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MINISTRY ASSESSMENT

To: Hubert Bunce
From: Luc Lachance

Date: August 20, 2013
File: PR-105809

Application: Permit Application (refuse / soil / effluent)			Pre-Application Date: October 12, 2011
NAICS: 212311 (Quarry) 562910 (Waste Management)	Production Capacity: 100,000 tonnes/yr	Risk Ranking: 1.68	Application Date: May 4, 2012
Applicant: South Island Aggregates (Cobble Hill Holdings Ltd (0754588 BC)			
Location of Facility: 640 Stebbings Road, Shawnigan Lake			

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Ministry of Environment
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LIST OF ACRONYMS

Active Earth	*Active Earth Engineering Inc.*	MoE	*Ministry of Environment*
BCA/WWQG	*BC Approved or Working Water Quality Guidelines*	MTBE	*Methyl Tertiary Butyl Ether*
BCGS	*BC Geological Survey*	PAHs	*Polycyclic Aromatic Hydrocarbons*
BTEX	*Benzene, Toluene, Ethylene and Xylene*	PCDD	*Polychlorinated dibenzo-p-dioxin*
CALA	*Canadian Association for Laboratory Accreditation Inc.*	PCDF	*Polychlorinated dibenzofuran*
CSR	*Contaminated Sites Regulations*	PCOC	*Potential Contaminants of Concern*
CSRA	*Contaminated Soil Relocation Agreement*	RL	*Residential Level*
CVRD	*Cowichan Valley Regional District*	SIA	*South Island Aggregates*
EMA	*Environmental Management Act*	SRA	*Shawnigan Residents Association*
EMS	*Environmental Management System*	STMA	*Soil Treatment and Management Area*
EPM	*Environmental Procedures Manual*	TAR	*Technical Assessment Report*
HW	*Hazardous Waste*	TEF	*Toxicity Equivalency Factor*
HWR	*Hazardous Waste Regulation*	TEQ	*Toxicity Equivalent Quotient*
IL	*Industrial Level*	VIHA	*Vancouver Island Health Authority*
LEPHs/HEPHs	*Light and Heavy Extractable Petroleum Hydrocarbons*	VPH	*Volatile Petroleum Hydrocarbons*
LRO	*Land Remediation Office*	WHO	*World Health Organization*
M/FLNRO	*Ministry of Forest, Land and Natural Resources Operation*	WTS	*Water Treatment System*
MEM	*Ministry of Energy and Mines*		

1. ADMINISTRATIVE ASPECTS

1.1. Application Request

South Island Aggregates Ltd. (SIA) applied for a permit to treat and discharge hydrocarbon contaminated soil and landfill untreatable waste (including but not limited to soil) at their active quarry site located at 640 Stebbings Road, Shawnigan Lake, BC. SIA retained Active Earth Engineering Inc. (Active Earth) as their consultant and agent for the application. The initial application form was received by MoE on October 12, 2011, including the first technical assessment report by Active Earth. A preliminary meeting was attended by the Ministry of Environment (MoE), SIA and Active Earth on May 5, 2011.

The application is for the treatment and landfilling of a maximum of 100,000 tonnes/year of contaminated soils and associated ash (referred to as material or waste throughout this document). Two types of wastes are proposed to be received at the site. The first type of incoming material is amendable hydrocarbon contaminated soils above the Contaminated Sites Regulation (CSR) Residential or Industrial Land Use (RL or IL) standards but excluding Hazardous Waste (HW) as defined in the Hazardous Waste Regulation (HWR). The proposed soil treatment will reduce hydrocarbon concentrations below the CSR IL standards prior to discharge at the quarry site. The second type of incoming material is untreatable waste above the CSR IL standards but excluding HW. This second type of waste is proposed to be permanently encapsulated in engineered landfill cells of various sizes and shapes. The material received at the site is proposed to be used as fill (placed in landfill cells) and, if appropriate, as cover material for the progressive closure of the quarry site. Received soil may also be shipped off site once treated although this is not expected to be common operation. The proponent may also receive soil for direct discharge in the landfill (for direct backfill of the excavation) if soil quality is meets final land use.

1.1. Application Revision

The initial application submitted on October 12, 2011 was for the discharge of contaminated soils only. However, following the first review of the application MoE identified that an effluent discharge was also part of the proposal (Refer to Section 1.2 below) and that an effluent discharge authorization was required in addition to the soil discharge authorization. The effluent discharge application was submitted with the second draft TAR in February, 2012. The effluent discharge application submitted provided details on the proposed effluent discharge and indicated that the discharge would meet the BC Approved and/or Working Water Quality Guidelines (BCAWWQG), whichever is most stringent, for Freshwater Aquatic Life.

There were no revisions to the application to discharge contaminated soils (i.e. discharge quantity, quality and receiving environment), though Active Earth's Technical Assessment Report (TAR) went through numerous drafts.

The application revisions resulted in changes to the design, operational and closure aspects of the proposal. The revision also provided clarity on the type and quality of incoming material and the Potential Chemicals of Concern (PCOC). The PCOC list was defined as Benzene, toluene, ethylbenzene, xylenes (BTEX), styrene, Methyl tertiary butyl ether (MTBE), Volatile petroleum hydrocarbons (VPHs), Light and heavy extractable petroleum hydrocarbons (LEPHs/HEPHs), Polycyclic aromatic hydrocarbons (PAHs), Chlorinated Hydrocarbons, Phenolic Substances, Glycols and Metals as defined in Schedules 4 and 5 of the CSR. Later in the process, the proponent indicated that contaminated soils and associated ash were being considered for the site and the PCOC list was amended to include dioxins and furans, which are often associated with incinerator ash. The consultation period spanned May 2012 through to October 2012. The final TAR and Consultation Reports are dated August 2012 and November 2012 respectively.

Due to the nature of the application, MoE reviewed the authorization process and determined that the proposed activity did not constitute a reviewable project as defined under the Reviewable Project Regulation, Part 6 – Waste Disposal Projects. Therefore, the application could be assessed and approved following the process described in the Waste Discharge Regulation and did not require an Environmental Assessment. This is based on the fact that the proposed facility did not constitute a hazardous waste facility as defined under the HWR.

Based on a phone discussion with SIA (Marty Block on February 5, 2013), SIA requested to issue the authorization to Cobble Hill Holdings Ltd. (0754588 BC). SIA and its consultant, Active Earth, confirmed the facility location to be 640 Stebbings Road and not 693 or 639 Stebbings as stated in documents submitted previously.

2. HISTORY

The proposed soil treatment and landfill facility is located on Lot 23, Blocks 156, 201 and 323 within an active granite quarry site permitted under the *Mines Act* permit Q-8-094. The quarry permit was issued in August 2006 and last amended in April 2009. Concurrent to the application to discharge waste under the *Environmental Management Act* (EMA), an application was also made to the Ministry of Energy and Mines (MEM) to amend the mine reclamation plan. The purpose of the *Mines Act* permit amendment was to modify the intended end land use of the quarry site for Residential Level (RL) to Industrial Level (IL) in order to accommodate the proposed soil discharges. The SIA property zoning is defined in the Electoral Area B – Shawnigan Lake Zoning Bylaw No. 985 and is currently is zoned F-1 – Primary Forestry. The quarry site is owned by Cobble Hills Holdings Ltd (0754588 BC) and managed by SIA and its expected life is in the order of fifty to sixty years.

MoE does not have any compliance history on file as there is currently no authorization associated to the site under EMA. However, some information is available regarding a fill site located on the adjacent quarry site, on Lot 21, Blocks 156 and 323. This lot is owned by a numbered company (0782484 BC) which is also managed by SIA. Contaminated soils from 140 Hallowell Rd., View Royal (site 1947), was delivered at SIA fill site without a Contaminated Soil

Relocation Agreement (CSRA) between October and November 2010. Since then, MoE Land Remediation Office (LRO) who is responsible for the issuance of CSRA has been in regular contact with SIA to resolve the situation. In January 2011, the presence of Tetrachloroethylene exceeding CSR IL land use standards in the soil was confirmed by Active Earth in an email to the LRO.

A notice of independent remediation dated November 17, 2011 was received by the LRO. However, because the work did not proceed, LRO requested SIA to proceed with an independent remediation order under section 54(3)(d) of the Act on November 30, 2011. Due to delays in the remediation work, a letter was issued by the LRO on March 20, 2012 indicating their non-compliance with this section of EMA. The soil was ultimately excavated from the fill site, temporarily relocated and protected from the weather along the east boundary of the quarry site. The issue has not yet resolved and soil is still stored along the east boundary of the quarry site.

Both the quarry site and the fill sites have a restrictive covenant running along their East property boundary which aims at protecting the Shawnigan Creek drainage. The covenants are discussed in greater details in the TAR (Section 8.7, p.93).

3. TECHNICAL ASPECTS

3.1. Source of Discharge

3.1.1. Soil

Contaminated soil is proposed to be accepted for treatment and landfilling from excavation and remediation of contaminated sites originating in the Southern Vancouver Island area. The proponent proposes to receive soil for treatment with worst case concentrations exceeding CSR RL or IL standards but less than hazardous waste levels. Organic/treatable soils are proposed to be bioremediated prior to being encapsulated, reused as fill material at the quarry site or shipped off-site if appropriate.

The following parameters are listed in the TAR and proposed to be treated using typical bioremediation treatment in bio piles:

- Petroleum Hydrocarbons
- Polycyclic Aromatic Hydrocarbons
- Chlorinated Hydrocarbons
- Phenolic Substances
- Glycols

Inorganic/untreatable soils such as soils contaminated with metals, other inorganic contaminants and/or heavy molecular weight/complex organic contaminants are proposed to be landfilled within engineered landfill cells at the site. The PCOC associated to this application are listed below and are defined in Schedules 4 and 5 of the CSR:

- Benzene, toluene, ethylbenzene, xylenes (BTEX);
- Dioxins and Furans;
- Styrene;
- Methyl tertiary butyl ether (MTBE);
- Volatile petroleum hydrocarbons (VPHs);
- Light and heavy extractable petroleum hydrocarbons (LEPHs/HEPHs);
- Polycyclic aromatic hydrocarbons (PAHs);
- Chlorinated Hydrocarbons;
- Phenolic Substances;
- Glycols;
- Metals.

Dioxins and furans were included in the assessment process when the proponent indicated that incinerator ash may be associated with some soils to be landfilled at its facility.

3.1.2. Inert Industrial Waste

Inert industrial waste materials from industrial processes may also be accepted at the proposed facility, excluding Hazardous Wastes (HW) as defined under the HWR. The proponent specifically mentioned incinerator ash as a potential source of industrial waste discharge. Incinerator ash may be associated to other contaminants like dioxins, furans, metals and hydrocarbons but the co-contaminants concentrations must not make the waste HW. Liquid waste is NOT proposed to be accepted at the site.

In the TAR, the source of incoming industrial waste is not limited to excavation and remediation of contaminated sites. However, industrial waste was later limited to soil with associated ash for the purpose of this assessment. This is further discussed in the assessment section below (Section 7.1).

3.1.3. Surface Water

Contact and non-contact treated surface water runoff as well as treated leachate constitutes the three distinct sources of surface water discharge at the facility.

Surface water runoff that may be in contact with contaminants (contact water) is proposed to be diverted away from the clean runoff (non-contact water) by the construction of diversion swales and channels. Clean runoff will be directed to a settling pond located downstream of the proposed water treatment system (WTS) while contact water and leachate will be directed to specific holding tanks prior to being treated and discharged to the settling pond. The initial

proposal, as stated in the TAR, indicated that water discharged from the WTS would meet BC Water Quality Guidelines for the protection of aquatic life (BCWQG-AL). This was revisited by the proponent following the Draft Permit Consultation period (refer to Section 6 of this assessment). The water discharged from the WTS is now proposed to meet the BCWQG for drinking water use (BCWQG-DW).

The settling pond will discharge to a natural drainage path to an ephemeral tributary leading to Shawnigan Creek approximately 1 km downstream from the Site. Phased drainage systems are proposed to ensure the separation of potentially contaminated and clean water will be maintained throughout the life of the operation and following the mining plan. A variety of preventive measures are also proposed to limit the amount of leachate generated at the Site. Details on the WTS, the settling pond and the associated preventive measures are discussed in the TAR and summarized in the sections below.

No groundwater discharge is proposed from the facility. Risk to groundwater quality is further discussed in the assessment section below.

3.2. Treatment of Discharge

3.2.1. Soil

As described in the TAR (TAR Section 9.1), soils are proposed to be treated using standard biopile techniques. Bioremediation will take place in soil piles under a covered area, as naturally occurring bacterial break down hydrocarbons. The process may be enhanced through the addition of nutrients and other amendments. Soil piles will be aerated (mixed or turned) from time to time and volatilization will also occur for some hydrocarbon constituents.

Untreatable soils will be permanently landfilled in engineered cells equipped with leak detection and leachate collection systems. Leachate generated within the cells will be stored and treated by the WTS prior to discharge to the settling pond. Details of the WTS are provided in Section 3.6 and the leak detection and the leachate collection systems are provided in Section 7.2.

3.2.2. Surface Runoff and Leachate

Clean surface runoff will be kept separate from the active areas and diverted to the settling pond where solids will be removed prior to discharge to an ephemeral tributary to Shawnigan Creek (refer to Section 3.4.4 below). Potentially contaminated water and leachate will be stored in dedicated holdings tanks prior to treatment and then discharged to the settling pond. The proposed WTS is composed of a pH and flocculent injection system, a primary settling tank with three separate chambers in series, parallel bag filters and activated carbon vessels. Based on discussions with Active Earth, the WTS treatment efficiency and capacity can easily be increased by adding or duplicating specific treatment components to the proposed WTS. Treated water can also be recirculated if additional treatment or removal efficiency is needed.

Operational aspects are summarized in the operations' section below (Section 3.6) and details can be found in the TAR (TAR Sections 6.0 and 8.4). Additional details on the WTS and its operation were provided by Active Earth in the February 15, 2013 letter and are summarized below.

3.3. Discharge Location

3.3.1. Soil Discharge

The contaminated soil discharge location is described in the TAR (TAR Section 5.4, p.43) and referred to as the landfill area. Treated and encapsulated/landfilled soil is proposed to be initially discharged in the northwest corner of the property. The soil discharge area will progressively move south as mining progresses as the soil discharge plan will closely follow the established quarry phasing plan (TAR Figures 11 to 14). The mining operation is currently implementing phase 5 of its mining plan. A minimum buffer of 20 m is proposed to be maintained between the operation and the Shawnigan Creek covenant located along the east boundary of the property. Treated soil is also proposed to be used as fill or as cover for the engineered cells and provide the initial contour required for the mine closure, provided that all specifications are met.

