planned during construction and operations to identify areas of instability before they become a problem.

7.2.3.8 Collapse of Underground Works during Mining

Exploration of the Star and Orion South kimberlites included underground drifting. The open pits are planned to mine through these underground drifts. There is the possibility that heavy equipment could inadvertently drive over these underground workings, and cause a collapse. This would have minimal environmental effect, but could impact operations.

The locations of the drifts are surveyed and known, so proper mine planning will identify the areas and depths of the underground workings so that these areas can be excavated safely.

7.2.3.9 Explosives Magazine Fire

In the event of a fire in the explosives magazine, up to 70 tonnes of ammonium nitrate-fuel oil (ANFO) explosives may explode. Mitigation includes proper siting and maintenance of buffer areas, construction of an appropriate fire break around the facility, and the following of safe handling procedures. The environmental effects of this event are considered minimal and short term, however the potential effects on health and safety are considered high. No

interaction with other chemicals is expected, as no other chemicals will be stored in the magazine. Details on specific explosives fire management will be included in the detailed ERP.

7.3 SUSTAINABILITY MANAGEMENT PLAN

7.3.1 Introduction

Shore recognizes the value in incorporating the principles of sustainable development in all aspects of the Project. Shore's success with the Project depends on the responsible management of economic, environmental and social factors. This plan outlines Shore's vision, values, goals, and implementation to guide the sustainable development of the Project.

7.3.2 Scope

Shore's values are guided by a commitment to long-term sustainable development. These values are outlined in the following subsection.

7.3.2.1 Values

Shore's sustainability management plan is based on the following key values: Safety, People, Environment, Community and Security. Shore also acknowledges that responsible development of the Project requires careful consideration of economic viability.

Safety

Shore seeks to maintain a safe and healthy workplace for all employees with the ultimate goal of zero lost time incidents, and to foster company-wide awareness and cooperation in safety to develop an environment in which all employees can work safely and productively.

People

Shore values its workforce and strives to develop a respectful and representative workplace which recognizes the diversity of individuals while promoting a team environment.

Environment

Shore recognizes and respects the inherent value of the environment and seeks to minimize impact on the environment through strategic planning, implementation of best management practices and innovation, while striving to continually improve the quality of its environmental practices.

Communities

Shore values the communities neighbouring its operations and hopes to see the quality of life of their citizens enhanced by emerging employment and business opportunities.

Security

Shore seeks to provide professional and efficient security to ensure appropriate safeguards are in place to protect our employees and assets.

7.3.3 Vision Statement

Shore's vision statement, set out below, will guide the decisions made and the development of all activities with regard to the Project.

> *At Shore Gold Inc., we seek to provide value to shareholders by identifying, exploring, and ultimately developing quality natural resource properties in an environmentally, socially and economically responsible manner while providing employment and economic opportunities to individuals and communities.*

7.3.3.1 Goals

Safety Goals

Shore will ensure that it maintains a comprehensive Health and Safety program incorporates the safety measures necessary to provide a safe workplace and will ensure employees are aware of their roles and responsibilities as key partners within all components of the Health and Safety Program.

Shore is committed to:

- identifying, assessing and managing health and safety risks;
- educating employees in best health and safety practices;
- educating employees in compliance with applicable health and safety rules and regulations; and
- investigating incidents promptly and thoroughly to determine the root cause and prevent re-occurrence.

People Goals

In order to develop a workforce which represents the diversity of skills required to advance the Project and is representative of the population of the geographic areas in which the Project operates, including communities and cultural groups surrounding the Project, Shore will recruit and develop a dedicated workforce committed to the advancement of the Project.

Shore is committed to:

- providing a workplace that rewards and inspires talented and motivated individuals;
- offering opportunities for growth and success, supporting performance excellence and fostering continuous improvement in all areas of work;
- creating and maintaining a work environment in which all individuals are treated with respect and dignity; and
- establishing a work environment which promotes equal opportunity, cooperation and full participation for all its employees.

Environmental Goals

Shore considers the environment as an integral part of all stages of project planning and strives to implement and follow environmental best management practices. In order to meet or exceed regulatory and industry standards, promote a shared responsibility for environmental management with all employees and to adapt to changes in regulation and the natural environment, Shore will:

- collect and analyze meaningful environmental information to better understand the potential effects of its activities on the environment;
- evaluate alternatives and maintain flexibility in project design to reduce its environmental footprint where practical;
- educate employees in environmental best management practices and permit conditions relevant to their work;
- continually monitor, evaluate and modify its environmental practices and procedures where applicable;
- use innovative solutions to reduce its environment footprint by:
  - reducing, reusing and recycling wastes;
  - maximizing the benefits of any resource utilized; and
- evaluate procedural alternatives and new technologies.

Community Goals

Shore will build long-term relationships with neighbouring communities and will engage these communities through open communication and mutual respect to share information and allow community partners to participate in meaningful ways. Shore will gather community input to shape Project development and will provide opportunities for communities to enhance their ability to participate in economic opportunities provided by the Project.

For the duration of the Project, Shore will recognize the unique position of First Nations and Métis people in Canada through their treaty and constitutional rights, will provide support to the government in respect of the government's duty to consult with First Nations and Métis people, and will assess and discuss the potential socio-economic benefits of the Project with First Nations and Métis communities through employment and business participation.

Shore will achieve this by:

- working collaboratively with communities, governments and institutions to create training opportunities for skill development in industry-related occupations;
- providing employment opportunities with a focus on local participation and build relationships with local suppliers and businesses to obtain quality, competitively priced goods and services in a timely fashion;
- developing meaningful engagement and communication with First Nations and Métis and other neighbouring communities;
- creating mutually beneficial relationships with First Nations and Métis communities to promote training and recruitment of young people into trades, technical and skilled occupations; and
- networking with the government to support and facilitate the government's duty to consult process, when possible.

Security Goals

In order to ensure a safe and secure work environment and to limit the possibilities for theft and ensure the protection of its assets by planning and coordinating effective and efficient security initiatives, Shore will:

- develop and promote a sense of security awareness as a shared responsibility for all its employees;
- ensure professionalism, cooperation, sensitivity, and mutual respect are maintained throughout security programs and initiatives; and
- foster stakeholder and partner confidence by ensuring a consistent standard of enhanced security.

7.3.4 Sustainability Policy

Shore's Sustainability Policy includes commitments to benefit the local economy, environmental protection, capacity building, and partnerships, including:

- implementing and maintaining ethical business practices and meeting or exceeding applicable sustainability standards and legal requirements;

- integrating short, medium, and long-term sustainable development considerations and practices into its decision making;
- engaging with people affected by its activities in an effective and transparent manner and considering their views and concerns;
- respecting cultures, customs, heritage and values in its dealings with local First Nations, Métis and other communities;
- contributing to the conservation of biodiversity, and using integrated and consultative approaches to land management; and
- developing partnerships that foster sustainable development, including enhancing the social and institutional development and economic benefits for the local First Nations, Métis and other communities.

7.3.5 Sustainability Objectives

Within each value, objectives were determined, and goals established to strive to meet each objective. These objectives and goals are summarized below.

Safety Objective:

To ensure a safe and healthy workplace and to share responsibilities related to safety.

People Objective:

To value performance and foster a respectful workplace that is representative of a diverse workforce.

Environmental Objective:

To undertake comprehensive planning utilizing industry best environmental management practices, innovation and continuous improvement.

Community Objective:

To be involved in the local communities, including First Nations and Métis communities, and to provide economic opportunities for those communities.

Security Objective:

To provide security for employees and assets and foster stakeholder and partner confidence.

7.3.6 Implementation

Program Development

Shore corporate governance practices guide the development of management systems. Some of the performance objectives will be further developed during the transition between development and production of the Project to include mine managers in the process.

Shore has a variety of programs that have been previously developed that support its sustainability initiatives.

Sustainability Planning

Shore has begun to identify and engage stakeholders in discussions about the elements of sustainability. Potential objectives for the Project will be assessed with reference to Shore's vision and sustainability commitments. This engagement process will result in a set of Project-specific sustainability objectives, implementation plans, metrics and reporting criteria.

Assessment of Progress

Shore will test its progress against the sustainability objectives both at the corporate and Project level.

Indicators and Monitoring

Shore will establish a set of specific indicators to monitor its contributions to, and effects on, sustainability.

Results of indicator monitoring will be reported annually in the Project's Sustainability Report as a part of the annual environmental report beginning at the end of the first full year of operations.

Ongoing Engagement and Review

As part of the on-going consultation process Shore will continue to host regular (likely quarterly) Diamond Development Advisory Council (DDAC) meetings, with representatives from the local First Nation, Métis and other communities. An engagement and review process will be established that provides for annual reporting as a part of the annual environmental report, including comment monitoring results and an on-going stakeholder forum process for discussing current and future initiatives.

7.4 MONITORING AND FOLLOW-UP PLAN

The monitoring and follow up plan provides the conceptual framework for construction, operation, closure and post closure monitoring for the Project. A more detailed plan will be developed prior to construction once detailed engineering is completed.

7.4.1 Introduction

Monitoring will allow Shore to adjust the Project to inevitable changing conditions. Mitigation and management for the Project before it is constructed depends on assessment of potential impacts and public and government concerns expressed through engagement and the approval process; however, it is almost impossible to fully and accurately predict all environmental effects which might arise from the Project at an early stage, as it is possible that the impact assessment may fail to identify and mitigate all negative impacts which the Project could have on the natural and social environment. For these reasons, monitoring and evaluation of the Project's environmental impact following approval and implementation is an important part of the overall project cycle.

7.4.2 Biophysical Monitoring

Monitoring of the biophysical environment will include monitoring of the valued components identified as part of the impact assessment, as listed below, and will be carried out through all phases of mining as appropriate:

- air quality;
- noise;
- terrain and soils disturbance;
- vegetation, wildlife habitat and wildlife;
- hydrology;
- surface water quality;
- aquatic effects;
- groundwater quality and quantity;
- sediment;
- reclamation and revegetation;
- geochemical stability (ARD/ML); and
- geotechnical stability (of berms, dykes and overburden and rock storage and processed kimberlite storage piles).

7.4.2.1 Air Quality Monitoring

The air quality monitoring plan will address the concentration of suspended particulate matter in the air surrounding the major areas of activity (dynamic monitoring; Figure 7.4-1) and the deposition rate of particles (static monitoring; Figure 7.4-2).

Dynamic monitoring will be based on high volume (HV) air sampling for PM_{10} and $PM_{2.5}$. The monitors will be deployed at the site boundary in the direction of the prevailing wind (i.e., the east side), away from any taller structures or trees. Results will be extracted on a monthly basis for comparison to the relevant ambient air quality standards in order to determine the status of Project compliance and, if necessary, guide in implementation of the most appropriate mitigation method.

Static monitoring of dust deposition will follow the ASTM D1739-98 Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter), using a dust canister to measure the amount of dust that settles out of the atmosphere by the effect of gravity deposited on a unit area over a certain length of time. The Saskatchewan provincial standard is 20 g / (m^2 month). It is proposed to deploy three static samplers: one, at the east side of the site, near the dynamic sampler; one by the Star pit near the waste conveyor; and one in the area of the processing plant near the overburden and rock storage pile. The samplers will be replaced every month and gravitational analyses performed at an accredited laboratory.

The purpose of ambient air quality monitoring is not only to check degree of compliance but also to:

- commit to reporting emissions in support of Canada's Voluntary Challenge Registry (see www.ghgregistries.ca/assets/pdf/Challenge_Guide_E.pdf);
- refine environmental management systems, reporting and stewardship;
- share data with regulators to provide a better understanding of air quality; and
- report particulate matter emissions to National Pollutant Release Inventory (NPRI), if necessary.

The particulate matter monitoring program will be implemented for the operations phase only as emissions during the construction phase will continuously change spatially and temporally. After the first year of monitoring during the operation phase, the results will be reviewed and the sampling program will be maintained, expanded, contracted, or discontinued, as appropriate. The monitoring program will adhere to the Air Monitoring Directive for Saskatchewan (SMOE 2007).

7.4.2.2 Noise Monitoring

To effectively manage noise and blast emissions throughout the life of the Project a noise monitoring program will be implemented.

An ambient 24-hour sound monitoring survey will be conducted annually once full production is reached to verify predictions in Section 6.2.3.3 and measure the actual ambient sound level for the day and night time periods, 1500 m from the noise sources and at any identified critical receptors. The survey will include the sound pressure level of the slow-response, A-weighted, 1/3 octave bands between 31.5 Hz and 16 kHz required for the tonal and impulse/impact adjustment. The calculated permissible sound levels described in Section 6.2.3.3 will be reviewed when the Project is in operation.

No other noise monitoring program is proposed unless a noise complaint investigation must be undertaken. In such cases Shore will attempt to resolve the issue through direct contact with the complainant to understand the concerns and establish a dialogue to set reasonable expectations, and a time frame for action to resolve the issue.

7.4.2.3 Soil Quality Monitoring

Sampling frequency and parameters analyzed for soil quality will be adapted based on results from air quality and surface water monitoring results, to evaluate the linkages between deposition of dust on soil quality and potential drawdown of groundwater on soil moisture. Soil monitoring will be coordinated with vegetation monitoring to occur at the same sites, and may be integrated with existing Provincial monitoring sites within the FalC.

The soil monitoring program will include two rounds of sampling in Year 1 (May and August to determine if any seasonal variations occur) to collect additional baseline information, including moisture content. Thereafter, monitoring will take place as required based on the results of the air quality monitoring and surficial groundwater monitoring.

Monitoring would be conducted with test pits located downwind and down gradient from mine facilities; and upwind and upstream from these facilities at designated control points.

The suite of analyses for the monitoring program may include:

- inorganic:
  - pH (H_2O), CEC+Ca+Mg+K+Na;
  - Anion Exchange Capacity;
  - electrical conductivity+S+SO_4;
  - Phosphorus; and
  - full metals scan using ICP-MS;

- organic:
  - toluene extractable organics.

7.4.2.4 Vegetation, Wildlife Habitat and Wildlife

Biodiversity

Impacts were predicted at a regional level due to increased areas of disturbance and linear disturbances. These are best monitored by maintaining a spatial disturbance data layer and measuring landscape level indicators on a regular basis. An update interval of 10 years is suggested. Other biodiversity effects are addressed within the Vegetation and Wetlands and Wildlife subheadings below.

Vegetation and Wetlands

Vegetation monitoring will provide additional information to verify predicted impacts and could be used to help develop mitigation programs and best management practices and policies.

The increase in weeds and other non-native plant species was predicted to have significant effects on vegetation in the Local Study Area. Vegetation monitoring will include annual on-site monitoring of weeds and other non-native plant species. Information from this monitoring will be used to help plan control measures as planned in the Project Weed Management Plan (Appendix 7-C). Successful implementation of this plan will reduce these predicted impacts.

Biodiversity monitoring is suggested for species at risk that occur within the LSA. The suggested monitoring interval is annually for two years to establish initial conditions, followed by once every five years, to examine long term trends. The following taxonomic groups, with consideration of appropriate SARA listed species, would be monitored using standard methods applicable to each discipline:

- Plants;
- Songbirds;
- Amphibians; and
- Butterflies.

Searches will be conducted to identify suitable habitat outside of the Project footprint. These areas could then be used to transplant known rare plants that would be disturbed or removed during Project clearing as mitigation. This is needed to ensure that these species are not permanently lost within the confines of the Project footprint. If species can be relocated into suitable habitat prior to clearing activities, these relocation sites will be

monitored as part of the species at risk program. If a rare plant species is delisted, monitoring of this species would cease.

Monitoring of vegetation within a variety of sites (i.e., old growth forests, wetlands, riparian communities and uncommon vegetation classes) will be conducted to ensure theses areas are not further affected by encroaching weeds or other edge effects. The monitoring interval will be annually for two years followed by once every five years. The total area of these vegetation features should also be monitored using updated spatial data on 10 year intervals, to ensure the total area is not being reduced by Project disturbances. As part of the vegetation monitoring, berries and other country foods will be collected to supplement understanding of effects on country foods.

Wetlands are also predicted to be impacted by the Project due to drawdown associated with mine dewatering. A monitoring program examining the effects on wetland vegetation will be implemented. The monitoring interval will be annually for two years followed by once every five years.

Wildlife

Effects monitoring for wildlife will be used to confirm the accuracy of the effects predictions in the EIA and to assess the effectiveness of mitigation and enhancement measures. Adaptive management will form the basis for the mitigation and monitoring program. The Project effects will be minimized and managed by following best management practices, adjusting mitigation measures, and implementing new mitigation measures where required. As part of the wildlife monitoring, wild game meat will be periodically collected and tested to further understanding on effects to country foods.