The facility will include a soil treatment and soil management area combined into what is referred to as the Soil Treatment and Management Area (STMA). This is where the incoming soils will initially be received, characterized and treated. The STMA will be built on an asphalt pad and will operate under a "semi-permanent or intermediate" cover to limit rainwater contact with contaminated soils and the generation of leachate. The TAR specifies that the soil management area where the soil will initially be received and characterized will be covered at all times while the soil treatment area will be covered only during unfavorable conditions (inclement weather). However, Active Earth noted in recent communications and in their February 15, 2013 letter that tarps would initially be used to cover the soil piles. The STMA will also include a holding cell designated to temporarily store suspect or reject soils. The holding cell is proposed to be within the soil management area, adjacent to the STMA and equipped with tarps and lock blocks. The suspect or reject soils will be kept out of the elements to limit leachate generation. Details of the operation of the STMA and the associated design are presented in sections 3.6.3 and 5.2.3 respectively.

As indicated above, drainage from the STMA and any active landfill area where engineered cells are being built will be diverted to the WTS prior to discharge. Site drainage will be modified as mining, soil treatment and disposal progresses to maintain an effective separation between clean and potentially contaminated runoff. The STMA is approximately 1800 m^2 while the estimated active landfill area is also 1800 m^2.

The entire landfill area, including the STMA footprint, is approximately 8.24 hectares and its capacity is estimated at 100,000 tonnes over approximately 50 years based on current mining

rate. The STMA is intended to remain at that location for many years but will eventually need to be moved to allow the construction of landfill cells and Site closure. The STMA and the landfill area may be referred to as the Site or the Facility in the following sections.

3.3.2. Ancillary Discharge – Effluent

The ancillary discharge resulting from the soil treatment and landfilling operation is proposed to be routed to one specific discharge point located along the west property boundary. The discharge will be composed of sediment ladden stormwater runoff originating from contact and non-contact water as described above. Water treatment will be done via a designated settling pond and the WTS. Both discharges are proposed to be combined in the settling pond prior to discharge to an ephemeral creek (refer to Section 3.4.4).

3.4. Receiving Environment

3.4.1. Geology and Structural Geology

The Site is located within the Warwick Range that extends to the Saanich inlet to the east, and Shawnigan and Sooke Lake to the north and west. The geology is well described in the TAR (Section 2.3) and in the report issued by the BC Geological Survey (BCGS) titled *Bedrock Geology of the South Island Aggregates Stebbings Road Quarry,* dated 30 October 2012 and the report's addendum issued on 22 April 2013. The BCGS report and addendum were prepared to assist MoE and MEM in their respective assessments. The Site bedrock is part of the Wark Gneiss complex and is mainly composed of "foliated to massive hornblende-plagioclase gneiss with minor quartz and magnetite". The Wark Gneiss is part of the West Coast Complex, as described by Canil et Al (2010), referenced in the BCGS report. The gneiss has been metamorphosed and evolved to well foliated gabbros / diorites. The BCGS report also refers to the presence of contiguous limestone lenses within the gneiss formation. Those lenses are limited in extent and are typically forming 'slivers or isolated pods' within the gneiss. However, no limestone was observed within the quarry site and as explained by the BCGS author, Kirk Hancock, PGeo, the rock types and features observed at the site are representative of the underlying geology considering the near vertical lithology dip measured between 80° to 90° north. BCGS refers to the adjacent Butler Brothers limestone quarry, located approximately 500 meters south of the Site, as a good example of these limestone lenses. Mr. Hancock spent time at both the SIA and the Butler Brothers quarries in order to prepare his report. The gneiss foliation dips approximately 20-25 degrees to the northwest and dykes have normally followed these same alignments. The closest regional fault is the Shawnigan fault (aligned southwest – northwest) and is located about 6 km north of the site.

Locally, three types of rocks were observed at the Site and consisted of a fine grained pale green diorite, a fine-medium grained dark green diorite and a medium-coarse grained gabbro. Based on BCGS report, none of the rock types really dominates and the Site geology is relatively heterogeneous where some areas of the quarry are made of one rock type or another. Transitions are also subtle and sometimes progressive. One exception is the fine grained pale

green diorite which formed dykes within the gabbro and the fine-medium grained dark green diorite. The dykes' contact with the host rock shows some degree of alteration and varies in thickness (5-20 cm). Biotite, chlorite and hornblende minerals are the typical minerals observed in the alteration zones. The description is similar to the one reported in the petrographic study prepared by Professional Service Industries (PSI) for Active Earth on behalf of SIA, dated May 31, 2011. Two types of fractures were identified, one group defined as "tight" and another group as "filled" fractures. Most fractures observed at the Site and reported in the BCGS report characterized as "tight" and less than 1 mm thick. They typically lack visible infills and alteration zones. Filled fractures were slightly larger fractures (up to 3 mm approximately) filled with quartz, calcite and sericite. All fractures observed were well bounded with the host rock. This is consistent with observations made by Active Earth in its TAR.

No evidence of limestone was observed at the Site by either Active Earth or BCGS. However, drilling logs of a well located between the quarry entry weigh scale (86152) and Shawnigan Creek reported the presence of limestone as did another well log from a well located further East of the Site (95485). Based on both BCGS and Active Earth, these drilling logs cannot be relied upon considering the destructive drilling method used to drill the wells (rotary drill) and the qualifications of the drillers interpreting the rotary drill material. This is further explained in the BCGS report.

Bedrock leachability was assessed as part of this application and is summarized in the TAR (Section 6.9). Based on the assessment conducted by Golder Associates (Golder, June 2012), the Site bedrock does not have an Acid Rock Drainage (ARD) or Metal Leachate (ML) potential but has the potential to leach some aluminium, chromium and iron above the BCA WQG. This is supported by results obtained from the baseline monitoring conducted as part of the application. This is further discussed in the Section 5.3 below.

3.4.2. Soil Condition

The Site is underlain by bedrock described in the section above which is covered with thin and discontinuous layers of topsoil and till. As part of the mining operation, till and topsoil has been (or will be) removed to expose the bedrock in many areas. Access road consists of a gravel road made of material originating from the quarry operation. A very fine and light dust is often present on the access road where heavy equipment operates and travels regularly. For these reasons, soil was not considered a potential receptor in this application and potential impacts on soil quality was not assessed in this report or in the TAR. The generation of dust and dust control aspects are further discussed in the assessment below.

3.4.3. Hydrogeology and Groundwater

The TAR presents an extensive review of the regional and local hydrogeology (TAR, Section 3.2, p.16). The MoE Water Resources Atlas does not show any aquifer beneath the site but indicates the Shawnigan Lake / Cobble Hill and Spectacle Lake / Malahat aquifers located at approximately 2 km north and 1 km east of the Site respectively (TAR, Figure 3). TAR figures 5,

6 and 7 present cross sections based on well logs from MoE database and from five monitoring wells logs installed at the Site.

The proposed regional hydrogeology model encompasses Shawnigan Lake, located about 5 km north of the site, a deeper aquifer referred to as a deep fractured bedrock (below 75 m) and lakes and streams at higher elevation south of the Site. Based on Active Earth's assessment, the recharge of the aquifer is from infiltration of precipitation at higher elevation where the deep fractured bedrock is exposed and believed to form the base of important lakes like Devereux Lake that act as important recharge reservoirs. Although more permeable than the upper bedrock, the reported permeability of the bedrock remains low. This stratigraphy is Active Earth's interpretation of the drilling conducted at the Site and reported yield capacities from available drilling logs. Active Earth in fact suggests that a stratification of fracture density/permeability exists beneath the site and conceptually defines two types of bedrock, the upper (between 0 to approximately 75 m) and the deep bedrock (below 75 m). Standard hydraulic response tests were conducted on all five monitoring wells installed at the Site and used to confirm the conceptual model presented in the cross sections.

As presented in the TAR, the upper bedrock conductivity has been estimated using tests conducted on three monitoring wells: MW11-1S, MW11-2, MW11-3S (labelled as MW-1S, MW-2 and MW-3S in other documents) while the deep and more permeable bedrock has been characterized similarly on two monitoring wells: MW11-1D and MW11-3D (labelled MW-1D and MW-3D in other documents). The estimated conductivity values and calculated travel times to Shawnigan Lake are presented in the table below:

Table 1 – Upper and deep bedrock properties

Bedrock	Conductivity	Gradient	Travel time
Upper bedrock	7.6×10^{-10} m/s	0.001 m per year	3,000,000 years
Deep bedrock	1.6×10^{-7} m/s	1.7 m per year	103,000 years

The method used to estimate the conductivity has been discussed at length during the review of this application and will be discussed in greater details in the assessment section below. LRO also reviewed the information presented by Active Earth at MoE's request. The LRO response is briefly discussed in the consultation and assessment sections below.

Groundwater flow direction was interpreted to be towards the northwest based on readings taken in the summer (June 27, 2012) from the available monitoring wells. A downward vertical gradient was evaluated at 0.4% using the nested well 1 (MW11-1S and MW11-1D). A second nested well (MW11-3S and MW11-3D) confirmed the same downward vertical gradient, although more pronounced (~3.5%), as presented by Active Earth in their February 15, 2013 letter. However, the gradient from the MW11-3 nested well was not initially presented in the TAR as it was believed to be less representative then MW11-1 at the time. Active Earth indicated that an additional PVC riser had to be installed on MW11-3S to measure the stabilized piezometric level.

Evidence of groundwater flow through overburden soils also exist in some areas in the watershed. The subsurface flow is believed to be recharged by infiltration of precipitation and was observed in areas located lower in the valley, close to Shawnigan Lake and away from the Site where soil and granular material is more common.

The wells #86152 and #93401 both installed on the East side of Shawnigan Creek, on and upstream of the property respectively, have both been observed dry in dry periods which could potentially indicate a connection to surface recharge zones. Based on AEE assessment, this reflects the site hydrogeologic model as presented in the TAR and cross section A where the more permeable deep bedrock layer is recharged at higher elevations. The cross section A also shows the contact between the upper and the deep bedrock getting closer to the ground surface going towards Devereux Lake (South of the proposed facility).

3.4.4. Hydrology and Surface Water

The Site is part of the south Shawnigan Lake catchment area and is situated at an elevation of approximately 330 meters above sea level. Shawnigan Lake discharges to Shawnigan Creek before reaching Mill Bay and then entering the Saanich Inlet. The catchment area is independent from the Capital Regional District drinking water catchment area which is located south of the site, in a valley beyond a high ridge. However, the assessment indicates there are no hydraulic connections between the Sooke aquifer and the Shawnigan Lake watershed.

Devereaux and Logan Lakes are at the headwater of the catchment area and feed Shawnigan Creek, providing base flow during the dry months. Climate data indicate that most of the rainfall occurs mainly as rain during the fall, winter and spring seasons, with a peak normally early in the winter. Shawnigan Creek flows through the property through a covenant on the east side of the property boundary. Shawnigan Creek is fed by lakes and streams above the site that originates from Devereux Lake. The creek then flows to Shawnigan Lake at approximately 5 km downstream. Creek flow follows closely precipitations and therefore, the highest flows are normally recorded in the winter season in response to abundant precipitations. In the summer time, Shawnigan Creek flows are much reduced and can be as low as 5 USgpm based on the TAR. The base flow is attributed to the discharge from lakes upstream, including Devereux and Logan Lakes. Creek flows were not initially measured as part of this application. However, Active Earth later proposed to monitor creek flows as part of their environmental monitoring program discussed in Section 5.5. The first flow monitoring exercise was done in the spring of 2013. Representative creek base flow dataset is being developed over time.

The closest surface water body downstream of the facility is an ephemeral creek (named Creek 1 for the purpose of this report). The creek is located a few meters west of the property boundary. A natural drainage path links the Site to Creek 1 and it is proposed to be used to drain all surface water discharges coming from the Facility. Creek 1 initially flows west and quickly turns north before joining another, larger ephemeral creek (Creek 2). Creek 2 flows north for a few hundred meters and then turns west for a similar distance before cascading into

a third ephemeral creek (Creek 3). This third ephemeral creek then flows north for about 500 meters before entering into Shawnigan Creek, approximately 1 km downstream of the Site (TAR, Figure 4). An upper reach of Shawnigan Creek is located closer to the Site, at approximately 100 m from the north-northeast property boundary. However, the creek bed is approximately 20 meters higher than the projected quarry pit bottom and more than 30 meter higher than the surface water discharge point. An ephemeral wet area is also located on the east of the Site. This area drains to Shawnigan Creek through a partially natural and constructed ditch. However, site grades and diversion channels and swales will ensure that Site runoff will only be discharged to the west side of the Site, to Creek 1. Direct discharge to Shawnigan Creek located to north-northeast of the site is neither planned nor possible unless the water is actively pumped to that location from a lower elevation. A similar drainage arrangement is proposed in the conceptual closure plan discussed in Section 7.3.12.

3.4.4.1. Fish Presence

A report prepared by Cascadia Biological Services (Cascadia) titled *Fish Presence and Hydrology Survey* was prepared to characterize the first and second ephemeral streams (Creeks 1 and 2) to which the proposed Facility will discharge to. The report is based on one site visit conducted on February 18, 2012 which focused on Creeks 1 and 2. However, the author walked the third ephemeral creek to Shawnigan Creek as well. Based on the report, Wetland areas were observed along Creek 2 and Creek 3.

The author concludes that due to natural barriers and the lack of spawning area observed between the Site and the confluence of Creek 2 and Creek 3 where a waterfall was observed, it is unlikely that any salmonids inhabit the area above the waterfall. No fish was observed during the survey.

3.4.5. Drinking Water (surface and groundwater)

Drinking water is extracted from both surface water and groundwater sources in the Shawnigan Lake watershed area, including both Shawnigan Lake and Creek. Both surface and groundwater uses are reviewed in the sections below.

3.4.5.1. Surface Water

Two diversions points were identified downstream of the Site along Shawnigan Creek. The closest point of diversion is located at approximately 4 km downstream of the Site. Surface water is also extracted directly from Shawnigan Lake by both residents and municipalities as far as Mill Bay. Active Earth did not specifically refer to these diversion points in the TAR. However, it indicated that the proposed effluent was unlikely to have an impact on drinking water quality downstream of the Site because of the dilution available in Shawnigan Creek and more specifically the dilution available between the Site and the diversion points downstream. This aspect is further discussed in the assessment section below (Section 5.5 – Potential for impacts). Other diversion points were identified upstream of the Site, one of which is

associated to a small scale irrigation water dam which could affect the Shawnigan Creek flow downstream, and therefore the available dilution at times.