Wildlife monitoring will include pre-construction monitoring and construction/operations phase monitoring. Pre-construction wildlife surveys will be conducted by trained Shore employees. The pre-construction surveys will be subject to the timing of construction activities relative to construction activity restriction windows, to identify active nests or dens of species of conservation concern. Activity restriction buffers (distance and timing) during construction will be followed as per industry best practice. The majority of clearing is planned to occur during early and mid-winter, outside of the activity restriction windows. However limited clearing of smaller blocks may occur during an activity restriction window. Should such instances arise, appropriate pre-construction surveys (e.g. a migratory bird nest search) will be conducted within 7 days of the clearing activity to confirm whether the clearing can proceed without affecting a species of conservation concern (including relevant SARA listed species.

Construction and operation phase monitoring will include:

- Annual monitoring at least the first two years of construction to establish an appropriate baseline. The monitoring will then be adjusted (e.g 3 year intervals) where appropriate to monitor trends during the operation phase. Monitoring will include:
    - Wildlife winter track and ungulate pellet transect surveys to assess changes in range occupancy by ungulates and other wildlife within the LSA ±10 km buffer.
    - Wetland monitoring of representative sites within the LSA ±5 km buffer to assess changes in wildlife distribution and use in relation to project activities by amphibians (spring call survey), waterfowl/waterbirds (spring nesting survey) and passerine birds during breeding/nesting season
    - Systematic point-count bird surveys of the LSA and a control area to assess changes in community structure in relation to the project footprint and to monitor use by migratory birds and bird species of conservation concern.
    - Nesting raptor survey of LSA ±5 km buffer during construction and operation phases to assess whether local project activities might be having an effect on raptors (particularly for species that reuse platform nests) proximate to the Project area
- monitoring of wildlife mortalities due to human interactions (e.g., vehicle collisions) along Project roads and facilities;
- monitoring the, sewage lagoon, kimberlite and overburden piles, and other site facilities for wildlife use during the life of the project to identify potential or actual wildlife-project conflicts that can be mitigated or avoided;
- monitoring reclaimed areas as appropriate, to assess effectiveness of reclamation on wildlife re-colonization and use; and
- maintaining a daily wildlife management log to determine Project areas where wildlife interactions are most common and helping to develop a hazard awareness program to reduce wildlife/human/operations interactions.

7.4.2.5 Hydrogeology and Hydrology

A program to monitor groundwater levels in dedicated monitoring wells installed by Shore in all appropriate geological layers (i.e., Mannville Formation, Colorado Shale (if present), lower till, upper till, and surficial sands) and in private water supply wells will be developed to confirm the predictions of dewatering effects. This will include wells located close to and distant from the Project and wells completed in different aquifers, including the Mannville Group aquifer and deep sand seam aquifers in the till. Limited domestic wells in surficial sands will also be monitored, as will peizometers installed in the surficial sands within the FalC. A number of monitoring wells outside the drawdown cone of the mine in analogous

environmental conditions will also be included to identify seasonal and climate variations. Further details are provided in Section 6.2.6. Other monitoring will include:

- continuous measurements of the discharge volume from the dewatering systems;
- periodic sampling of the discharge water;
- stream flow measurements in area creeks and in a reference watershed; and
- collection of climate data from established monitoring stations, including precipitation and snow pack data.

The monitoring will be used to confirm that the predictions based on the groundwater model are consistent with observed drawdowns, and to incorporate newly drilled private wells drilled in the region into the monitoring program. As part of the follow up program, the ground water model will be periodically updated and calibrated to the new data. The monitoring will continue for at least two decades after pumping ceases, and will continue until a clear recovery trend is established after mine closure.

Groundwater modelling predicts changes in area streams, particularly English Creek which is fish bearing. The hydrology monitoring network set up for the baseline studies will be re-established and will be updated to include water level gauges to be installed and operated throughout the open water season. These sensors will be pulled during the ice-over season since levels on ice covered streams are not accurate due to water flowing over the ice and between ice layers. The established stage-discharge relationships will be used to convert water levels to discharges. Data will be used to monitor the effects of the Project on stream water levels and as a check against impact predictions.

7.4.2.6 Surface Water Quality

Water quality monitoring will commence at construction and continue through the post-closure period, with the goal of identifying changes in water quality before they become impacts, according to the principles and study design suggested in the Metal Mining Effluent Regulations (MMER). The aquatic effects monitoring plan will be designed according to all applicable regulations. Methodology will follow guidance contained in CCME Protocols Manual for Water Quality Sampling in Canada (CCME 2012). Monitoring will be modified as required by changes in the Project and future regulatory requirements (i.e., the development of specific diamond regulations) to reflect:

- adaptive management and lessons learned;
- changes in the mine configuration; and
- regulatory requirements at the time of the update as prescribed.

Construction Period

Mine Site

During site clearing, temporary sedimentation ponds will be constructed as needed to prevent sediment export to surface water bodies, and will operate to settle suspended solids and release water overland or receiving streams. Target release water quality will be in accordance with the *Metal Mine Effluent Regulations* or other appropriate limits. During construction, daily field turbidity readings will be taken and monthly samples will be collected for lab TSS analyses. A turbidity action level (where additional mitigation/treatment may be needed) will be negotiated with SMOE prior to issue of the effluent permit. The location and timing of construction of temporary sedimentation ponds will be developed during detailed engineering and prior to commencement of construction.

Access Road Upgrade

Access road upgrades will follow best practices and, for crossings of fish-bearing waters, DFO Operational Statements pertinent to road construction and maintenance in Saskatchewan. Silt screens will be used to prevent sediment transport downslope into water bodies. Construction that could affect fish bearing water bodies will not be carried out during rain storm events. Any new or upgraded ditches over 5% grade will be armoured to reduce erosion. Standard erosion and suspended sediments monitoring will be provided to ensure adequacy of mitigation measures.

Operations Period

During operations surface water quality monitoring will include monthly sampling of the sites shown on Figure 7.4-3 to evaluate compliance with water quality requirements and to observe changes over time. Monthly sampling of PKCF water effluent will commence once the facility is constructed and Fine PK is pumped to it. Rationale for the sites selected is provided in Table 7.4-1.

Table 7.4-1: Rationale for Surface Water Quality Site Section

Site	Rationale
English Creek above the PKCF	Control site upstream of the Project
English Creek at mouth	Control site down gradient of the Project facilities
Wapiti Ravine at mouth	Monitor effects of Coarse PK storage on water quality
Duke Ravine at mouth	Monitor effects of Project facilities on water quality before entering the Saskatchewan River
East Ravine upstream of access road	Control site upstream of the Project
East Ravine at mouth	Monitor Project effects on water quality before East Ravine enters the Saskatchewan River
West Ravine at mouth	Monitor Project effects on water quality before West Ravine enters the Saskatchewan River
101 Ravine downslope of overburden & rock storage	Near field site to monitor effects of the storage facility on water quality
101 Ravine at mouth	Monitor effects of the OB & rock storage facility on water quality before it enters the Saskatchewan River
Caution Creek upslope of the overburden & rock storage facility	Control site above the facility
Caution Creek at mouth	Monitor effects of the OB & rock storage facility on water quality before it enters the Saskatchewan River
Saskatchewan River upstream of the Project	Control site for Saskatchewan River water quality
Saskatchewan River downstream 200 m below English Creek	Monitor Saskatchewan River water quality downstream of the Project below the mixing zone with English Creek.
PKCF	Monitor water quality of the PKCF
Discharge to Saskatchewan River	Monitor discharge water quality

Closure

At closure, periodic sampling of surface water will continue at the above-referenced sites until reclamation is completed and the site has stabilized.

Post-Closure

At the end of the closure period, and depending on water quality from previous monitoring, water sampling will be scaled back and sites where water quality has reached background levels will be discontinued in communication with SMOE.

7.4.2.7 Field and Laboratory Procedures for Water Quality

The parameters for analysis will be finalized with SMOE through permit review but are anticipated to be similar to those used during baseline studies, although detection limits used by the analysis laboratory will keep pace with advances in assay technology (i.e., industry standard detection limits will apply). Table 7.4-2 lists the parameters that will be analyzed. These parameters are the same as those monitored during baseline studies.

Table 7.4-2: Surface Water Quality Parameters for Monthly Monitoring

Physical	Anions	Cations	Nutrients
pH	Chloride	Calcium	Ammonia – N
Conductivity	Fluoride	Magnesium	Nitrite – N
Total dissolved solids	Sulphate	Potassium	Nitrate – N
Total suspended solids	Carbonate	Sodium	Total Kjeldahl N
Turbidity	Bicarbonate		Total dissolved P
Total hardness		**Organics**	Total P
Total alkalinity		Total organic carbon	
Total and Dissolved Metals			
Aluminum	Cesium*	Molybdenum	Tin
Antimony	Chromium	Nickel	Titanium
Arsenic	Cobalt	Rubidium*	Tungsten*
Barium	Copper	Selenium	Uranium
Beryllium	Iron	Silver	Vanadium
Bismuth	Lead	Strontium	Zinc
Boron	Manganese	Tellurium*	Zirconium*
Cadmium	Mercury	Thallium	

Note: * optional, to be discussed with SMOE.

An accredited laboratory will be contracted to undertake analyses. Standard field and laboratory procedures and QA/QC will be employed including blanks and duplicates in the field and duplicates and spiked standards in the laboratory. Results will be reported to appropriate regulatory agencies monthly and summarized in an Annual Report.

Water quality predictions will be updated and presented to regulators every 5 years as part of updates to the overall Closure Plan.

7.4.2.8 Fisheries and Aquatic Resources

For fisheries and aquatic resources monitoring will commence at construction and continue through the post-closure period, and will be coordinated with water quality monitoring into an aquatic effects monitoring plan, in order to achieve the goals set out by the Environmental Effects Monitoring system set out in the MMER. The plan will be modified as required by changes in the Project and regulatory requirements to reflect:

- adaptive management and lessons learned;
- changes in the mine configuration; and
- regulatory requirements at the time the update is prescribed.

Construction Monitoring

Construction of Site Facilities

Monitoring in local streams, including the 101 Ravine, West Ravine, East Ravine, and Duke Ravine as well as Caution Creek and English Creek, will be conducted simultaneously with fish capture and salvage operations. Fish count and species identification will be recorded to confirm habitat utilization in these areas. Total suspended sediments / turbidity monitoring will be in place at all construction sites that can have a potential effect on streams to ensure mitigation measures are effective.

Operations Period

Saskatchewan River and Major Tributaries

During operations fisheries and aquatic resources monitoring will include sampling every other year of the sites shown on Figure 7.4-3 to evaluate the affect of the Site and to observe changes over time. Fisheries and aquatic resources sampling sites have also been selected in conjunction with the water quality monitoring locations to get a comprehensive assessment at these locations. Rationale for the sites selected is provided in Table 7.4-3.

Table 7.4-3: Rationale for Fisheries and Aquatic Resources Site Section

Site	Rationale
English Creek above the PKCF	Control site upstream of the Project
English Creek at mouth	Control site down gradient of the PKCF
Caution Creek upslope of the overburden & rock storage facility	Control site above the facility
Caution Creek at mouth	Far Field site to monitor effects of the overburden & rock storage facility on fisheries and aquatic resources before it enters the Saskatchewan River
Saskatchewan River upstream of the Project (upstream of Caution Creek)	Control site for Saskatchewan River fisheries and aquatic resources
Saskatchewan River downstream 200 m below English Creek	Monitor Saskatchewan River fisheries and aquatic resources downstream of the Project below the mixing zone with English Creek.
Discharge to Saskatchewan River	Monitor potential discharge effects on fisheries and aquatic resources

At each of these sampling locations, fish populations surveys (electrofishing) and benthic community surveys with sediment texture and chemistry will be conducted every second year. Additional control sites may be added during detailed design.

Note that a draft Habitat Compensation Plan is proposed in Section 6.3.1 to offset direct impacts to fish habitat. Additional monitoring for the plan will be detailed in the plan.

Closure

At closure, periodic sampling of surface water will continue at the above-referenced sites until reclamation is completed and the site has stabilized.

Post-Closure

At the end of the closure period, and depending on water quality from previous monitoring, water sampling will be scaled back and sites where water quality has reached background levels will be discontinued in communication with SMOE.

7.4.2.9 Waste Water

Monitoring wells will be installed within 50 m from the outer perimeter of the sewage lagoon at three sites (one upgradient and two downgradient) of the sewage lagoon. Shallow

groundwater quality will be monitored on a seasonal basis for the parameters listed in Table 7.4-4.

Table 7.4-4: Waste Water Monitor Well Parameters

Parameter	Canadian Drinking Water Guidelines
Biochemical Oxygen Demand	no guidelines
Total coliform	Health Canada: <10% of samples/ mo. w/ detectable TC
Fecal coliform	Health Canada: none detectable
Ammonia – N	no guidelines
Nitrite – N	3.2 mg/L
Nitrate – N	10 mg/L
Odour	Inoffensive
Oil and grease	Inoffensive
Taste	Inoffensive
Total Kjeldel Nitrogen	no guidelines
Total Phosphorus	no guidelines
pH	6.5 – 8.5

7.4.2.10 Sediment Sampling

Prior to construction, during the first year of operation and subsequently every five years, sediment samples will be collected and analyzed for metals from:

- Saskatchewan River downstream of English Creek;
- Saskatchewan River upstream of Caution Creek; and
- Saskatchewan River 100 m downstream of the outfall from the diffuser.

7.4.2.11 Reclamation and Revegetation

Construction and Mine Operations

Vegetation monitoring will entail the establishment of representative vegetation sampling locations to assess potential effects of fugitive dust emissions during construction and mine operations. During construction and mine operations, experimental/test plots will be continued to investigate on a small scale those revegetation practices to be used when the reclamation plan is fully implemented. Test plots will help determine the most appropriate plant species and revegetation methods for use on a large scale. Routine monitoring of the test plots will continue and will include vegetation condition, and observations of wildlife

grazing pressure. Success criteria (e.g., survivorship, cover, and plant health/vigour) will be developed in order to define success versus failure.

Post-Closure

A post-closure monitoring program for reclaimed areas, as well as for areas of "natural" recolonization, will be developed, based on what is learned from the programs established during the operations phase. Monitoring locations will be established systematically and will encompass the dominant post-closure habitats, including upland forests, shrublands, wetlands, marshes, and pit lakes. Vegetation monitoring protocols will be adapted to the different habitat classes. The goal of this monitoring will be to examine species that colonize the sites, their growth rates and biomass, the amount of downed wood and litter layer development on terrestrial sites, growth of mosses in wetlands and establishment of aquatic vegetation in pit lakes and marshes. The suggested monitoring interval is annually for 4 years followed by once every 5 years to a maximum of 10 years, after which the program would be re-evaluated.

7.4.2.12 Geochemical Drainage

Drainage from overburden and processed kimberlite storage facilities will be monitored on a monthly basis during operations and periodically post mining, to confirm that these drainages are not acidic and do not contain elevated levels of metals in the ravines. Seepage from the PKCF will tested during operations and either pumped back to the PKCF or released through natural wetlands. The need for treatment of other site drainage will be assessed from water quality samples collected during the operations and closure phases. Based on studies to date, acid generation is not expected.

7.4.2.13 Geotechnical Stability

The physical stability of Project facilities will be monitored annually by an independent geotechnical engineer. This monitoring will be designed to meet the Canadian Dam Safety Guidelines (Canadian Dam Association 2007) where necessary. A report will be forwarded to the SMOE and the Ministry of Energy & Resources, Mines Branch presenting these findings annually.

Weekly visual inspections of these facilities will be conducted by appropriate mine personnel and observations logged for inspection by the independent geotechnical engineer, and government regulators upon request.

7.4.3 Socio-Economic Monitoring

The purpose of socio-economic monitoring is to determine the actual effects of the Project on the human environment as construction and operations progress. Results of socio-

economic monitoring will be used to ascertain the extent to which the assessment predictions bear out, and whether Project socio-economic programs could be improved. Monitoring is particularly critical for socio-economic issues as they are driven largely by individual choice and interplay with other societal factors and developments that progress and evolve over time.

7.4.3.1 First Nations, Métis and the General Public

Shore intends to develop a socio-economic monitoring program that will operate throughout the life of the mine. The program will meet the following objectives:

- comply with any permits, authorizations and approvals that are related to socio-economic effects;
- assess the effectiveness of approved mitigation and enhancement measures; and
- verify the accuracy of impact predictions made in the EIS.

This monitoring will be an important part of the on-going dialogue between Shore and the nearby affected communities. Depending on the extent to which monitoring findings indicate the Project is compliant with any permits, authorizations and approvals, the extent to which mitigation and enhancement measures are effective, and the extent to which effect predictions are accurate, monitoring can contribute to adaptive management. Shore will use this principle by assuring timely feedback of monitoring results to Project management, triggering appropriate follow-up.

Best practices in mining projects suggest that monitoring is best done in co-operation with affected stakeholders. Shore will seek to design and implement its monitoring program, and indicators to be monitored, in collaboration with governments, Aboriginal groups, communities and other stakeholders. Shore commits to sharing the results of its annual monitoring exercises with the SMOE, First Nations and Métis and other communities and the public at large, as requested. The Monitoring Plan will be reviewed as required with the SMOE. While precise monitoring indicators will be developed in consultation with local communities, economic indicators that could be monitored include:

- Aboriginal and local employment;
- employment of women;
- value of contracts for local firms/contractors as well as Saskatchewan firms;
- number of successful completions of local training programs; and
- Shore's corporate investments, donations and other spending in the local area.