3.4.5.2. Groundwater

Eleven drinking water wells located within 1 km from the Site were identified using the Active Earth WELLS database. Other than well 86152 installed for SIA on their property in 2010 on the east side of Shawnigan Creek, all other wells identified are located at more than 500 m away from the site and most are installed at a depth of 60 m or more (the deepest well installed at 135 m). Well 93401, installed at a lower depth of approximately 38 m (el. 347 m), is the only exception. However, the well is located at approximately 600 m upstream of the Site and was constructed at a higher elevation than the proposed facility which has a proposed maximum elevation of approximately 330 m. Therefore, the well was not considered a potential receptor in the TAR prepared by Active Earth. Note that well 86152 is not used for drinking water.

In response to questions from the Ministry of Forest, Land and Natural Resources Operations (FLNRO) Groundwater Water Protection Service, Active Earth provided additional information in a letter dated October 5, 2012, on drinking water wells located in the vicinity of the proposed facility. Four additional wells were considered, two of which are located less than 500 m from the Site. The LRO review, dated July 24, 2013, indicated that the drinking water standards applied to the deep aquifer only.

3.5. Air

The proposed facility will add to the current quarry operation activities. The Site is located in an area where large residential properties coexist with small to medium scale industrial activities (mainly logging, soil and aggregates extraction). The Site is located high up in the Shawnigan Creek valley and looks over Shawnigan Lake. Prevailing winds are from the northeast and the southwest. There are six residences within a 1 km radius from the site, including two located northeast and one located south-southeast of the Site. Odours, fugitive dust and noise are discussed below.

3.5.1. Odours and Human Health Risks

Active Earth states that soil contaminated with hydrocarbons may at times generate volatile organic emission (VOC) when the soil is undergoing treatment and is turned, especially during the summer when evaporation of the organic components would mainly occur. However, based on Active Earth assessment, the risk to cause unacceptable odours is considered low because of the size of the operation and the distance from the potential receptors (i.e. residences nearby).

Although VOC concentration is expected to decrease quickly with distance from the contaminated soil stockpiles, Active Earth proposed an ambient air monitoring program and

mitigation measures to reduce the risk to human health. This is further discussed below in the assessment section below (Section 5.4 and 5.5).

3.5.2. Fugitive Dust and Noise

Dust and noise may be generated as a result of the proposed activities. However, these new activities will be combined to the current operation and are not expected to increase noise and dust generation. Blasting, truck traffic and operation of heavy equipment will remain the main source of noise and dust at the Site. The proposed monitoring program is presented below in Section 5.5.

3.6. Operations

3.6.1. Generalities

The Site operation is well described in the TAR (TAR Section 9 (p. 95)) and is summarized below. Active Earth proposes to have a designated STMA where the soil will initially be characterized and dumped. The soil will be weighted at the existing weigh scale located at the Site entrance. Once the soil is treated, or if the soil is found or known to be untreatable using bioremediation but authorized for disposal at the Site, the soil will be moved to the landfill area. The soil may also be shipped offsite for disposal as needed. Stormwater runoff and leachate originating from the facility will be treated through the settling pond and the WTS prior to be released to Creek 1 and then to Shawnigan Creek.

3.6.2. Soil Acceptance Plan

Active Earth presented a Soil Acceptance Plan in its TAR (Section 10, p. 105) where it describes the controls it proposes to put in place. Based on the plan, Active Earth will require all clients to submit a Waste Approval Application, including a certified lab analysis (Canadian Association for Laboratory Accreditation Inc. (CALA), prior to delivering the waste to the Site. An example of the form is included in the TAR (Appendix J) and includes the followings information:

- Generator details;
- Nature of contamination;
- Physical soil description;
- Moisture content;
- List of PCOCs;
- Maximum identified contaminant concentration and;
- Estimated soil quantity.

The Waste Approval Application may be submitted by the generator or by the qualified professional (QP) representing the generator. To avoid receiving unacceptable materials, additional analysis are required if soils contain concentration of LEPH and/or HEPH in excess of

the CSR IL standards or if soils impacted with metals have the potential to create leachate (using the "rule of 20").

The Environmental Engineering Consultant (also a QP) will review and approve the Waste Approval Application and then send a Soil Arrival Form to the generator to confirm that it can or cannot be accepted at the Site. The soil will then be received, weighted and dumped in the STMA for inspection by the technician. Active Earth proposes to train the staff to systematically inspect the incoming soil dumped to validate that it corresponds to the description provided at the application stage. If the soil is considered suspect, it will then be temporarily placed in the designated holding area for further characterization or return to the generator site if not yet unloaded. The soil temporarily deposited in the designated holding area will be protected from the elements (under a permanently covered area or under a tarp). In the context where suspect soils have been received, no other material from that generator site will be accepted until the soil is proved acceptable. Additionally, Active Earth proposes to reconciliate the amount of soils delivered and received on a daily basis to make sure that all incoming soils are accounted for.

Section 4.2 and 4.3 of the TAR also discusses how the proponent will ensure the incoming material is not HW. Apart from reviewing the type and origin of waste considered, analytical data will be required including systematic leachabilty tests. Leachabilty tests are proposed to be conducted according to the Modified Leachate Extraction Procedure as defined in the HWR, Schedule 4, part 2.

A QA/QC program is also proposed to confirm incoming soil quality at a regular frequency. Active Earth proposes to follow CSR Technical Guidance 1 and collect one random sample for the first 250 tonnes shipment, one random sample for the next 250 to 1000 tonnes and then one for every load exceeding 1000 tonnes in total. The table below summarizes the approach:

Table 2 – Incoming soils QA/QC sampling routine incremental steps

Step 1	**Step 2**	**Step 3**
0-250 tonnes	250-1000 tonnes	>1000 tonnes
1 random sample	1 random sample	1 random sample

This is based on an estimated density of 1.67 tonnes/m^3 and will ensure that a minimum of one confirmatory sampled is collected for each generator site.

Liquid waste and soils exceeding prescribed moisture contents by soil type will not be accepted at the site. However, if a soil is delivered and found to be supersaturated but meets all other requirements, it will be treated in the STMA to reduce water content to acceptable level prior to landfill.

3.6.3. *Soil Treatment and Placement*

As discussed above, soil will be treated using typical land farming techniques. Treatment efficiency will be optimized by aerating the soil and by adjusting pH and nutrients. If the soil is found to be untreatable using bioremediation, the soil will be stored temporarily in an area of the STMA or immediately landfilled if a cell is ready to receive the material. Additional details are provided in the TAR (Section 9.1). The implementation of the Soil Acceptance Plan presented above will also inform the technical staff on the soil specific characteristics which will ultimately optimize the treatment process efficiency. Although permanent covers are not proposed for the STMA, tarps will be used to cover soils to prevent direct rainfall and resulting soil moisture increase. Permanent cover may ultimately be constructed for the treatment of soils that are more sensitive to moisture. That being said, the soil treatment area is proposed to be covered during the winter season (i.e. between November and March, inclusive).

Incoming soils will either be placed above landfill cells as cover material (above the prescribed sand drainage layer required as per the landfill cells design) or will be landfilled depending on the materials physical and chemical properties. Landfill cells will be covered with a clean top soil layer of a minimum of 1 m thick. Cover design details are discussed in the closure section below (Section 5.2.12) and in the TAR (Figure 10). Direct rainfall on the soil piles will be limited during the construction of landfill cells by using tarps or temporary soil covers.

A soil tracking system will also be implemented (Refer to the TAR, Section 9.6 for additional details) and will ensure that incoming waste is tracked throughout the process (receiving, storage, treatment and final placement). Active Earth intends to assign a soil Tracking ID unique to each source site prior to soil delivery. The Tracking ID will include three descriptors (XXX-YY-ZZ), one for the source site, one for the suspected contaminant level (IL+, RL+, etc) and one for the nature of the contamination. Soil stockpiles and their associated Tracking ID will be reviewed and logged at the end of each day to ensure that Site plan is kept current.

Active Earth indicated that, due to expected variability / heterogeneity of the incoming waste soil, it is unlikely that compaction will meet ASTM D698. This standard prescribes soil compaction required to optimize soil engineering properties. However, the ASTM D698 suggests that in this case, test fill compaction tests could be used to determine the appropriate equipment and compaction method required to obtain an acceptable compaction. This could include for example the type of equipment that should be used and the lifts thickness, the acceptable water content and the number of passes. This may vary from what Active Earth recommends in the TAR: placement of soil in 600 mm lifts and compact it with a minimum of one pass with a vibratory roller. The compaction aspect is further discussed in the assessment section.

3.6.4. *Stormwater and WaterTreatment*

The facility is designed to limit the amount of potentially contaminated runoff and leachate generation. Clean stormwater runoff will be diverted away from the active areas and will drain to the settling pond where solids will be removed prior to discharge.

Potentially contaminated runoff and leachate collected from the STMA or from the landfill area will be collected by catch basins and conveyed to designated holding tanks prior to treatment. Dedicated tanks include one reservoir for the stormwater runoff and leachate from the STMA, one reservoir for the landfill area leak detection sump and another one for the leachate collection sump from the same area. The water will then be treated in batches before being discharged to the settling pond and then to Creek 1. BCAWWQG Aquatic Life guidelines are expected to be met at the settling pond discharge. Following the Draft Permit consultation process in March 2013, Active Earth proposed to meet BCAQWWQG for the protection of Drinking Water. Active Earth suggests that this is considered reasonable as the settling pond will also receive clean stormwater runoff and provide some dilution when the WTS is likely to operate. Based on Active Earth's assessment, as the source of effluent generated at the Site is directly linked to precipitation, the effluent discharge is unlikely to be discharged in a low stream flow situation. Active Earth also suggests operating the WTS on batch. This will increase operational controls available to limit WTS effluent flows to occur in favorable conditions. The level of dilution expected is further discussed in the assessment section below.

Stormwater controls upstream of the settling pond will also be implemented as described in Section 6.1, p. 51-52 of the TAR. These include consideration for sediment controls upstream and maintenance of the conveyance infrastructure. The proponent initially proposed to install a wheel wash facility at site access points. However, this was revisited in Active Earth's February 15, 2013 letter. Active Earth indicated that a wheel wash facility was not required as the haul trucks were not expected to drive through contaminated soils. However, should the STMA design change, Active Earth would review the need for a wheel wash facility. The TAR also refers to covering the stockpiles as necessary, maintaining existing vegetation and revegetate, cover or mulch but does not provide additional details.

3.6.5. *Staffing*

As described in the TAR (Section 9.4) a qualified Environmental Engineering Consultant (QP) will oversee the operation of the landfill, review the soil quality data from generators, interpret data from monitoring of effluent and soil quality at the site and in the receiving environment and will provide ongoing technical support to the onsite staff.

An operations manager and a technician will be onsite at all times when the facility is in operation.

3.6.6. *Inspections*

Inspections are proposed to be conducted daily by staff located on site. These inspections will include the stormwater conveyance infrastructure and soil placement. Active Earth indicated that the Site will also be inspected on a quarterly basis by the Environmental Engineering Consultant. This inspection will be formally documented and feedback/recommendations will be provided to the onsite staff. The scope of the daily and quarterly inspections is not detailed in the TAR and will need to be spelled out in the EMP and other supporting documents.

3.6.7. *Emergency Response Plan*

Active Earth prepared an additional appendix to complete its existing Emergency Response Plan (ERP) currently filed with the *Mines Act* permit and addresses specific scenarios related to the proposed facility. The ERP is further discussed in the assessment section below (Section 5.2.13).

3.7. Compliance with Standards, Objectives, Policy, Programs and Initiatives

As indicated in the introduction section, it was determined that the proposed facility did not constitute a hazardous waste facility as defined under the HWR and therefore it did not constitute a reviewable project as defined under the Reviewable Project Regulation, Part 6 – Waste Disposal Projects. As a result, the relevant review process is the one prescribed in the Waste Discharge Regulation.

The proposed facility is considered as a prescribed operation meeting the Waste Discharge Regulation Schedule 1 definition of "contaminated site contaminant management", and therefore an authorization for discharge to the environment is required. Should the facility be permitted, soil relocation agreements according to Section 55(5) of the *EMA* and Section 41(3) of the CSR would no longer be required. The movement and discharge of soils would be regulated as per the permit conditions and limited to the PCOC list defined in the permit.

The TAR and Soil Acceptance Plan indicate the use of CSR Technical Guidance documents 1 and 4 for soil sampling and vapour investigations respectively. There is also reference to CSR standards for soil and groundwater.

There is currently a draft EMA Section 64 Protocol (15) for Contaminated Sites, titled Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil (draft Protocol 15). It includes sections on biocell siting, access and security, basic design, multiple waste streams, soil preparation, operation and maintenance, monitoring and sampling and decommissioning and closure. This protocol can be used to help inform the current assessment.

Currently authorized bioremediation facilities in the region can also be compared to SIA's application. Quantum Murray Facilities LP's (Quantum's) refuse and effluent permits (PR-18231

and PE-18266) issued in 2008 for their Koksilah Road biocell are likely the most relevant, as it is for the treatment of waste level soils with an on-site soil and effluent discharge. However, Coast Environmental refuse permit (PR-105241) issued in 2012 is the most recently authorized soil remediation facility, permitted in 2012, and should be considered.

Other authorized bioremediation facilities on Vancouver Island accept hazardous waste soils are located at landfills, and were authorized over 10 years ago. However, SIA's application is similar to the Quantum's Koksilah Road bioremediation facility as it also has an effluent and a soil discharge permit and discharges to a gravel pit. Those two sites are similar as they both operate in a low population density area and discharge to a stream used as a drinking water source or is part of a drinking water community watershed. In both cases, the application is for treatment of contaminated soils at concentrations exceeding CSR Industrial Land Use (IL) standards but excluding or below hazardous waste or hazardous waste level as defined in the HWR. However, SIA's application remains unique as it proposes to receive a wider variety of contaminated soils and associated ash (not restricted to hydrocarbons contaminated soils). SIA's application also proposes to landfill untreatable soils (i.e. not suitable to bioremediation) in an engineered landfill facility. The proposal also suggests landfilling contaminated soils above IL in an advancing hard rock quarry rather than in a gravel pit.

For this reason, Active Earth referred to three different standards to design the landfill cells, the landfill area and the STMA. Those standards are the:

- HWR
- Draft (now published) Protocol 15 for Contaminated Sites, Soil Treatment Facility Design and Operation for Bioremediation of Contaminated Soil; and
- Landfill Criteria for Municipal Solid Waste (LCMSW) (1993)

The Wood Waste Landfill Guideline has also been considered when reviewing this application. Additionally, SIA has referred to the Geomembrane Protection Design Manual published by GSE Consultant, a well known synthetic liner manufacturer. The relevant aspects of the HWR, CSR Protocol 15 and the LCMSW standards are discussed below:

3.7.1. Standards and Objectives

3.7.1.1. Soil and Surface Water Quality

SIA's proposes to discharge and landfill contaminated soils (treated and non treated) as well as treated stormwater and treated leachate effluent.

The HWR schedules 1, 1.1, 3 and 4 (Part 3, table 1 – Leachate quality standards) are proposed to be used to assess the non treated or incoming soils. The soils must be better than HW, as described in the HWR schedules referred to above, exclude municipal, liquid and putrescible wastes and be limited to contaminated soils and associated ash (and the defined PCOC list).

The CSR Generic and Matrix Numerical Soil Standards in Schedule 4, 5, 7 and 10 (Column IV, "Commercial, Industrial Soil Standard") are proposed to be used to assess the treated soils. These soils should be equivalent or better than soils suitable for IL use, including the most stringent application site specific factors considering, intake of contaminated soil, toxicity to soil invertebrates and plants and groundwater flow to surface water used by freshwater aquatic life. Factors listed in the CSR Schedule 5 are proposed to be applied according to the CSR Technical Guidance 3 (TG3). Factors associated to groundwater used for drinking water are not applicable based on the fact that the Site is proposed to be built on low permeability, low productivity aquifer (i.e. with a permeability of less than 10^{-6} m/s, refer to Technical Guidance 6 (TG6)) and based on the Land Remediation Office review discussed in the consultation and assessment sections below.

The BCWAWQG are proposed to be used to assess the quality of the surface water discharges. For this purpose, the settling pond discharge and the WTS discharge are considered independently and both should meet the most stringent value of the Freshwater Aquatic Life and Drinking water use guidelines. Total Suspended Solids (TSS) concentration value of 25 mg/L is based on the BCWWQG for industrial discharges which was based on the most recent Canadian Council of Ministers of the Environment (CCME) Quality Guidelines. CCME specifically states the following water quality guidelines for TSS:

Clear flow
Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d).

High flow
Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥ 250 mg/L.

The proposed discharge limits for the settling pond are further discussed in the assessment section below. The *Draft Guidance for assessing the design, size and operation of sedimentation ponds used in mining* was also used to assess the design of the proposed settling pond.

In regards to dioxins and furans, BC has established provincial standards for soil and water quality. The soil standards are defined in the CSR Schedule 5 where 17 dioxins and furans congeners are defined and assigned a Toxicity Equivalent Factor (TEF). The individual TEF value is used to calculate the Toxicology Equivalent value (TEQ) by multiplying each individual TEF with the associated concentration value. The most potent congener is the 2,3,7,8 TCDD is assigned a TEF of 1.

The dioxins and furans standards for soils stated in the CSR (Schedule 6) are based on the CCME standards and are due for review (based on emails and personal discussion with Land

Remediation Office staff and other MoE staff). Therefore, dioxins and furans results should be assessed using the most recent information available. At the time of writing this assessment, the 2005 World Health Organization (WHO) publication was the most recent review. The 2005 report reviewed and updated some specific TEF values for dioxins and furans congeners. Therefore, the CSR standards (Schedule 6) do apply but should be used in conjunction with the WHO 2005 report and use the updated TEF values (as done by USEPA - http://www.epa.gov/superfund/health/contaminants/dioxin/pdfs/Use_of_Dioxin_TEFs_in_Calculating_Dioxin_TEQs_at_CERCLA_and_RCRA_Sites.pdf and framework http://www.epa.gov/raf/teframework/pdfs/tefs-draft-052808.pdf). The same TEF can be used for different matrices, i.e. soil, water and groundwater. However, because dioxins and furans tend to be very stable and often remains bound to soil particles, there is limited information on standards for these contaminants in water. The CSR Schedule 6, column II only defines a standard for Carbofurans in water. After discussion with the MoE Water Protection and Sustainability Branch, an interim criterion was established for the protection of Aquatic Life prepared by H. Singleton in 1994. The standard is called interim criterion because "toxicity data for Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were considered insufficient to meet the minimum requirements necessary to set full aquatic life criteria". The standard refers to all PCDD/F for which chlorine atoms are present in positions 2, 3, 7 and 8 but only defines an interim criterion for direct water uptake of dioxin 2,3,7,8 TCDD. The criterion was set at 0.15 pg/L which is the geometric mean of two criteria (0.38 and 0.06 pg/L) obtained through two different methods. As a comparison, the USEPA guideline (http://water.epa.gov/drink/contaminants/basicinformation/dioxin-2-3-7-8-tcdd.cfm) is 0.00003 ug/L (or 0.03 pg/L) for drinking water. In addition to this standard, the USEPA states a long term goal to eliminate dioxins and furans completely from drinking water sources.

Based on discussions with analytical lab performing these analyses, the lowest level of 0.03 pg/L is typically below detection limits. Dioxins and furans issues are further discussed in the assessment section.

Certain PCB congeners are also known to behave similarly to dioxins and furans and the 2005 WHO review indicated that dioxins and furans TEF should be used for certain PCB congeners. However, the CSR standards have not yet been reviewed to date to reflect this new approach.

3.7.1.2. Groundwater Quality

The CSR Generic Numerical Water Standards for drinking water (Schedule 6 and Schedule 10) are proposed to be used to assess groundwater quality of the deep aquifer. The groundwater quality of the upper aquifer should be compared to the aquatic life standards as per LRO review.

3.7.1.3. Siting

SIA's proposed that the landfill cells and STMA design meet all of the siting requirements defined in the HWR, the Draft Protocol 15 and the Landfill Criteria for Municipal Solid Waste

(1993) with the exception of two aspects of the HWR which were not assessed as part of the application. Those aspects are related to siting requirements applicable to HW secure landfill and are defined under Section 25 (2), (7)(a) and (8) of the HWR. The intent of these sections is to exclude areas where seismic acceleration (and associated probability of occurrence) is considered unacceptable, exclude areas in a designated community water supply watershed (Category I) and areas where record of precipitation statistically exceed evaporation and transpiration.

These aspects were reviewed as part of this assessment. However, as the proposed facility will be limited to non HW material, the HWR sections 25(2), 25(7)(a) and 25(8) are not directly applicable. Therefore, the sitting of both the landfill cells and the STMA are considered to meet the requirements. Specific requirements of the Wood Waste Landfill Guidelines are also discussed in the assessment section below.

3.7.1.4. Access and Security

Draft Protocol 15 indicates soil treatment facilities should have restricted access by means of fencing or otherwise, and should have signs to warn of risks such as contaminated soils and heavy equipment. There are no requirements in PR-105809 on facility access or security. However, access and security measures are in the best interest of the company. Although specifically required under the current *Mines Act* permit, the quarry operation controls access at the site entrance where the gatehouse and weigh scale are located.

3.7.1.5. Landfill Cells Design

The landfill cells (the Cells) design is based on an interpretation of the HWR, Division 6 – Secure Landfills and to a lesser extent on the Landfill Criteria for Municipal Solid Waste (1993) and the CSR Draft Protocol 15.

The cell design is presented in the TAR in details (Section 5.5) and is only summarized here. The proposed landfill area will be established on a slightly compacted till surface (K ≤1x10-8 m/s), which will be placed on the quarry floor and form a 3% slope. A drainage layer (K >1x10-3 m/s) will then be placed above the till followed by the base liner (40 mil LLDPE). These two initial layers will also act as a protective layer to lay the liner on safely. The first cells constructed on the base layer will constitute the first lift. The top of those cells will be similarly covered with a drainage layers placed underneath and above the top liner and will form the base of the next lift. A maximum of three lifts is planned. The first and second lifts are designed to approximately 10 meter thick while the third will be limited to about 6.5 m, depending on the location and the final grade required for closure. Figures 10 and 10B of the TAR shows typical cross sections of the landfill area and indicate how cells will be constructed and linked together to ensure that leak detection and leachate collection systems are and remain effective as the landfill area expands. Cleaning ports are also included in the leak detection and leachate collection systems design.

The drainage layers (horizontal drainage blankets and chimneys) will be hydraulically linked and report to a leachate collection piping located at the toe of the cells, drain to a single leachate collection sump and then to a leachate detection reservoir. It is expected that, as the landfill area expands, networks of leachate collection pipes will be developed and report the main collection sump. Similarly, leak detection piping is proposed to be installed in base drainage layer (above the till) and drain to a leak detection sump and then to the leak detection reservoir.

An additional 2 meters of soil will be added on top of the last lift and will consist in a 1 meter layer of soil (K ≤1x10-7 m/s) and 1 meter of growing medium.

3.7.1.6. Soil Management and Treatment Area Design

The STMA design is presented in the TAR (Sections 8.1, 8.2 and 8.3). As documented above, the STMA is where the soil will initially be received, temporarily stored and characterized if needed and then treated. The entire area is proposed to be constructed on the same asphalt pad. Surface water falling on the pad will report to catch basins tied to a dedicated reservoir and then to the WTS. The catch basins are proposed to be equipped with filter cloth to prevent the collection of solids and silting of piping and the reservoir.

The design of the pad is based on the HWR and the CSR draft protocol 15 and will consist in the following:

- A 300 mm layer of clear washed granular siting on bedrock. This layer will be equipped with a perforated PVC piping network reporting to a leak detection sump which will be designed to overflow to an adjacent catch basin
- A layer of till as required to create a sloped working surface (sloped between 2 to 5%)
- A synthetic liner
- A geomembrane to protect the synthetic liner
- A 50 mm layer of road base (sloped between 2 to 5%)
- A 50 mm asphalt layer

A berm will be built around the area to ensure that surface runoff is confined and collected on the pad. Additionally, a separate and isolated runoff and leachate collection sump will assigned to the holding area to avoid feeding directly to the WTS.

Figure 9 of the TAR represents the typical cross section of the STMA.

3.7.1.7. Erosion Control and Stormwater Management

The proposed erosion controls and stormwater management infrastructures, including the proposed settling pond were designed to accommodate 1 in 200 year 24-hours storm events. In addition, the settling pond was designed to remove solids for 1 in 10 year 24-hour storm

events as it is typically required. The peak flows corresponding to these events were calculated using the stormwater modeling numerical model HydroCAD. The modeling exercises took into account worst case scenario where rain falls on a snowpack and causes increased runoff flows (due to snow melt and reduced infiltration). The calculated 1 in 200 year 24-hour storm event corresponds to 181.4 mm rain/equivalent snow melt. Details of the storm event flow calculations are available in the TAR (Section 6.5).

The design of the settling pond is based on the Intensity Duration Frequency (IDF) curve derived from a weather station located about 20 km away from the Site (North Cowichan Climate Station) and on other design criteria stated in the TAR (Section 8.4.3). Those other design criteria refer to a 1993 DFO guideline document (Land Development Guidelines for the Protection of Aquatic Habitat) which suggests that a settling pond surface area should be at least 1% of the total erodible area and should include a minimum freeboard of 500 mm and TSS effluent of <75mg/L. This TSS effluent target was reviewed to <25mg/L following MoE reviews. Active Earth has proposed minor modifications to the settling pond design in order to meet the TSS effluent target. Details of the proposed changes were provided in an email to MoE dated 21 February 2013 and include the followings: dividing the settling pond in 2 sections to improve settling, increase residence time by creating longitudinal flow pathways, construct a sand filter at the discharge point, prior to discharging to the creek and lastly increased monitoring during the wet season (November to April). The Site is subject to the North Cowichan Community requirements for the management of stormwater and, based on Active Earth's review, has to ensure that stormwater is piped or channeled away from the Site. The NCC has no specific requirements for stormwater storage prior to discharge. It is recommended to consider the CCME guidelines approach and set a higher limit for periods of high flow (i.e. exceeded 1 in 10 year, 24-hours flood event).

MoE requested the proponent to follow the Draft Guidance for assessing the design, size and operation of sedimentation ponds used in mining. This draft guidance document is available on MoE website at http://www.env.gov.bc.ca/epd/industrial/mining/pdf/settling_ponds.pdf.

Although not specified in the application or in the TAR, Active Earth proposed erosion controls are expected to be based on the document Best Management Practices and be inspired by the MEM Aggregate Operators Best Management Practices Handbook available on Ministry of Energy and Mines website at http://www.empr.gov.bc.ca/Mining/Aggregate/BMP/Documents/Agg_BMP_HB_2002(Vol1).pdf. The main intent is to prevent soil losses at the source and reduce pressure on the unique control downstream, the settling pond.

These aspects are further discussed in the assessment section.

3.7.1.8. Multiple Waste Streams

Draft Protocol 15 specifies that soils of different origins, compositions or contaminant concentrations must be kept and treated in separate cells or stockpiles. Recent soil

remediation facilities permits (PR-18231 and PR-105241) have similar language with a 'Prohibition of Blending' clause. A similar prohibition of blending clause is recommended for the authorization as well. Operational details SIA's TAR assessment and Soil Acceptance Plan indicate that they plan to keep soils segregated.

3.7.1.9. Soil Preparation

Draft Protocol 15 indicates that soil amendments may be used to enhance bioremediation potential, and gives reference to difficulties remediating soils which tend to clump together. Bulking materials such as sawdust or straw are listed as acceptable amendments to ensure soil has a loose or divided texture prior to treatment. The TAR makes mention of this in the operational section, Section 9. As SIA proposes to use soil amendments to improve soil treatment efficiency it is recommended to include allowances for this in the authorization. Use of disking device is proposed to be used for turning / aerating the soil.

3.7.2. Operation and Maintenance

Monthly facility inspections and soil turning are listed as requirements in the draft protocol P15. Also included is a requirement to reuse leachate on the soil piles or to dispose of it at an appropriately authorized facility, and requirements around management to ensure optimal levels or key parameters in bioremediation (micro-organisms, oxygen, pH, soil temperature, soil moisture, and nutrient levels). This practice has not been incorporated in the TAR and it is recommended to include a clause in the authorization that will promote the recycling of leachate collected at the site (STMA or the landfill area) to adjust the soil piles moisture. A site wide water management plan included in the EPM should be prepared and modified as needed to reflect this approach.

The TAR indicates that facility inspections will be conducted daily and documented quarterly. The intent is to turn piles monthly and to reuse leachate on the piles or treat via the WTS.

It is not recommended to be overly prescriptive in the management of the facility for achieving optimal bioremediation. It is in the best interests of the operators to ensure the bioremediation process is optimized, as if not, the process will take longer and space will not be available for additional projects. However, it is recommended to document inspections on a monthly basis to align with the P15 requirements. It is also recommended to specify the scope of these routine inspections in the authorization or in the supporting documentation.