Social indicators that may be monitored could include: concerns about traffic safety and road conditions, concerns about local service provision and quality of life (including health

and social conditions such as traffic violations, drug/alcohol and violent crimes), injuries, infectious disease, addiction services caseloads, children-in-care caseloads, and service provider perceptions of social issues.

The methods used to gather information will originate with the DDAC and may include the compilation of statistical data, public meetings, individual interviews, or focus groups. Any data limitations and underlying assumptions will be documented.

To assist with data collection, Shore will develop consistent and timely data gathering procedures and mechanisms to ensure that the information collected and analyzed (for example, on numbers of employees by home community) is accurate. In addition, Shore will adhere to its Code of Ethics to protect confidential information from misuse or disclosure.

Results of the monitoring program will be presented to communities, governments, local First Nations, Métis, and other communities and the general public will be done through public meetings, newsletters, annual reports and other methods as appropriate.

7.4.3.2 Worker Health Monitoring

Shore will work through its Occupational Health and Safety Committee to develop a worker health monitoring program that will have three key components:

- health surveillance;
- exposure assessment; and
- environmental monitoring.

Health surveillance programs may include monitoring for respiratory conditions and hearing loss. Exposure assessment may include area and personal monitoring programs. Physical, chemical, biological and ergonomic hazards will be assessed in through the Health and Safety Plan.

7.4.4 Auditing and Continual Improvement

Regular review of the monitoring plan will be undertaken and modifications made as necessary.

Formal evaluations of the monitoring plan will be documented, deficiencies noted, and progress in addressing deficiencies tracked in writing. Responsibilities to address deficiencies and accountabilities will be assigned and deadlines for addressing required changes will be set. The Occupational Health and Safety Committee will assume overall responsibility for the process.

7.4.5 Record Keeping and Reporting

Monitoring records will be maintained for all significant environmental and health and safety matters, including accidents, spills, fires, occupational illnesses and other emergencies. This information will be reviewed and evaluated to improve the effectiveness of all the programs that involve environmental and health and safety programs.

Annual or periodic reports as required will be filed with government agencies as specified in Project permits.

7.5 CLOSURE AND RECLAMATION PLAN

The proposed conceptual closure and reclamation plan provides for soil salvage, closure, conservation and reclamation activities needed to comply with regulatory and permit requirements, including the *Reclaimed Industrial Sites Act*. A more detailed plan will be developed following construction once more accurate closure timelines have been established.

7.5.1 Reclamation Objectives

The objectives of the conceptual Closure and Reclamation Plan are to:

- revegetate disturbed areas as soon as they are no longer active;
- revegetate sites so that the vegetation communities post closure are similar to naturally occurring vegetation communities in the FalC forest post closure;
- reclaimed soils should be similar or better than baseline soils with respect to soil moisture holding capacity and organic matter content;
- replace a variety of ecosites (combinations of soil, drainage and aspect) such that a diversity of vegetation communities can be supported; and
- incorporate traditional knowledge and traditional land use (when available) into closure planning so that traditional uses can continue after closure.

The conceptual plan presented is expected to evolve using adaptive management to incorporate the most recent and best information available as mining progresses. Shore anticipates regular updating of this plan throughout operations, to incorporate the results from on-going revegetation trials (both research and operational) and traditional knowledge through regular meetings with regulators and Aboriginal groups.

7.5.2 Merchantable timber

All merchantable timber within the Project footprint will be harvested according to discussions with the Forest Service branch of the SMOE and an appropriate forest product contractor. Shore will coordinate with the Forestry Branch to ensure that the volumes

expected from the Project footprint are appropriately incorporated into the FalC annual allowable cut.

7.5.3 General Soil Salvage

Soil salvage is generally not warranted on the coarse textured Brunisols of the Pine and La Corne soil associations. These soils have coarse texture (sand to loamy sand), very thin LFH (typically less than 4 cm) and Ae horizons less than 10 cm. Due to the very thin A and LFH horizons, salvage of topsoil is not feasible without dilution of organic material with poor material below. In general, these soils are rated as having a poor reclamation suitability (Table 7.5-1).

Table 7.5-1: Reclamation Suitability Ratings of Soils within the Project Footprint

Quality Rating	Topsoil			Subsoil		
	Baseline Area (ha)	Disturbed Area (ha)	Disturbed Area (% of LSA)	Baseline Area (ha)	Disturbed Area (ha)	Disturbed Area (% of LSA)
Good	781.1	31.1	-	-	781.1	31.1
Good-Fair	297.8	-	-	-	297.8	-
Fair	-	-	1,473.2	98.3	-	-
Poor	7,688.0	3,320.0	7,688.0	3,320.0	7,688.0	3,320.0
Poor-Fair	2,170.8	270.0	2,170.8	270.0	2,170.8	270.0
Organic	621.5	101.2	227.2	34.0	621.5	101.2
Disturbed Land	251.0	158.8	251.0	158.8	251.0	158.8
Water	407.5	1.1	407.5	1.1	407.5	1.1
Total	12,217.7	3,882.2	12217.7	3,882.2	12,217.7	3,882.2

Note: From Table 6.2.2-9, Section 6.2.2 (Terrain, Soils and Geology).

Short term (i.e., less than 2 years) stockpiling or direct placement of fair or good reclamation suitability material will be considered as practical. In particular, soil from ravine areas (e.g., West Ravine) may be targeted for salvage and direct placement on areas not planned for further development. Any short term stockpiles will be located within the facility footprint.

7.5.4 Non-merchantable vegetation, woody debris and perimeter berms

Stumping and grubbing of non-merchantable material will only occur where needed for geotechnical stability, and generally placed only when suitable for direct placement. Material around the perimeter of the site will be pushed into large windrows to act as natural security berms, and serve as a long term stockpile of organic matter and limited topsoil.

This material will otherwise be placed in the overburden pile or buried. Chipping and shredding will be considered for use as erosion control or as a mulch for revegetation.

7.5.5 Revegetation

Revegetation is assumed to mean tree planting, and areas will be planted or seeded with understory species (i.e., shrubs and/or native grasses) if required to meet reclamation goals. All seeds and seedlings will be sourced locally and inspected for weeds prior to use. In areas where rapid revegetation would reduce erosion risk, or on areas that may be re-disturbed in the future, annual and perennial grasses may be seeded. Annual barley may be seeded on these areas, and seeding of native grasses will be evaluated during construction to determine if their use is appropriate. Possible revegetation options are listed below:

1. natural revegetation on areas with direct placement of topsoil;
2. planting of tree seedlings in reclaimed disturbed areas;
3. seeding of tree species and other species on bare soil;
4. planting of native shrubs on reclaimed disturbed areas; and
5. temporary seeding of annual grasses for erosion control.

Tree planting would supplement any natural regeneration on site using 4-10a or 4-12a containerized seedlings at a rate of approximately 1,200 to 1,600 stems per hectare. In dry areas, an open canopy is targeted (a/b canopy closure) while on moist and wet areas, a closed canopy is targeted (c/d). Planting of understorey species is assumed to be at a density of 200 stems/ha and may occur at the same time as tree planting or may be delayed until the tree species are established. The exact species composition will depend on site specific conditions, and is provided on a conceptual basis in the Table 7.5-2. Dry sites are defined as xeric to submesic, moist sites are generally mesic and sub hygric, and wet sites are hygric to subhydric. For the FalC forest, soils generally have low nutrient contents. In general, medium nutrient sites include medium and isolated rich sites, while poor nutrient sites include poor and very poor sites.

Table 7.5-2: Conceptual Replanting Densities (Adapted from Alberta Environment 2010)

Moisture	Nutrients	Tree Species	Density	Understory Species[1]	Density
Dry	Poor	*Pinus banksiana* (jack pine)	1,200	*Vaccinium myrtilloides* (blueberry)	100
				Ledum groenlandicum (Labrador tea)	100

Moisture	Nutrients	Tree Species	Density	Understory Species[1]	Density
	Medium	*Pinus banksiana* (jack pine)	800	*Vaccinium myrtilloides* (blueberry)	50
		Populus tremuloides (aspen)	500	*Ledum groenlandicum* (Labrador tea)	50
				Amelanchier alnifolia (Saskatoon)	50
				Rosa acicularis (rose)	50
Moist	Poor	*Pinus banksiana* (jack pine)	700	*Amelanchier alnifolia* (Saskatoon)	100
		Populus tremuloides (aspen)	700	*Corylus cornuta* (beaked hazelnut)	100
	Medium	*Picea glauca* (white spruce)	1000	*Alnus rugosa* . (river alder)	100
		Populus balsamifera (balsam poplar)	400	*Ribes* spp. (current)	100
		Populus tremuloides (aspen)	200		
Wet	Poor/Medium	*Picea mariana* (black spruce)	600	*Salix* spp. (willow)	200
		Picea glauca (white spruce)	600		

Note: These understorey species are a preliminary list only; species may be added or subtracted based on results of the TK and TLU studies and revegetation studies, or to more accurately reflect vegetation conditions at closure.