3.7.2.1. Monitoring and Sampling

Baseline monitoring has been conducted prior to the construction of the facility and the proposed operational monitoring exceeds the P15 requirements. This includes a baseline subsurface soil and groundwater investigation with a minimum of three monitoring wells, annual groundwater monitoring during the operation, and collection of soil samples during the treatment process and prior to soil removal. Although SIA's proposed facility meets and

exceeds these requirements, benthic invertebrate sampling has not been included in the proposed monitoring program even though Active Earth recommended it in its initial review. Active Earth justified this decision based on their proposal to meet the BCWQG for aquatic life at the effluent discharge. Benthic invertebrate and sediment sampling is further discussed in the assessment section.

It is proposed to include the monitoring and sampling requirements in the authorization and to specify the standards used to compare the monitoring results as well. P15 indicates soil samples should be analyzed for a minimum of pH, temperature, moisture, microbial content, nutrient levels and contaminant concentrations.

3.7.2.2. Vapor Generation

The draft P15 indirectly refers to vapor generation from soil treatment facilities by prescribing soil aeration methods. However, P15 is not so prescriptive or quantitative in that regard and in the absence of policies directly applicable to soil treatment facilities, Active Earth proposed to develop an approach based on the CSR technical guidance 4 (CSR TG4) and on the Report of Screening Level Risk Assessment (August 2005), submitted by the Science Advisory Board for Contaminated Sites in BC.

Additionally, Active Earth used a conservative model (TSCREEN) and compared the results to the CSR Schedule 11, Colum III RL standards.

Active Earth's approach is discussed in the assessment section below (Section 5.4 and 5.5).

3.7.2.3. Dust Generation

The HWR, Division 6 requires the operator to prevent dust generation originating from waste material (and contaminated soils). Section 7.1 of the TAR proposes an approach to monitor and mitigate dust emission that could originate from the STMA or the landfill area. This includes the use of a real-time monitoring device when dry or windy conditions exist or when dust is observed potentially migrating offsite. The proponent proposes to implement dust suppression measures and cover fine grained material stockpiles. Fine grain material will also be covered during transportation on-site. If deemed necessary, particulate monitoring equipment, such as MiniVol PM_{10} and $PM_{2.5}$ samplers may be permanently installed at strategic locations.

3.7.2.4. Decommissioning and Closure

The HWR, draft CSR P15 and the Landfill Criteria for Municipal Solid Waste (LCMSW) all have specific site closure requirements. However, the HWR and the LCMSW closure requirements are much more specific and relevant to the SIA facility and SIA's proposed closure design reflects that reality (TAR Section 12). A summary of the final cover design is presented here (top to bottom):

- 30 mil LLDPE liner over the whole landfill area
- 1 meter thick (minimum) of a low permeability clean soil ($K \leq 1x10^{-7}$ m/s)
- 1 meter thick (minimum) of a vegetated growing medium suitable for rooting and sloped at 3%

The design exceeds the LCMSW requirements and includes and exceeds some aspects of the HWR requirements with the integration of the 30 mil (0.762 mm) LLDPE liner, slightly thinner than the 1 mm required by the HWR and the 1 meter thick growing medium.

Both standards require that the final cover be long lasting, self draining and maintenance free and that it be sloped between 3 to 5%. In the closure design, the low permeability clean soil under the growing medium is proposed to act as a hydraulic barrier to ensure runoff is drained away from the site and does not permeate or build up into the growing medium and generate leachate. Therefore, it is proposed to be compacted and tested for permeability during construction. MEM recommends that it be done using the standard proctor tests. It is recommended to limit compaction activities to dry periods (May and October), when full compaction can be achieved. This should be stated in the Environmental Procedures Manual (EPM) and set in collaboration with MEM.

Side slopes of the landfill are planned to be 2.5:1 (H:V) which also exceeds the LCMSW requirements of 3:1.

Lastly, the closure is planned to be implemented progressively, as landfill capacity is met. The closure is proposed to be supported by a post closure monitoring program. This is particularly relevant as a security bond is recommended to be included in the permit. Section 14 of the TAR covers this aspect in greater details and is further discussed in the assessment section below.

3.7.2.5. Record Keeping and Reporting

CSR draft P15 requires records for demonstration trials to determine biodegradation potential, facility drawings, inventory of soils undergoing treatment, operational activities such as aeration and amendments, monitoring results, maintenance and repairs, inspection records, and documentation of waste discharge authorizations (e.g. soil movement, leachate or air discharges).

Active Earth indicated that record keeping would, in general, meet the requirements of the draft P15. It is recommended to state in the permit the record keeping and reporting requirements. Records should include waste approval application forms, soil deliveries, soil treatment inventories, rejected soils, treated and encapsulated soil relocation, landfill cells design and location, site map, leak and leachate collection volumes, and facility inspections. A clause, or requirements in the EPM, similar to the HWR Division 6 requirements Section 26 (4) should also be considered for the landfill area.

Reporting requirements in draft P15 are specific to the Spill Reporting Regulation and the CSR. These apply to all relevant sites at all times and are thus not necessary to write into the permit. However, a permit clause on annual and quarterly reporting is recommended.

3.7.3. Policy

All EPD Operating policies were considered as part of this assessment. The most important policies for this assessment are the followings:

- 1.03.01 Financial Security Policy and Procedures
- 1.05.01 Science and Decision Making - A Framework
- 1.06.01 Our Plan for the Future: BC Pollution Free

3.7.4. Programs and Initiatives

The main programs and initiatives which were taken into consideration during this assessment are listed below:

- Living Water Smart and its associated initiatives
- Cumulative Effects Assessment and Management Framework
- Area Based Planning
- HWR review (ongoing)

3.7.5. Local bylaw and land use definition

The SIA property zoning is defined as the Electoral Area B – Shawnigan Lake Zoning Bylaw No. 985. The property is zoned F-1 – Primary Forestry. This zoning allows for various activities to occur including the "extraction crushing milling concentration for shipment of mineral resources or aggregate materials excluding all manufacturing". Based on the permitted use and conditions of use listed in the bylaw, it is unclear whether or not the proposed activities (contaminated soil treatment and landfilling) are acceptable uses for the F-1 zoning. The interpretation of the bylaw was left to the Cowichan Valley Regional District (CVRD) planning department as per legal advice.

The operation of mines (or quarry) corresponds the CSR "industrial land use" definition which is worded as follow: "the use of land for the primary purpose of conducting industrial manufacturing and assembling processes and their ancillary uses including, without limitation, factories, metal foundries, wood treatment facilities, mines, refineries, hydroelectric dams, metal smelters, automotive assembly plants, rail car or locomotive maintenance facilities, railyards, non-retail breweries and bakeries, roads and highways, wastewater and sewage treatment plants, electrical transformer stations and salvage yards".

4. CONSULTATION ACTIVITIES

4.1. General Consultation Period

A summary of the consultation requirements for this application is provided in Table 3. Initial consultation requirements were communicated to SIA and their consultant Active Earth via email dated April 19, 2012. In addition to the minimum Public Notification Regulation requirements, MoE requested that the Environmental Notice be posted at the site entrance. The First Nation consultation process was done jointly with MEM and notification letters were sent on behalf of both MoE and MEM. The notice also indicated that two applications were made, one to MEM under the *Mines Act* and one to MoE under the *EMA*.

The consultation period was initiated on May 9, 2012 with the publication of the Environmental Notice and the posting at the site. Due to a high level of public interest, the consultation period was extended beyond the minimum 30-days required but no firm end date was set by MoE. The initial consultation period continued through October 2012.

Table 3 – Public Consultation Summary

Consultation Requirements	Date/Response
Publishing Requirement	
British Columbia Gazette	May 10, 2012
Cowichan News Leader	May 9, 2012
Posting at the site entrance	May 9, 2012 to today
Notification of First Nations	
Malahat First Nation Stz'uminus First Nation Cowichan Tribes Halalt First Nation Lyackson First Nation Penelakut Tribe Scia'new First Nation Lake Cowichan First Nation	April 26, 2012 (Letters issued by Active Earth and MEM)
Notification of Agencies	
Cowichan Valley Regional District (Planning and Development and Engineering and Environmental Services Department)	July 20, 2012
Ministry of Energy and Mines (MEM)	July 20, 2012
Ministry of Transportation (MOT)	July 20, 2012
Ministry of Health (VIHA)	July 20, 2012
Ministry of Forests, Lands and Natural Resources Operations (MFLNRO)	July 20, 2012
Environment Canada (Department of Fisheries and Oceans) (EC)	July 20, 2012
Notification of Public Interest and Stewardship Groups	
Shawnigan Lake Watershed Roundtable (SLWR)	July 20, 2012
Shawnigan Lake Watershed Watch	July 20, 2012

Consultation Requirements	Date/Response
Association (SLWWA)	
Shawnigan Lake Residents Association (SLRA)	July 20, 2012

In addition to the notification and consultation requirements listed above, a number of consultation activities initiated by the proponent, concerned parties or citizens or by the local government (the Cowichan Valley Regional District) were completed as part of this application. The activities are listed in the summary table below:

Table 4 – Consultation Activities Summary

Consultation Activities	Initiated by	Attendance	Date
Community Meeting, local coffee shop on Stebbing Road	SIA	~30	May 8, 2012
Online discussion forum at www.sialtd.com	SIA	n/a	
Open House Meeting, Shawnigan Lake Community Center	SIA	~203	May 31, 2012
Public Meeting	CVRD	~350	July 12, 2012

SIA also published information relevant to the application, contact information and created an online discussion forum on its website (www.sialtd.com). SIA also offered on its website to meet with individuals or groups to discuss the application in smaller, informal meetings. Two informal meetings were held with the Shawnigan Lake Watershed Roundtable on May 29 and June 11, 2012.

In addition to the consultation activities above, SIA also met with the Cowichan Tribes and the Malahat First Nation chiefs, Chief Harvey Alphonse and Michael Harry respectively on June 7 and June 10, 2012. This is further discussed in the Section 4.4 below.

The Consultation Report for this application was submitted by Active Earth as appendix of the TAR and is dated August 2012. The report includes tear sheets from the local newspaper and BC Gazette showing that the publication requirements were met. There is also a copy of the public notice and pictures of the notice indicating that the notice was posted at the site entrance as requested by MoE. Letters to First Nations, agencies and summary of other consultation activities were also provided in the report. Further details on agency, public and First Nation consultation are discussed below.

The proponent also met with the Environment Minister early in the process on October 31, 2011 to promote its application.

4.2. Draft Permit Consultation Period

Considering the high level of interest from the general public, the agencies and First Nations, MoE thought appropriate to provide interested parties with the opportunity to review and

comment the propose draft permit conditions. The approach is based on the consultation process associated to the review of operational certificates which are part of liquid and solid waste management plans implementation under EMA.

The draft permit was made available online and on paper at the local community center (Shawnigan Lake Community Centre) for an initial period of 14 days, starting on March 19, 2013. The review and comment period was extended by an extra 7 days in consideration for spring break and following the requests from various groups and individuals. The review and comment period ended on April 9, 2013. A dedicated email address (EnvProtectResponseWestCoast@gov.bc.ca) was setup for people to send comments to. As indicated, the scope of this consultation prior was limited to the draft permit conditions. However, many comments received did not specifically target the draft permit but questioned the proposal in general, the site selection, the science, the decision making processes, etc. Those comments were integrated in Section 5 below and a summary of comments received on the draft permit conditions are presented in Section 6. The Active Earth Technical Assessment and Consultation Reports were posted on the MoE regional website (http://www.env.gov.bc.ca/epd/regions/vanc_island/env-mgt/sia_permit.htm) upon request from the public. The BCGS geological report and addendum were also posted for convenience.

5. COMMENTS AND QUESTIONS – GENERAL

5.1. Agencies

SIA was requested to consult with the agencies listed in Table 3. Active Earth sent notification later due to a misunderstanding with MoE. Active Earth was under the impression that MoE was to issue those letters initially but this was limited to First Nations notification letters. Regardless, the notification letters were sent to the agencies and to the public Interest and stewardship groups on July 20, 2012 by Active Earth. Active Earth reported that no responses were received from the agencies by either SIA or Active Earth. However, responses were received by MoE from VIHA and FLNRO and then forwarded to Active Earth for follow up. The Ministry of Health (MoH) also provided comments to MoE during the draft permit consultation period (refer to Section 6). The agencies comments are presented below:

5.1.1. VIHA

VIHA issued a response by email on November 5, 2012 followed by regular mail to MoE. The letter, dated November 2, 2012, was forwarded to Active Earth who provided a response which is included in their Consultation Report. VIHA issued a second letter to MoE during the draft permit consultation period, dated April 2, 2013, to which MoE responded on April 9, 2013. VIHA first letter covered a number of topics which are summarized below (Table 5) along with responses provided by Active Earth. The topics raised in the second letter are presented Section 6 – Draft Permit Consultation below.

Table 5 – VIHA questions (November 5, 2012) and summary of Active Earth responses

VIHA Questions / Comments	Active Earth Responses
Is the 200 year design storm event adequate to deal with less severe but more frequent back to back events?	Calculations includes conservative assumptions: ▪ Worst case scenario (rain on snow) ▪ Impermeable surface Active Earth indicated the proposed stormwater management design exceeds requirements.
What are the specifics of the soil management area – details of cover, soil heights and criteria for determining when soils are covered?	Active Earth referred to the TAR where this information is provided and provided additional information: ▪ Typical soil stockpiles heights not more than 2-3 meters ▪ Construction of a building above the Soil Management Area
VIHA asked if field test kits could be used to sample effluent considering the proposal to sample on a monthly basis. VIHA also recommended that the effluent be compared to the Guidelines for Canadian Drinking Water Quality (GCDWQ).	Active Earth response indicated the following: ▪ Sampling frequency will increase to monthly during periods based on flow and time (i.e. one every 2000 m3 and monthly). ▪ The TAR compares all background monitoring results to GCDWG in addition to the BCAAWQG (aquatic life) and the CSR AW.
What assurances are in place that monitoring for fractures and anomalies under newly mined zones will be identified?	Active Earth indicated the followings: ▪ No fractures to date (6 years mining) ▪ Drilling and surface water wells indicate very low permeability rock for approximately the first 75 m. ▪ Made reference to the report from the BC Geological Survey titled: "Bedrock Geology of the South Island Aggregates Stebbings Road Quarry". ▪ There will be inspection of the quarry floor prior to the construction of landfill cells. ▪ A clay layer of a minimum thickness of 1 m will be placed beneath the landfill area. Further clarifications were provided by Active Earth in their February 15, 2013 letter.
Will the plan adequately address mining gradients to keep the surface water from flowing towards the soil management area?	Active Earth indicated that the Soil Management Area was proposed to be outside the mining footprint and that surface water collection and diversion works will intercept surface flows prior to reaching the area.
Will there be an increase [noise, truck traffic] that could cause concerns to the community?	Active Earth responded that there would be no net increase in traffic as a result of the proposed facility as the mine had to be reclaimed. The proposal changes the quality of the soil used for reclamation but not the volume.
VIHA and local residents should be notified of spills to Shawnigan Creek or any discharges of contaminated water to the environment.	Active Earth referred to the Emergency Response Plan included in the TAR and to their obligation to report to Provincial Emergency Program (PEP) should a spill occur.
VIHA encouraged SIA to regularly notify the public of activities conducted at the site and of soil and water discharges quantity and quality.	No comment was provided by Active Earth.