Jack pine seeding or spreading of cones may replace or reduce the need to plant containerized seedlings on areas of disturbed soil for the dry-poor, dry-medium, and moist poor sites. Jack pine is adapted to disturbance and has been demonstrated to germinate well on bare soil based on preliminary observations of the on-site revegetation trials as described below. Table 7.5-2 should be read in coordination with Figure 7.5-1, which shows the predicted areas of different nutrient-moisture conditions in the reclaimed landscape by facility. The generalized planting prescriptions and soil nutrient-moisture conditions were analyzed to estimate the post-closure vegetation communities on the landscape (Figure 7.5-2). Note that site-specific conditions would lead to the development of a somewhat more

complex distribution of vegetation communities. This complexity is discussed in a general manner in the sections below, as more specific analysis would be highly speculative.

It is important to note that the entire site is not expected to be cleared, but rather islands of intact forest will be left near the facilities, and within the proposed mineral lease area, where possible. These forested islands will assist with natural recruitment of vegetation, and provide a nearby source of seeds, reflecting the vegetation composition in the baseline forest.

7.5.5.1 On-Going Revegetation Trials

Several revegetation studies have been initiated by Shore to determine appropriate reclamation and revegetation options at closure. These trials include:

- Greenhouse trial conducted by Dr. Anne Naeth of the University of Alberta. This study looked at plant growth of various species on Fine PK, Coarse PK on their own and amended with sand from the FalC, agricultural topsoil from north of the FalC, compost, composted biosolids from Prince Albert, and chemical fertilizer. The final report is included as Appendix 7-E. Although conclusions varied for each processed kimberlite type, in general, un-amended PK showed reduced germination and growth as compared to the treatments. Response of trembling aspen was poor, enven in the potting soil controls, which suggests that the greenhouse conditions may not have been ideal for this species. Overall, amended PK was able to support growth of several reclamation species. As a result of this work, the depth of sand or overburden placed as a cap on the CPK and the PKCF was increased to a minium of 100 cm;;
- Site Revegetation Plots. Plots were established in 2008 to look at plant growth on bare sand, sand with topsoil and slash rolled back, Fine PK, Coarse PK, a mix of Fine and course PK with the following treatments: no treatment, spreading of jack pine cones, seeding native grass and planting jack pine seedlings. Initial results show that the roll back areas have the highest vegetation growth, the bare sand has the highest jack pine seedling survival, and the kimberlite treatments have the lowest revegetation. In general, this trend has continued, however, with good growth of established vegetation on all treatements (likely due to relatively wet conditions over the last two growing seasons, with increased grass density in all treatments. More results are expected, as this study is on-going; and
- Pad Reclamation Study. Drill pads from were selected to monitor long term revegetation based on age, reclamation method and size. Several sites were inaccessible due to localized flooding in 2011, and could not be surveyed. Results are expected in 2012 or 2013.

7.5.6 Development and Reclamation of Site Facilities

7.5.6.1 Plant Site

The area of the plant site is 36.9 ha, and occurs in an area regenerating from past fire and harvesting activities. None of this area currently contains merchantable timber. The plant site will be cleared and levelled. About 42,000 m^3 of soil rated with a fair or good reclamation suitability will be salvaged and placed in windrows along the south and northwest perimeter of the site for future use.

At closure, once all mining and processing has been completed, all infrastructure and equipment will be removed from the site or buried (inert waste only), sold as used equipment or scrap where possible and the land returned to an acceptable end-land use as determined by the EIA. All industrial wastes would be either returned to suppliers or removed from site for disposal by a licensed waste contractor. All concrete foundations would be broken up and buried.

The plant site will then be re-contoured to blend into the surrounding topography, and any salvaged organic material rolled back to an average depth of 15 cm. Deep ripping may be required to alleviate the effects of compaction.

At closure, the plant site is expected to have a combination of dry-poor, dry-medium and moist-poor areas based on changes in slope position and limited availability of reclamation material, and planting prescriptions will be applied as outlined in Table 7.5-2. Even considering the re-coutouring, the site is expected to be relatively level, and have a somewhat homogenous distribution of vegetation types at closure (Figure 7.5-2). Closure vegetation is expected to resemble BP03 (Jack pine- feathermoss) ecosite over the entire site (36.9 ha), with inclusions of BP04 (Jack pine - trembling aspen – feathermoss) in specific micro site conditions. Due to potential future accessibility, the plant site area could be identified as an area where traditionally used plants are targeted, depending on the results of future discussions. There will be no opportunities for direct placement of reclamation material or progressive reclamation on the plant site as it will be active for the duration of the Project.

The plant site is expected to be returned to a jack pine dominated area, with similar soil nutrient capacity as existing pre-development.

7.5.6.2 Processed Kimberlite Containment Facility (PKCF)

The area of the PKCF is 513.6 ha, of which approximately 3.3 ha is merchantable timber. Stumping, grubbing and removal of all organic material will be required under the starter berm, and under the outer berm as it is being constructed with the dewatered fine kimberlite. Assuming a 30 cm depth to ensure geotechnical stability, the estimated amount of material

from under the starter berm is 0.1 Mm^3, and the amount from the ultimate berm footprint is estimated to be an additional 0.45 Mm^3. The current plan is to dispose of the first 0.1 Mm^3 within the PKCF. Approximately 25% (about 0.11 Mm^3) of the remaining material is planned to be pushed to the outer boundary of the PKCF using bulldozers to create a perimeter security berm. The remainder will be used for direct placement or disposed within the overburden pile or PKCF.

Internal drainage within the PKCF will follow the existing slope created by the beached Fine PK at a slope of 1%. Internal drainage at closure will toward the low area in the PKCF, with surface runoff directed to the Duke Ravine at closure. Drainage of the outer slopes will be collected initially collected in the perimeter ditch and routed natural wetlands in the Duke and English Creek watersheds. No engineered drainage channels are expected to be required on the outer slopes of the PKCF, with the exception of the main outlet, which will either feed into the existing drainage system or directly to the Duke Ravine.

Note that the PKCF is expected to operation only during mining at Star. Although, due to the center line construction method using dewatered Fine PK, progression reclamation is not possible of the PKCF, reclamation of the entire facility can begin in approximately year 17, beginning with the outer berm slopes. Ponded water in the PKCF will pumped to the Star pit prior to closure, and the surface allowed to dry out before placement of reclamation material. During exploration, sub 0.5 mm fine PK was found to be free draining, with no permanent ponded water 1 year after use. Since the fine PK in the PKCF is less than 1 mm material, higher permeabilities are expected, and no issues are expected (i.e., problems with trafficability) with capping once inputs cease. .

At closure, the perimeter berms will be rolled back onto the toe slope of the PKCF. Assuming a 15 cm depth, about 73 ha would be covered. The remaining exposed Fine PK will be mixed with a top dressing of at least 100 cm of sand or other overburden material, and/or mixed with suitable soil amendment (composted biosolids or other) based on the results of ongoing research.

A gently undulating surface topography will be constructed using place cap material and reworked fine PK with slopes ranging from 0 to 2%. Relief within the PKCF would be less than 2 m. Closure characteristics are summarized in Table 7.5-3.

In general, the perimeter of the PKCF is expected to be dry-moderate (149 ha), while the interior of the PKCF is expected to range from wet-moderate (15 ha) near the centre, moist-poor (93 ha) around the central area, and dry-poor (257 ha) around the inside of the berm (Figure 7.5-1).

Revegetation prescriptions (Table 7.5-2), based on the closure moisture and nutrients, would be applied to the PKCF, resulting in 199 ha of BP02, 149 ha of BP04, 57 ha of BP12,

89 ha of BP14, 16 ha of BP25 and 3 ha of BP28 at closure (Figure 7.5-2). A conceptual vegetation-landscape cross section is presented in Figure 7.5-3.