In addition, VIHA asked to be kept informed of the comments issued from other stakeholders, specifically the Shawnigan Residents Association (SRA) and the CVRD. An electronic copy of the Technical Assessment and the Consultation Report were sent to VIHA by MoE (via Active Earth).

5.1.2. BC Geological Survey

MEM commissioned the BCGS to conduct a review of the geology of the SIA quarry. This review was commissioned to further characterize fractures in the bedrock in relation to their ability to facilitate groundwater flow. The BCGS geologist spent two days in September mapping the site and making observations and returned to the site in the spring 2013 at which time he also visited the Buttler Brothers limestone quarry nearby.

The results of this review are presented in a report titled: "Bedrock Geology of the South Island Aggregates Stebbings Road Quarry", dated October 30, 2012 and the addendum, issued in April 2013, along with a clarification email dated June 4, 2013. The geological units forming the Wark gneiss complex are described in the report and align with the detailed petrographic analysis commissioned by SIA and identifies the main rock formations as: fine grained pale green diorite, fine-medium grained dark green diorite and medium-coarse grained gabbro. No limestone was observed on any of the outcrops at the SIA site which suggests that drilling cuttings may have been misidentified by the drillers. Based on the author, limestone formation found in the Wark gneiss complex forms "slivers and pods" typically follow major structures or gneissic textured foliation. Two types of fractures were identified, one group defined as "tight" and another group as "filled" fractures. Most fractures observed at the Site and reported in the BCGS report characterized as "tight" and less than 1 mm thick. They typically lack visible infills and alteration zones. Filled fractures were slightly larger fractures (up to 3 mm approximately) filled with quartz, calcite and sericite. All fractures observed were well bounded with the rock. The report concludes that "the bedrock at the SIA quarry site appears to have minimal permeability or porosity." The report was presented by the author at a meeting on October 17, 2012 between Active Earth, SIA, MoE, FLNRO (Groundwater Protection division) and MEM. The report is summarized in Section 3.4.1 - Geology and Structural Geology of this document.

Active Earth indicated in their response dated November 21, 2012 that they were in agreement with this report which supported conclusions made in their own TAR stating that "shallow bedrock did not readily transmit the flow of water and is considered to be an aquitard". This is further discussed in the assessment section below.

5.1.3. FLNRO Groundwater Protection Division

MoE contacted MFLNRO directly to confirm they had received a referral letter from SIA or Active Earth in regards to the proposed facility. MFLNRO (Paul Marquis, Section Head, Regional Operations Division - Coast Area) provided an initial response saying that it was ultimately the responsibility of the proponent to comply with the Water Act and that referrals were not typically processed by FLNRO. MoE then contacted the Groundwater Protection division of

FLNRO to seek their input on specific groundwater aspects relevant to the application. This led to a first letter from the Groundwater Protection Division dated September 14, 2012 issued to MoE, Active Earth, SIA and the CVRD. As per their internal policy, the Division normally shares information with the regional districts involved. The letter was then made available to the public and published on the CVRD website. Active Earth provided a response to the letter on October 5, 2012 which was also discussed at the meeting on October 17, 2012 (referred to above). Active Earth response is included in of the Consultation Report, Appendix N.

Following the meeting, the Groundwater Protection Division issued a second letter dated November 16, 2012 to MoE regarding Active Earth October 5, 2012 response. The letter was forwarded to SIA and Active Earth by MoE on November 16, 2012 but no formal response was issued to the Groundwater Protection Division. Outstanding items are summarized below and discussed in the assessment section.

Table 6 – MOE Groundwater Protection Division (letter dated November 16, 2012)

Comments and Outstanding Items Reference #	**Details (extracted from the letter)**
1	The characterization [of the upper bedrock unit] is based on a limited amount of data in a few boreholes not well spatially distributed on the site. [...] a single fracture analysis should provide a more conservative estimate of groundwater velocity and contaminant travel time. [...] is considered more applicable in comparison to a matrix diffusion or porous media approach [as used by Active Earth] and should be provided for comparison.
2	Additional characterization of the hydrogeological properties and thickness of the upper confining layer unit should be undertaken through the construction of more monitoring wells distributed around the site.
3	[...] characterization of the upper rock unit would be gained if the core drilling method was used for construction of any additional monitoring wells on site, compared to [...] standard (air rotary)drilling.
4	We recommend that possible seasonal variations in the potentiometric gradient at the site should be evaluated through periodic monitoring of existing piezometers and those constructed in the future.
5	With respect to the bacterial results from piezometer MW3S which indicated E.Coli of 10 MPN/100 ml and Total Coliforms fo 1940 MPN/100 ml on March 16, 2012 [...]. It may be worth considering whether there is some other cause of the bacteria presence.
6	[...] Although it is not a contiguous fault feature, some reaches of Shawnigan Creek could be considered to meet the lineament definition (Kirk Hancock, B.C. Ministry of Energy, Mines and Natural Gas, personal communication, October 17, 2012). [...] highlighting the importance of ensuring that the potential impacts from leachate and/or runoff generated from the site on surface water bodies are addressed through treatment, containment or other means, thereby protecting both the surface water and potential groundwater recharge sources.

These issues were later resolved and are discussed in the assessment section below.

5.1.4. *Ministry of Transportation*

MoE also contacted the Ministry of Transportation (MOT) and had a brief discussion over the phone with Ross Deveau and Michael Person which indicated that they would respond in writing once they would receive the electronic referral. The documentation was sent to MOT via email on July 12, 2012 but Active Earth received no response.

5.1.5. *MoE Land Remediation Office*

The Land Remediation Office (LRO) was not officially notified as part of this application. However, MoE has been in contact with LRO prior to and throughout the SIA's formal application to discharge waste. LRO was not officially asked to provide comments in regards to the application but did provide insight on non-compliances with a specific Soil Relocation Agreement discussed in section above. This aspect is discussed Section 2 (History) of this document.

The LRO has been in regular contact with the Cowichan Valley Regional District (CVRD) in 2011 and 2012 to provide support and follow through on commitments made by the Environment Minister in regards to contaminated soil relocation issues in the Cowichan valley. A number of meetings were held between the LRO and the CVRD in 2012, one of which covered CVRD questions on SIA permit application. The questions were listed in the presentation made by the Alan McCammon (LRO) on May 23, 2012 and are:

- Concerns about potential impact to Shawnigan Creek and drinking water sources
- Status of the application
- Decision making, consultation and input processes

As indicated above, the LRO was requested by MoE to review the available technical information pertaining to hydrogeology and the application of the CSR Technical Guidance documentation later in the process. LRO provided recommendations regarding the site water use determination for the both the upper and the deep aquifers. LRO also provided recommendation regarding groundwater flow direction and methods used to assess bedrock permeability and estimation of travel time.

A letter report, dated July 24, 2013, was submitted to MoE to assist in the assessment.

5.2. Cowichan Valley Regional District

The Cowichan Valley Regional District (CVRD) was notified of the application by the applicant as requested by MoE as part of the initial public consultation process. MoE was not initially involved in the early discussions between the CVRD and SIA. The CVRD issued formal letters and emails to MoE as well as news releases regarding SIA's application. In essence, the letters and news release issued by the CVRD stated their objection about any application entertaining

the discharge of contaminated soil within a community drinking watershed. A summary of the formal news release and letters are presented below:

Table 7 – CVRD Communication Activities and Summary

Communication	Summary
June 7, 2012, News Release "CVRD calls for a Moratorium on Contaminated Soils Relocation"	The News Release was mainly focusing on the general issue of contaminated soil relocation. However, it did specifically referred to SIA application requesting an extension of the consultation period and announcing the CVRD would be convening an open public meeting soon.
June 18, 2012, Letter to Active Earth	The letter clearly identified key requests and comments: ▪ A moratorium on SIA's (and similar) applications made in the CVRD area ▪ Extend SIA application consultation period to November 30, 2012 ▪ Convene a public meeting in collaboration with Active Earth, MEM and SIA
June 25, 2012, News Letter "Public Meeting Announced"	The letter announced the public meeting for July 12, 2012. It also stated that "In general, the public feels they have not been heard and their questions and concerns have not been adequately addressed".
July 19, 2012, News release "Contaminated Soils in the Cowichan Valley"	The News Letter indicated the CVRD intentions to increase its control over relocation of contaminated soils in the Cowichan Valley.
July 26, 2012, Letter to Active Earth	The CVRD sent the July 12, 2012 public meeting minutes and requested that the information be taken into consideration in the Active Earth decision making process.
August 2, 2012, Letter to Active Earth	In this letter, the CVRD clearly stated that it: ▪ is opposed to the permitting of contaminated soil discharge within a public domestic water supply watershed, specifically referring to the Shawnigan Lake watershed ▪ is opposed to the issuance of a permit of the proposed SIA facility ▪ is preparing necessary bylaw to prohibit dumping of contaminated soil or waste in a designated community watershed within the CVRD ▪ is determined to work collaboratively with Active Earth to prevent future risks to community domestic water supplies within the CVRD
August 27, 2012, Letter to the Environment Minister	The letter reiterated the key points mentioned in the August 2, 2012 letter to Active Earth and added the followings: ▪ CVRD was hoping to continue on a mutual search of a suitable site within the CVRD but not "proximate to a public water supply". ▪ Asked to put SIA application decision on hold while collaboration continues with MoE. Requested a meeting with the Environment Minister
November 29, 2012, Letter to Active Earth	In this letter, the CVRD provided its comments regarding the Consultation Report prepared by Active Earth for SIA.

MoE indicated in a letter dated June 26, 2012 that it did not have the legal authority to impose a moratorium on SIA's application or other similar applications and it had to consider and assess the application. MoE did not specifically agree to extend the consultation period as requested but indicated that comments would continue to be received and considered in the adjudication process.

It is important to note that MoE and CVRD communications are not limited to the list above. Ongoing communications were maintained throughout the process by phone, emails and meetings. The latest questions from the CVRD were related to the decision making process and how the decision would be made public.

5.3. Public Interest and Stewardship Groups

SIA's application to discharge waste at their active quarry raised a lot of interest from the local public, businesses, and public interest and stewardship groups. Comments from the public were sent before, during and after the formal consultation period and came from residents living nearby the proposed facility, in Shawnigan Lake or in Mill Bay area.

Comments were sent mostly to the MoE Regional Office but a number of communications (letters or emails) were sent directly to the Minister of Environment office in Victoria as well as other elected officials. The name and contact information of the members of the public are listed in the AMS system and not listed here in this report. The questions and concerns were paraphrased and issued to Active Earth for consideration in their Consultation Report, in addition to those collected at the SIA open house, on SIA website and at the CVRD public meeting. It is to be noted that many of the comments received by MoE simply objected the permitting of SIA's proposed facility. A few letters and emails referred to scientific or operational management concerns. Those questions and concerns are grouped and listed below:

5.3.1. Summary of Questions from the Public

Site Selection

- Why was this site selected for a contaminated soil facility?
- Could a more suitable site be jointly selected by the CVRD, Active Earth and the proponent?
- Why approve such a site in a designated Community Watershed?

Design and Other General Aspects

- What is the type of material proposed to be discharged / treated at the site?
- Are there similar operations approved in the province?
- How does a BC requirement compare to US EPA requirements for the construction of a similar facility? Would SIA meet US EPA requirements?
- What was the earthquake design requirement utilized? Does it match the risk at the site (1 in 1000 year / 7.2 Richter). Refer to HWR Division 6, Section 25 (2).

Monitoring Requirements

- What is the surface water and groundwater monitoring requirement over the life of the operation, during closure and post closure?

- Has there been baseline information collected prior to the construction of the facility?
- Will the monitoring requirements allow tracking of contamination if it occurs and will it provide enough information to trace it back to its origin?
- Will the monitoring requirements in the receiving environment (Shawnigan Creek and Lake) be modified to reflect changes in the watershed?

Operations

- How can we be sure about to ability of the proposed water treatment system to meet the BC Water Quality Guidelines for fresh water aquatic life?
- Why accepting a discharge in an ephemeral stream where limited dilution is available?
- How will the proponent reduce contaminated soils exposure to weather (rain, snow)?
- How will soil erosion be minimized and stormwater be kept out of the proposed facility?

Potential for Impacts (Environmental and Human Health)

- What is the potential impact on drinking water (surface and groundwater) downstream of the operation, including existing diversion points/water licenses?
- What is the potential impact on groundwater underlying the proposed facility?
- Is there a hydraulic link with the CRD watershed (Sooke Lake watershed)?
- Has the risk to ecologically sensitive areas nearby the proposed facility been assessed (including covenant area on SIA's property?)
- How can be we confident of the upper bedrock low permeability assessment (i.e. absence of conductive fractures)?
- How can permeability assessment be complete if it does not consider fractures in the bedrock?
- Did Active Earth take into consideration the introduction carcinogens into the waterways through contaminants found in the contaminated soils?
- Why was there no environmental impact conducted as part of the application review?

Compliance

- How will the permittee ensure that it only accepts approved material?
- How will compliance be monitored and who will ensure the permittee meets all permit conditions?
- What is SIA compliance record with Active Earth?

Contingency and Emergency Plans

- Is there a risk of puncturing the liner during construction and over the life of the facility? What are the preventive and mitigating measures in place should this happen?

- What are the contingency and emergency response plans in the event of an engineering failure or an accidental spill?

Closure Plan and Security Bond

- Will there be a security bond required from the proponent?
- Will the financial security consider long term surface and groundwater monitoring as well as water treatment?
- Will the financial security include provisions to address potential contamination of the entire Community Watershed?

Other questions outside of MoE's scope and jurisdiction were raised by members of the general public. Those questions were related to potential noise and dust emissions offsite and associated to an anticipated increase in traffic, to cost of road maintenance and to hours of operation. A number of questions related to general soil relocation issues in the Cowichan Valley region were raised throughout the consultation process. As these questions could not be directly addressed by MoE, they were communicated to LRO for follow up.

MoE received one letter of support from a local business owner who referred to the value of having a formal soil remediation facility in the area. The letter indicated that the proposed facility would offer an alternative to illegal dumping of soil and therefore reduce the risk to the environment.

Direct responses to all enquiries were also sent by email or letters by MoE.

5.3.2. Shawnigan Residents Association

The Shawnigan Residents Association (SRA) represents the residents of the Shawnigan community and has been very active throughout the process. SRA has stated its opposition to the proposal at numerous occasions through letters, emails and articles published in local newspapers. SRA specifically asked to extend the consultation period to allow them to commission additional studies to assess the risks associated to the proposal. SRA enquired about similar facilities across BC. MoE provided relevant information for the Vancouver Island and the Lower Mainland on August 13, 2012.

SRA hired the service of local hydrogeologist firm (Lowen Hydrogeology Consulting Ltd.) to review the groundwater aspects of the proposal. The letter report titled: "Proposed SIA Contaminated Siols Landfill, Stebbings Road, Malahat Land Distirct, BC" was provided to MoE on September 23, 2012. MoE forwarded the information to the proponent for consideration in the TAR. The report was also presented at a public meeting organized by SRA on November 29, 2012. However, MoE and Active Earth were not present at the meeting.

Lowen letter report suggested that the vulnerability of the aquifer underlying the proposed facility had been underestimated by Active Earth. Aquifer vulnerability was estimated by Lowen using the Aquifer Vulnerabilty Index Calculation indicating a high degree of vulnerability.

The report also suggests that the upper bedrock has a higher hydraulic conductivity (i.e. $5x10^{-7}$ m/s) than estimated by Active Earth.

The letter report from Lowen also lists key recommendations which are presented below:

1. Complete a comprehensive Environmental Impact Study as part of the proposed facility approval process.
2. Construct monitoring wells, aquifer testing, water quality sampling and groundwater flow modeling to assess suitability of the proposed site.
3. Incorporate leak detection system and contamination containment plan.
4. Require long term financing plans.
5. Assess sustainability of the facility (Lower recommends to conduct a cost-benefit analysis).

Active Earth responded in writing to the Lowen letter report in November 16, 2012 (Public consultation Report, appendix N of the TAR). Active Earth response indicated that Lowen made site specific conclusions based on limited information and that the TAR was not consulted prior to issuing his letter. Active Earth responses are summarized the table below:

Table 8 – Lowen comments and Active Earth summary response

Topic presented in Lower letter report	Summary of Active Earth response
1 - Aquifer underneath the site	Active Earth acknowledged the existence of an aquifer underneath the proposed site (Site Aquifer). It is also indicated the aquifer was located at approximately 75 m below ground surface and protected by the upper bedrock aquitard.
2 - Aquifer vulnerability	Active Earth mentioned that the Site Aquifer was not identified as being vulnerable due to the aquitard. It also indicated that aquifers #203 and #208 were compared to the Site Aquifer without supporting data.
3 - Upper bedrock conductivity and presence of limestone at the Site	Active Earth mentioned that conductivity figure proposed by Lowen was based on literature review only and therefore not necessarily relevant. Site specific information is more reliable. Additionally, Active Earth indicated that no limestone had been identified at the Site on surface and drilling cuttings description may be incorrect. Active Earth also referred to the BCGS report prepared as part of this assessment which indicated that no limestone was observed on surface.
4 - Vertical subsurface travel time	Active Earth indicated that Lowen conclusions were based on regional data and not Site specific information.
5 – Multiple layers of protection (risk of leaks)	Active Earth acknowledge the multiple layers proposed in its design and referred to the TAR for details.
6 – Fractured bedrock	Active Earth referred to its responses provided above (points #1 and #2). It indicated the Site Aquifer vulnerability to surface contamination is not as Lowen described it and is dependent on the aquifer recharge. Based on Active Earth (and in reference to the TAR), the aquifer is recharged from areas located upstream of the Site.
7 – Limestone	As described under point #3
8 – Regional hydrogeology	Active Earth indicated that site specific information was not used and therefore that conclusions made by Lowen were not valid.
9 – Aquifer vulnerability (versus	Active Earth mentioned that assumptions made by Lowen (presence of

Topic presented in Lower letter report	Summary of Active Earth response
presence of limestone)	limestone in SIA quarry) were incorrect and therefore that conclusions made were not valid.
10 – Site selection	Active Earth indicated the Site was "very well" located.
11 – Site characterization	Active Earth referred to the installed groundwater monitoring wells (total of three) and additional two groundwater monitoring wells, once the facility is authorized.
12 – Existing contaminated soils on the site	Active Earth indicated that this was not relevant to the application.
13 – Surface water management (at closure)	Active Earth mentioned that a closure plan had been developed as part of the application which took into consideration storm water runoff.
14 – Recommendations (as above)	Active Earth indicated the TAR was extensive and presented an adequate assessment for the proposed Site. It also indicated that Active Earth had no intention to modify its design to include a "pump and treat" system for groundwater.

The study findings and Active Earth response are discussed in greater details in the assessment section below.

A second letter from LHC was submitted during the draft permit consultation period and is summarized in Section 6 below.

5.3.3. Shawnigan Watershed Roundtable

The Shawnigan Watershed Roundtable (SWR) was formed in 2012 and is composed of general members of the public, representatives from the private industry, the CVRD and other agencies including MoE. The SWR was formed shortly after the SIA's application was submitted to MoE, at a time where potentially contaminated soils were suspected to be relocated within the watershed. Although the SWR is still relatively new, it took shape quickly and its mission to protect the watershed was quickly communicated.

MoE was invited to be part of the SWR and attended a watershed visit (June 23, 2012) as well as a meeting (September 29, 2012) organized by the SWR. No specific questions or comments were sent by the SWR with the exception of a request to extend the consultation period.

5.3.4. Living Forest Communities

The president of Living Forest Communities (LFC), a private forestry enterprise operating nearby the proposed facility, issued a letter to Active Earth on August 20, 2012 (dated August 19, 2012) requesting the proponent to "finance sufficiently credible environmental and hydrogeological studies by arm's length third party professionals, so as to determine the potential for negative impact that the SIA contaminated site may have upon the safety and security of the ground water system of the upper Shawnigan Watershed..." The main concern expressed by the LFC was in relation to the presence of limestone at the site and the potential existence of the limestone fault line close to the proposed Site. LFC provided a letter report titled *"Review of*

groundwater resources" from Gulf Island Geotechnical Services (GIGS) documenting the presence of limestone at the surface about 400 m from SIA site. The letter report was dated November 19, 2007. LFC also indicated that anecdotal information obtained from local masons and geologists suggested limestone was present at the edge of SIA property. LFC mentioned the existence of a high productivity well recently installed and provided a report by Waterline Resources Inc. to support this information. The report titled "*Water Supply Assessment Trail Production Well #1 Elkington Forest Property Cowichan Valley Regional District, BC*" finalized on September 14, 2012. A third document was provided by LFC titled "*Ecological Baseline Assessment*", prepared by Mimulus Biological Consultants Ltd, dated January 29, 2008.

Ultimately, LFC requested that "further study is required to determine the exact formation and porous nature of this fault at the property (SIA)".

The GIGS report and the Waterline Resources reports were considered as part of the assessment and are discussed in the assessment section below.

5.3.5. Shawnigan Creek Protection Association

The Shawnigan Creek Protection Association (SCPA) was also formed in response to SIA's application. SCPA clearly opposed to SIA proposal, created a blog (http://www.shawnigancreekprotection.ca), published articles in local newspapers and organized protests. SCPA also organized the posting of opposition signs across the community prior to SIA's open house and CVRD's public meeting.

MoE did read the blog on a regular basis but no formal comments or questions were extracted from it even though MoE suggested the association to summarize the concerns in writing for consideration in the decision making process. The last blog entry was posted on August 9, 2012.

5.4. First Nation

A review of the FNQ2 database was conducted to initially identify the First Nation groups that could have had rights or interests in the proposed project. A high level literature review confirmed that fishing, hunting and gathering interests had been documented in the area of Shawnigan Lake and Shawnigan Creek. However, no formal rights were noted. Letter of referrals were sent to a total of eight First Nations by Active Earth on May 22, 2012 but no formal response were received by either Active Earth or SIA with the consultation period.

As stated in the Consultation Report, SIA made direct contacts with the Malahat First Nation and the Cowichan Tribes and met with Chief Michael Harry and Chief Harvey Alphonse respectively. During the consultation process, MoE learned from the Ministry of Aboriginal Relations and Reconciliations (MARR) that land negotiations were underway with the Malahat First Nation for land adjacent to SIA's property. However, after review of the proposed project,

Chief Michael Harry clearly expressed his support to SIA's proposal at the July 12, 2012 public meeting.

6. COMMENTS AND QUESTIONS - DRAFT PERMIT

Comments and questions were received from the general public, key agencies and public interest groups as well as from First Nations. More than 300 communications were received by email and courier. The main focus was put on comments directly related to the draft permit conditions. However, other general comments were also considered.

6.1. Agencies:

6.1.1. VIHA

VIHA issued a second letter to MoE during the draft permit consultation period, dated April 4, 2013, to which MoE responded on April 9, 2013. VIHA questions and comments are listed below along with MoE responses (Table 9). Additional discussions via phone calls, emails and meetings were held between VIHA and MoE to further clarify concerns raised by VIHA and, to a certain extent, concerns raised by the Ministry of Health (MoH) and the SRA. A meeting was also held between VIHA and MoE on April 24, 2013, followed by a meeting with VIHA, MEM, MoE and Active Earth on May 13, 2013 in the VIHA Nanaimo office. This last meeting was held on Active Earth's request. Active Earth presented a Power Point presentation which summarized the information presented in the TAR.

Table 9 – VIHA questions (April 4, 2013) and MoE response

VIHA Questions / Comments	MoE Responses
Section 1.4.4 lists the standards to be met for water discharged from the water treatment system. **It is suggested that the conditions of permit include the parameters for frequency of sampling and requirements to monitor process parameters onsite. An example would be the use of a field test kit on a regular basis to ensure the water treatment process is operating optimally.**	Monitoring requirements are further defined under Subsection 3.4 of the draft permit for both the settling pond (SW-1) and the water treatment system (WTS) discharges. Subsection 3.4 refers to the parameters of concerns which are defined under Subsection 1.4.4 as: Inorganic Substances (including metals), Dioxins, Furans, VPHw, LEPHw, VHw6-10, EPHw10-19, PAHs, BTEX, styrene, Chlorinated Hydrocarbons, Phenolic Substances, chloride, sodium, Glycols, pH and oil & grease. Monitoring requirements associated to onsite processes are not included in the draft permit as this is beyond MoE scope. However, such requirements have been discussed with the proponent and will be integrated into the Environmental Procedures Manual (EPM) required under Subsection 2.13 i) of the draft permit. Monitoring sites internal to the operation include but are not limited to: leachate collection and leak detection sumps, collection reservoirs, catch basins associated to the soil treatment facility and the landfill area. As indicated in the draft permit, the Permittee shall prepare and submit the EPM to the satisfaction of the Director 30-days prior to receiving soil at the facility.

VIHA Questions / Comments	MoE Responses
Section 1.5.1 sets the maximum rate of the settling pond discharge of 42,500 cubic meters per day for up to 1 in 10 year 24-hour flood events. In the application, drainage was designed to handle a 200 year storm event including snowmelt. We asked the question if this would be sufficient to deal with less severe, but possibly more frequent back to back events without causing harm to the receiving environment. **It is suggested that the conditions of the permit include the possibility of a flood event greater than a 1 in 10 year 24-hour flood.**	The settling pond catchment area is limited to clean stormwater runoff diverted away from activities where contaminated soils are proposed to be stored, treated or landfilled. The stormwater runoff is considered non-contact water and does not pose a significant environmental risk other than risks associated to the discharge of sediment laden waters. That said, the settling pond is designed to treat stormwater up to 1 in 10 year 24-hour flood events and withstand 1 in 200 year 24-hour flood event, including rain on snow event. Additional erosion and sediment control requirements within the settling pond catchment area are stated in the draft permit under Subsection 2.8 and refer to industry best management practices. Details of the additional controls are to be included in the EPM.
The conditions should include monitoring to the receiving environment during events that exceed the flood event flow.	Receiving environment monitoring requirements defined in Subsection 3.6 refer to worst case scenarios, fall first flush and spring freshet, where flows are expected to be the highest and subject to remobilize the most dust or sediment. The frequency referred to as 5 in 30 'events' which means that, twice a year, during fall first flush and spring freshet, a minimum of 5 weekly samples will be collected over a period of 30 days. This is considered statistically better and more representative of worst case scenario than isolated sampling events throughout the year. There are currently no requirements to collect samples if flow exceeds the permit limit and MoE will consider adding this specific requirement in the permit.
Section 1.5.3 discusses the quality of discharged effluent. The leak detection reservoir, the leachate detection reservoir and the leachate, surface run-off and leak detection containment reservoir (soil treatment/management area) all flow into the treatment system, which then flows into the settling pond and on to the surface water discharge point. **The proposals and proposed conditions do not yet address what would be the implications of exceeding the flow to the receiving environment or whether the treatment occurring in the settling pond would be compromised.**	Subsection 1.5.3 defines the characteristics of the settling pond discharge which receive non-contact runoff water and treated effluent from the WTS. The characteristics of the WTS effluent are defined under Subsection 1.4.4. The water treatment system was designed to treat all potentially contaminated water (contact water) as described in your comments above. It is proposed to be operated in batch which means that potentially contaminated water will initially be stored in dedicated reservoirs, tested and then treated prior to be discharged to the receiving environment via the settling pond. In the event that water quality does not meet the requirements, the water is proposed to be reprocessed and retested or pumped and trucked to a facility capable of treating the water. As most of the potentially contaminated water generated is directly dependant on precipitation, the water treatment system was designed to treat all incoming flows up to a 1 in 200 year 24-hour flood event. The total area used to calculate the design peak flow include an area of 1800 m^2 for the soil management and treatment facility (Subsection 1.2 of the draft permit) and area of 1800 m^2 for any active portions of the landfill (Subsection 1.3). The peak flow associated to the water treatment is estimated at 274 m^3/d and represents less than 1% of the expected flow from the settling pond, in similar runoff