Table 7.5-3: Closure Characteristics of the PKCF

	PKCF Pile	
	Side slopes	Main pile
Parent Materials	Fine PK	Fine PK
Subsoil placement	100 cm	100 cm
Topsoil Placement	15 cm roll back	none
Slopes	4:1	0 to 2%
Aspect	Variable	Variable
Drainage structures	To permiter ditches	Contingency for overflow to ditches
Landform type	Incline	Gently undulating
Relief	<1 m	0-2 m

7.5.6.3 Overburden and Rock Storage Pile

The area of the overburden and rock storage pile is 2,008.3 ha, and contains approximately 1,391 ha of merchantable timber. Once merchantable timber is harvested, the overburden and rock storage pile will be constructed without stumping and grubbing, with the exception of a 20 to 30 m area around the perimeter of the facility to create a temporary material stockpile and security berm. The proposed security berm will be constructed around the final overburden and rock storage pile. Assuming an average depth of 20 cm (to avoid admixing) the total volume of reclamation material, minus the non-merchantable material would be about 100,000 m^3.

The overburden and rock storage pile will be constructed out of sand, silt, and till from the Star pit and the Orion South pit. This material will be placed as it is excavated, so that the surface of the pile has a mosaic of surface textures and drainage, thus creating a complex pattern of moisture regimes. It is not possible to predict the exact locations where the various material will be deposited; however, based on the proportions of sand, clay and till expected at the Star pit, approximately 15% of the surface area is expected to have a sandy soil texture and the remainder the surface area will have clay soil texture.

The overburden and rock storage pile would be progressively reclaimed with reclamation material from the Star and Orion South pits whenever possible. As described below, non merchantable material, organic soil horizons, and some mineral topsoil would be removed by small equipment prior to excavation by the In-pit Crushing and Conveying (IPCC) system

and directly placed on the overburden and rock storage pile. The side slopes would be constructed during excavation of the Star pit, and would be available for direct placement of topsoil from Orion South. In addition, the southernmost one third of the area is expected to be complete during excavation of Orion South, and would receive material from Orion South Phase 2. Topsoil placement depth would be 15 cm. The area reclaimed during operations will encompass almost 1,579 ha (Figure 2.6-3).

Of the total OB material (943 Mm^3), approximately 29 Mm^3 (or 3.0% of the total volume) will be Colorado Group shale. As described in the geochemistry baseline, this shale is saline and sodic due to its marine origin. As a result, it is unsuitable as a surface material for revegetation, and will be buried under a minimum of 2 m of other overburden.

Surface drainage will be constructed as shown on Figure 2.6-2 to direct any surface runoff into the 101 Ravine to the south, and into the Caution Creek drainage to the north. Slopes within the drainage areas will be designed to be geotechnically stable, and erosion control blankets will be applied as needed. Target slopes in the drainage channels will be 1 to 2%, and channel length will be extended on the OB pile side slopes by creating meanders. Surface topography will generally be undulating to level with slopes ranging from 0 to 10% in the main pile area, with drainage basins created by stacking at slightly different heights during operation. Moisture regimes are expected to be wet within depressions created within the drainage channels (45 ha), moist within the drainage areas (263 ha), moist on 85% of the remaining area due to the clay-clay loam subsoil, and dry on 15% of the area due to sandy subsoil (total of 1,700 ha). Closure characteristics are summarized in Table 7.5-4.

Revegetation prescriptions (Table 7.5-2), based on the closure moisture and nutrients, would be applied to the overburden and rock storage pile. Revegetation would be expected to replace 528 ha of BP032, 297 ha of BP04, 617 ha of BP09, 320 ha of BP12, 133 ha of BP14, 76 ha of BP25 and 36 ha of BP28. A conceptual vegetation-landscape cross section is presented in Figure 7.5-4.

Table 7.5-4: Closure Characteristics of the Overburden and Rock Storage Pile

	Overburden Pile	
	Side slopes	Main pile
Parent Materials	15% Sand, 85% Clay loam	15% Sand, 85% clay loam
Subsoil placement	None	None
Topsoil Placement	15 cm	15 cm (southern 1/3 only)
Slopes	4:1	0 to 10%
Aspect	Variable	Variable
Drainage structures	Designed channel for outlet to 101 Ravine and Caution Creek	Drainage as shown
Landform type	Incline	undulating
Relief	<2 m	0-10 m

7.5.6.4 Pit Areas

The Star pit has a total area of 588.8 ha and an area of merchantable timber of 45 ha. The Orion South pit has a total area of 427.6 ha, none of which contains merchantable timber.

The pit areas will be cleared for mining using smaller equipment as the IPCC system does not handle woody debris well. This separate handling of surface material (organic horizons and non merchantable timber) allows for subsequent direct placement on the overburden and rock storage pile for later stripping of Star. Orion South material will be placed directly on the last phase of the overburden and rock storage pile, and then directly placed on the PKCF. There is the opportunity to place Orion South overburden within the Star pit, reducing pit infilling time, reducing the area of the Overburden and Rock Storage Pile, and potentially reducing the area of the Star pit lake. This option will be further considered during detailed design.

Drainage on the Star pit will internal to the Star pit lake, and then to the south where the East Ravine intersects the pit. Slopes within the drainage areas will be designed to be geotechnically stable, and erosion control blankets will be applied as needed.

The exposed upper pit slopes will receive direct placement of at least 15 cm depth of reclamation material, and will be considered to have a moderate nutrient regime.

The final pit slope upper benches (i.e., surface sand and clay benches) on both pits will be revegetated with annual and native perennial grasses as soon as possible, whether or not they will be subsequently flooded at closure or potentially buried by back fill, either using broadcast seeding or a straw erosion control blanket over broadcast seeding. Lower bench

areas (i.e., benches within till) will be monitored for dust generation and may be revegetated as above. If necessary the former East Ravine channel will be armoured (if it to be used as drainage channel) or raised to prevent drainage from the Star pit Lake to the Saskatchewan River.

The Star pit will be used for the disposal some overburden from Phase 4 or Star and of Fine PK from Orion South. Material will be deposited from the north part of the pit. . The deepest part of the Star pit will be backfilled by overburden from pushback development up to 267 masl from year 10 to year 17 of mining. Fine PK material and process water from Orion South will be placed to the partially backfilled part of the Star pit from year 18 to year 24 and the pit bottom elevation will rise up to 307 masl at the end of mining.

At closure, the Orion South fine PK would be covered by groundwater naturally filling the Star pit. The elevation of the Star pit lake at closure is expected to be 392 masl (which is the elevation of the discharge point from the lake into the existing East Ravine). Up to 4,100 m^3 of water per day is predicted to be discharged through the East Ravine from groundwater. Surface runoff would add to the predicted flows. Modeling results show that 80% of the pit lake water, at a steady state comes from surface runoff (SRK 2011). Closure water quality is discussed in Section 6.2.7 and Appendix 6.2.7-A. In pit water quality is not expected to influence reclamation efforts.

At closure, the Orion South pit lake is expected to be at 411 masl. Upper pit slopes will be reclaimed progressively during pit construction with placement of at least 15 cm of reclamation material. The Orion South pit lake will not discharge.

Since the upper pit slopes will have a placement of top soil, and are likely to receive water both from precipitation and groundwater discharge, they are expected to be moist-moderate sites (128 ha for Star and 85 ha at Orion South). The remainder of the area would be considered open water, with wetland vegetation developing around the perimeter of the lake where benching creates shallow water (461 ha for Star and 343 ha at Orion South). Revegetation prescriptions (Table 7.5-2), based on the closure moisture and nutrients, would be applied to the upper slopes of the pits, and modified accordingly based on the composition of the seeded grasses. Resulting vegetation communities are expected to be BP 03 (<1ha), BP09 (37 ha), BP15 (91 ha) and BP 28 (62 ha) at the Star Pit and BP15 (85 ha) and BP28 (23 ha) at Orion South, with the remainder open water. Conceptual vegetation-landscape cross sections are presented in Figure 7.5-5 and 7.5-6. Slopes in the exposed area are expected to range from level to 20%.

Water quality modeling is presented in Section 6.2.7 for the pit lakes, and predicted discharge water quality for the Star pit is reproduced in Table 7.5-5 below. The Orion South pit lake is expected to remain brackish. The option to fill either or both of the pit lakes with water from the Saskatchewan River will be evaluated during detailed design. Further

reductions of the the hydraulic connection between the lake and the Mannville Aquifer could be achieved by placement of overburden from Orion South in the Star pit, along with fine PK. The decision as to the action to be taken at closure will be determined in conjunction with the local stakeholders and the regulators over the life of the mine.

Table 7.5-5: Predicted Star Pit Lake Discharge Water Quality at Closure

Parameter	Units	Star Pit Release Concentration
Conventional Parameters		
Total alkalinity	mg/L	120
Total dissolved solids	mg/L	460
Total hardness	mg/L	93.7
Turbidity	NTU	57
Major Ions		
Calcium	mg/L	30
Carbonate	mg/L	3
Chloride	mg/L	152
Fluoride	mg/L	0.23
Hydroxide	mg/L	1.8
Magnesium	mg/L	8.1
Potassium	mg/L	5.5
Sodium	mg/L	123
Sulfate	mg/L	65
Nutrients		
Ammonia as nitrogen	mg/L	0.2
Dissolved organic carbon	mg/L	1.6
Nitrate	mg/L	1.63
Total Phosphorus	mg/L	0.03
Metals		
Aluminum	mg/L	0.023
Antimony	mg/L	0.00009
Arsenic	mg/L	0.00083
Boron	mg/L	0.29
Cadmium	mg/L	0.00005
Chromium	mg/L	0.0035
Cobalt	mg/L	0.0005
Copper	mg/L	0.0006
Iron	mg/L	0.19
Lead	mg/L	0.00024
Manganese	mg/L	0.045
Mercury	mg/L	-

Parameter	Units	Star Pit Release Concentration
Molybdenum	mg/L	0.0007
Nickel	mg/L	0.007
Selenium	mg/L	0.00009
Silver	mg/L	0.000026
Strontium	mg/L	0.22
Thallium	mg/L	0.00006
Tin	mg/L	0.000033
Titanium	mg/L	0.004
Uranium	mg/L	0.0002
Vanadium	mg/L	0.0011
Zinc	mg/L	0.012

Linear corridors

Topsoil will be used to create a side berm along all linear corridors (i.e., internal roads, pipeline routes, conveyor right-of-ways [RoWs]). At closure, this material will be rolled back onto the corridor. Culverts and other infrastructure will be removed. On compacted areas, deep ripping may be needed to reduce soil bulk density. At closure, these areas are assumed to be a dry-poor or dry-medium sites, and will be revegetated to conform with undisturbed adjacent vegetation at closure as shown on Figure 7.5-2. The total area of these facilities is approximately 87.8 ha, with 5 ha of merchantable timber.

Coarse PK pile

The Coarse PK pile covers 179.9 ha with no merchantable timber. The Coarse PK pile will be constructed over the existing topography. No stumping or grubbing of non-merchantable timber is expected, however standing vegetation may be knocked down to create a working surface for the stacker. The organic materials at the perimeter of the Coarse PK pile will be pushed to create a security berm and act as a reclamation material stockpile.

The Coarse PK pile will remain active throughout operations and may be reprocessed, so progressive reclamation is not feasible.

In the event it is determined that the Coarse PK will not be reprocessed, a cap (at least 100 cm) of sand or other suitable reclamation material will be placed over the entire structure, along with any treatments determined during on-going studies. The cap material would likely be sourced from the Overburden and Rock Storage Pile to avoid creating additional disturbances. The perimeter berm would be rolled back to cover the lower slopes of the pile, and revegetated to a dry-poor (171 ha) site.

The Coarse PK pile will be contoured at closure to direct drainage to the south east toward the Duke Ravine, and to the west toward the East Ravine. Drainage channels will be engineered to be geotechnically stable with target slopes of 1% and erosion control blankets will be applied as needed. Due to the coarse nature of the CKP, limited runoff is expected, and the drainage channels are assumed to be dry for most of the year. However, these channels may be considered as moist-poor (9 ha) sites for revegetation. Closure characteristics are summarized in Table 7.5-6.

Revegetation prescriptions (Table 7.5-2), based on the closure moisture and nutrient regime, would be applied to the Coarse PK pile. Revegation is expected to result in 95 ha of BP02, 46 ha of BP04, 29 ha of BP12, and 9 ha of BP25. A conceptual vegetation-landscape cross section is presented in Figure 7.5-7.

Table 7.5-6: Closure Characteristics of the Coarse Processed Kimberlite Pile

	CPK Pile	
	Side slopes	Main pile
Parent Materials	Coarse crushed kimberlite	Coarse crushed kimberlite
Subsoil placement	100 cm	100 cm
Topsoil Placement	15 cm roll back	none
Slopes	3:1	0 to 5%
Aspect	Variable	Variable
Drainage structures	Outlets to Duke and east Ravine	Outlets to Duke and east Ravine
Landform type	Incline	undulating
Relief	<1 m	0-5 m

Access Corridor and Other Areas

The paved access road will remain in place at closure to provide access to the site for post closure monitoring and for access by other land users. The access corridor contains 19 ha of merchantable timber, both in the LSA and RSA. On-going maintenance of the access road once no longer required by Shore will be discussed with the local RM and with the Saskatchewan Ministry of Highways and Infrastructure at that time.

Other areas (and merchantable timber amounts) not covered above are listed below:

- Camp Facility 0.1 ha (0 ha);
- Explosive Storage <0.1 ha (0 ha);
- South Settling pond 1.7 ha (0 ha);

- Polishing pond 1.7 ha (0 ha);
- Runoff Pond 6 ha (2 ha);
- Sewage Lagoon 3 ha (0.6 ha); and
- Wells 0.1 ha (0.0 ha).

Final Closure Costs

Closure costs are estimated in Table 7.5-7 below.

The cost to re-grade and contour piles is estimated at $0.25 per square meter to create large topographic variations and construct the general layout of drainage channels. For costing, it was assumed that 25% of each area would require contouring.

The cost to move and spread reclamation material is estimated at $4 per cubic meter, assuming dump truck hauling and spreading with a bull dozer or grader.

The cost to create stable drainage channels has been estimated at $5.00 per square meter. This cost includes additional grading, slope stabilization (i.e., erosion control blankets at $1.50 /$m^2$) and revegetation. For costing, it was assumed that 10% of each area would require creation of drainage channels.

Tree planting costs were estimated based on information provided by the ForestFirst Center in Prince Albert (Michael Bendzsak Pers. Comm.). Planting density was assumed to be 1,400 tree stems per ha and 200 understory stems per ha, an average seedling cost of $0.34 per seedling (including $0.25 per tree seedling) and a contingency number of $0.90 for understory species (as determined by an internal Shore estimate), and a planting cost of $0.35 per seedling, totalling approximately $1,100 per ha.

Table 7.5-7: Closure Cost Estimates

Facility	Estimated Area (ha)	Contouring ($)	Reclamation Material Depth (m)	Reclamation Material ($)	Drainage ($)	Revegetation ($)	Total ($)
PKCF	513	320,625	0.3	6,156,000	2,565,000	564,300	9,605,925
CPK	180	112,500	1	7,200,000	900,000	198,000	8,410,500
Ob Pile	2,008	1,255,179	0.15	12,049,717	10,041,431	2,209,115	25,555,442
Star Pit	589	368,013	0.15	3,532,927	2,944,106	647,703	7,492,748
OS pit	428	267,228	-	-	2,137,822	470,321	2,875,370
Plant Site	37	23,091	0.15	221,677	184,731	40,641	470,140
Structures & HSWDG*		-	-	-	-	-	28,000,000
Roads and Access	141	88,125	0.15	846,000	705,000	155,100	1,794,225
Ponds	7	4,607	-	-	36,858	8,109	49,573
Conveyors and access	24	20,504	0.30	393,674	164,031	36,087	614,296
Other cleared Areas	9	5,625	0.15	54,000	45,000	9,900	114,525
Total	3,936	2,465,497	-	30,453,995	19,723,978	4,339,275	84,982,745

***Note:** The Structure and HSWGD costs include all potential remediation and removal of structures with no salvage value.

1- These costs will be considered in addition to mining costs.

Temporary shut down

For the purposes of this discussion, a temporary shut-down is a shut-down where all mining and processing is temporarily halted for a period of greater than 1 month. At the present time, no temporary shut-downs are anticipated. If a temporary shut-down is required, then the site may have to be put under care and control maintenance. Although the actual activities that would occur at this time would be dependent on management decisions at that time, from a conceptual basis it is envisioned that this may entail the following activities:

- incineration and/or removal of all garbage and hazardous waste;
- removal of all blasting materials and any excess/broken equipment;
- moving all in-pit equipment either to a bench at the mid-point of the pit or completely out of the pit;
- pumping out the sewage lagoon;
- ensuring that all environmental inspections and security continue during the shut-down; and
- regrading all steep slopes on the overburden and Coarse PK piles to reduce erosion.

7.6 REFERENCES

Alberta Environment. 2010. *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd Edition*. Prepared by the Terrestrial Subgroup of the Reclamation Working Group of the Cumulative Environmental Management Association, Fort McMurray, AB. December 2009.

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