VIHA Questions / Comments	MoE Responses
	condition. MoE will ensure these emergency scenarios are included in the Emergency Response Manual.
It is suggested that the conditions of the permit include details of where would this discharge go, and what sort of treatment and water quality standards will be met.	There is only one surface water discharge point proposed in this application and it is the settling pond discharge. The water treatment system discharges to the settling pond before flowing to an ephemeral stream (Creek 1), which then leads to the Shawnigan Creek approximately 500 meters downstream. It is standard design to include an emergency overflow infrastructure to avoid sudden release of water and sediment and/or damage to the settling pond should the actual flow exceed the design maximum flow. The emergency overflow is designed to flow to Creek 1 without compromising the infrastructure. Any discharge from the emergency overflow is required to be sampled and reported as per and the spill reporting requirements and the Emergency Response Plan referred to in Subsections 2.11 and 2.12 respectively. The results are then be compared to the requirements stated under Subsection 1.5.3.
This section says that a bedrock integrity inspection and risk assessment for any new landfill cell construction area must be submitted to the Director prior to construction of new landfill cells. **It is unclear from the documentation and therefore would be recommended that clear processes are established before issuing the permit regarding oversight of the submitted reports for accuracy and whether an approval or other mechanism be issued for each new cell, especially if the report identifies concerns.**	Details associated to the bedrock integrity inspection and risk assessment requirements will be included in the Environmental Procedures Manual (Subsection 2.13, d)). MoE agrees that a specific permit condition on landfill cells construction authorization would be beneficial in this particular case.
This section states storm water runoff will be diverted away from the soil management and treatment area, and all active landfill areas at all times. **It is suggested that the conditions of the permit include monitoring to ensure that the water quality meets all applicable standards such as the most stringent of the BCAWQG and the BCWWQG for Freshwater Aquatic Life uses and total suspended solids. The application should clearly identify where this water will be directed.**	As indicated above, all water will be discharged to Creek 1 which is shown on Figure A and B along with the specific discharges.
Any emergency related to the water treatment plant, the soil treatment	Subsection 2.11 and 2.12 of the draft permit intend to fill this requirement. However, MoE will consider adding a specific

VIHA Questions / Comments	MoE Responses
facility/operation resulting in a spill to Shawnigan Creek, or any discharges of contaminated water to the environment must be reported to VIHA promptly under Section 23, prohibition against contaminating drinking water or tampering with system or Section 24, requirement to report threats to drinking water, of the Drinking Water Protection Act.	reporting requirement to VIHA associated to potential contamination of surface water.
Will provisions be made to sample more frequently during heavy storm events, or unusually low flow situations to determine if either could impact water quality going to the receiving environment?	The proposed sampling frequency for the water treatment system effluent and the settling pond discharge is monthly. In the case of water treatment effluent, the monitoring frequency will increase based on throughput as one sample is also required every 2000 m^3.
Surface water will only be sampled two times a year during the first flush event and spring freshet. **It is suggested that the conditions of the permit include sampling during the dry times, when there is a possibility that parameters might be found at higher levels due to the lack of dilution**	Because water inflows at the proposed facility are expected to be highly (if not exclusively) dependent on precipitation, minimal or no discharge from the water treatment system and the settling pond are expected during the low natural flow conditions. MoE review indicates that the worst case scenarios are expected to be in the shoulder season, during the fall first flush and the spring freshet.

VIHA also indicated at the April 24, 2013 meeting with MoE that a request for investigation, under Section 4.2 of the Drinking Water Protection Act (DWPA), would likely be submitted if MoE was to issue a waste discharge permit to SIA. If such request is made, VIHA would assess whether or not it would proceed with a formal investigation and would likely request additional information to MoE. A key concern raised by VIHA is related to the divergence in professional opinion, i.e. Active Earth and LHC, in their hydrogeological assessment and associated risks to drinking water resources. The divergence in professional opinion is further discussed in the assessment section below.

Direct reporting to VIHA was not covered in this assessment as it is outside MoE jurisdiction. However, in order to comply with the DWPA the Permittee will have to report to both MoE and VIHA in circumstances where its activities are posing a risk to drinking water (DWPA, Section 13). This has been identified by Active Earth in the TAR and will be included in the ERP.

6.1.2. Ministry of Health

In response to concerns expressed by the CVRD and the Shawnigan Village Waterworks (SVW) (letter to the Ministry of Health (MoH), dated March 27, 2013), MoH, through Dr. Kendall, Provincial Health Officer, issued a letter to the Health Deputy Minister, copied to the

Environment Deputy Minister, and raised concerns on the review process and attention put on assessing human health risks. This letter, dated April 15, 2013 stated the following concerns:

- Divergence in professional opinions in regards to hydrogeology, specifically related to the vulnerability of the aquifer underneath SIA site;
- Potential "gaps in the approval process with respect to characterizing factors relevant to human health risk assessment";
- Lack of expertise in regards to health risk assessment with Active Earth, MoE, VIHA and MoH.

The letter states that it is highly likely that a third party health risk assessment will be requested if a permit is granted to SIA.

6.2. Cowichan Valley Regional District

The CVRD issued a letter to MoE, dated April 4, 2013 and raised similar points as those raised by VIHA. The letter had two attachments, i.e. the letter report from LHC (issued to the Minister of Environment and dated March 28, 2013) and an email from Colin and Rebecca Frostad. Both of these communications as discussed below in greater details. The CVRD letter highlighted the following points:

- Divergence in professional opinion (as above);
- Consideration of public opinion in MoE decision making process;
- Self monitoring and limited ability of MoE to ensure compliance to the permit;
- Truck traffic.

MoE met with the CVRD staff on June 19, 2013 at the CVRD office in Duncan. In attendance was W. Jones, B. Fraser, G. Jiles, R. Hutchins, T. Anderson, J. Lefebure, E. Taje (MEMNG), H. Bunce (MoE) and L. Lachance (MoE). The TAR and the BCGS report and addendum were sent to the CVRD staff, W. Jones shortly after the meeting.

Additionally, the CVRD Environment Commission issued three letters dated April 8 and 9, 2013. The first letter briefly stated the Commissions' objective and asked MoE to reconsider issuing a waste discharge permit to SIA. The Commission also indicated that the public did not have sufficient time to assess and comment on the project. In its April 9 letter, the Commission listed specific comments and questions and asked the Minister to consider using their powers and designate the SIA project as a Reviewable Project under the BC *Environmental Assessment Act*. The other comments and questions are summarized below:

- Divergence in professional opinion (as above);
- Clarification on compliance and enforcement approach including the application of penalties and the ability of MoE to fill its enforcement role;
- Adequacy of the surface water and groundwater baseline data;

- Request the use of water quality standards for the drinking water use (surface water and groundwater);
- Preparation of an erosion and sedimentation control plan by QP (CPESC)
- Monitoring and sampling requirements for mass loading calculation
- QA/QC requirements;
- Monitoring of nearby residential drinking water well quality;
- Transparency (availability of the monitoring data, non-compliance and performance reports).

MoE met with the Commission on June 4, 2013 to go over the questions and concerns before issuing a formal written response. The meeting was helpful in clarifying a number of points and resolved most of the outstanding items. The Commission insisted on the need to have a transparent operation if a permit is going to be issued and suggested that members of the public be informed and consulted and an ongoing basis, not only at the start. The Commission also indicated that it was concerned about the long term management of the facility and asked how MoE would ensure compliance with all proposed plans listed in the permit.

6.3. Public Interest and Stewardship Groups

6.3.1. Shawnigan Residents Association

The Shawnigan Residents Association (SRA) issued a formal letter commenting on the draft permit on April 9, 2013 and asking MoE not to issue a waste discharge permit until all concerns listed are addressed. The SRA letter included a letter report prepared by Patrick Lucey of Aqua-Tex Scientific Consulting Ltd which touched on water quality standards and geology.

The comments and questions are summarized below:

- Use water quality standards, similarly requesting the use of drinking water standards for the effluent and groundwater;
- Adequacy of the receiving environment monitoring program to assess the water quality of the Shawnigan Lake drinking watershed;
- Adequacy of the background water quality characterization;
- Site structural geology assessment.

A formal response was issued to SRA by MoE addressing the above concerns.

6.3.2. Living Forest Communities

The Living Forest Communities (LFC) issued a letter dated April 4, 2013. The letter similarly raised concerns on the local geology and hydrogeology. LFC also referred to potential negative impacts the nearby Butlers Brothers' limestone quarry future expansion activities may have on the SIA proposal.

LFC also questioned the design criteria used for the settling pond.

6.3.3. *Lowen Hydrogeology Consulting*

The letter issued by LHC dated March 28, 2013 was addressed directly to the Minister of Environment and listed concerns associated to the local geology and hydrogeology. The concerns raised were similar to those raised in the initial consultation period and did not directly provided comment on the draft permit conditions. The author stated that SIA site was inadequate for the proposed facility due to the "absence of natural protection" and the proximity of drinking water wells. LHC also raised the proven vulnerability of engineered infrastructures, especially when considering a long life operation like the one proposed by SIA.

6.3.4. *Colin and Rebecca Frostad*

Colin and Rebecca Frostad (Frostad) reiterated concerns by email regarding the site geology and hydrogeology and referred to Dr. Canils' work done on the West Coast Complex characterization. The emails also referred to well #93401 and its high yield at relatively low depth (22m). Active Earth provided a technical explanation to MoE and a conference call was also organized with Mr. Frostad, MoE and BCGS.

All questions and comments were reviewed and considered in the assessment below and contributed to the recommendation.

6.4. First Nation

As indicated in Active Earth Consultation Report, SIA met with the Cowichan Tribes Chief Harvey Alphonse before submitting the application and later during the consultation process. Based on discussions with Marty Block of SIA, Chief Harvey Alphonse did support the application and raised specific concerns during these initial discussions. However, the Cowichan Tribes referral coordinator, Tracy Fleming contacted the MEMNG and MoE during the draft permit consultation process and raised concerns that had not yet been addressed in the initial consultation process. Ms. Fleming indicated that the notification letter sent by MoE and MEMNG on April 2012 had been lost and never reached the Tribes' referral office as intended. She also mentioned that discussions between the Chief and the proponent could not substitute assessments done by the referral office.

The Cowichan Tribes referral coordinator issued a formal letter dated April 9, 2013 and requested to meet with both MEMNG and MoE to address outstanding concerns.

The Cowichan Tribes indicated that it was generally opposed to the dumping of contaminated soils in its traditional territory and stated the following points to support its position:

- Site selection (reference to fractured bedrock and to the current quarry operation)
- Engineered controls are prone to failure

The points raised were based on LHC letter report sent to the Minister of Environment and discussed above.

A meeting was held with the Cowichan Tribes, MEM and MoE to discuss outstanding concerns on June 26, 2013 in Duncan. A formal response was issued to the Cowichan Tribes by MoE on July 23, 2013 after consultation with the Legal Services Branch / Environment, Resource & Aboriginal Law of the Ministry of Justice.

7. ASSESSMENT

7.1. Potential Contaminants of Concern (PCOC)

The PCOC list has been presented in Section 3. As discussed above, the list includes the dioxins and furans considering that soils and associated (incinerator) ash may be received at the Site.

Dioxins and furans are persistent pollutants and their addition to the PCOC list does add to the overall longterm risks. Based on available information (soil and water quality standards and associated literature, discussed in Section 3.7), dioxins and furans congeners are highly toxic to mammals, fish and humans. Their toxicity is also known to be additive. That said, dioxins and furans are mostly hydrophobic compounds, chemically stable and therefore not very mobile in soil matrices and not normally transferred to surface or groundwater.

Therefore, the ingestion of soil particles and associated contaminants is considered to be prevalent pathway leading to toxicological effects. In fact, most of the standards available for water are derived from toxicological effect studies where ingestion was the pathway.

As a result, immediate risk of exposure associated to dioxins and furans at the Site are mainly linked to dust generation and contaminated soil erosion. For these reasons, dust management controls and the controls and efficiency of the WTS represent key environmental protection controls. Additionally, water treatment sludges should be characterized and compared to CSR standards (Schedule 6) for dioxins and furans prior to disposal if soils contaminated with these chemicals have been accepted at the Site for treatment or for landfilling. The consultant should also consider the most recent publication by the WHO when interpreting results (refer to Section 3.7).

That said, because dioxins and furans are persistent chemicals, trace amounts in the water could represent a long term risk. Therefore, it is proposed to limit all discharges to values below the lowest limit of quantification (LOQ) achievable regardless of the media (air, water, groundwater or soil). The authorization should be specific and state that analysis shall be conducted at a laboratory and using a method agreed by MoE. Based on discussions with ALS Environmental dioxins and furans analytical expert, the EPA criteria (0.03 pg/L (TCDD)) for drinking water is based on the lowest limit of quantification.

Some PCBs are also known to have similar toxicity as dioxins and furans. The WHO review done in 2005 proposed to adopt dioxins and furans TEF for these specific PCB congeners. However, the current CSR standards do not reflect this reality. Therefore, a conservative approach in regulating the release of PCB compounds is similarly needed. Based on discussions with LRO staff, all CSR standards are scheduled for review by 2016.

7.2. Incoming Soil and Discharge Characteristics

A holding area is proposed to be designated within the biocell for suspect soils. It is important to ensure that leachate from soils temporarily stored in the holding area does not mix with other soils to avoid cross-contamination. Suspect soils should only be stored in the holding area temporarily to allow for soil testing procedures to take place before relocating the soil. A maximum soil storage time (i.e. up to 30 days) should be stated in the authorization. Segregation and mapping of project stockpiles within the biocell is also important and should be done to allow for quick identification and resolution of problematic source soils. Active Earth indicated in the Soil Acceptance Plan that project stockpiles will be separated by a minimum of 1 m distance at the base of the piles. These requirements should be stated in the EPM.

The TAR indicates that SIA plans to accept soils at various concentrations, including those exceeding CSR residential, commercial and industrial land use standards, and discharge soils meeting CSR IL standards. Therefore, SIA may accept hydrocarbon contaminated soil at concentrations less than CSR IL levels for direct discharge to the soil discharge area without prior treatment. The TAR specifically indicates that metals contaminated soils will be accepted at levels below CSR IL concentrations. Therefore, soils co-contaminated with hydrocarbons and metals may be treated and discharged to the soil discharge area. Alternatively, soils contaminated with metals above IL but below HW only may be accepted for direct discharge in the landfill providing the levels meet the requirements. The types of contaminants that can be accepted for treatment or direct disposal should be limited to those contaminants already listed in the TAR, and referred to in the list of PCOC in the authorization.

In theory, discharge of contaminated soils meeting CSR IL levels should be acceptable, since the current final land use of the Site is defined as industrial. This process would be in effect similar to what is commonly authorized through the CSR contaminated soil relocation process. Allowing for direct discharge of soils through the authorization would relieve the proponent and the responsible MoE branch (LRO) from following the soil relocation process. Discussions with LRO staff have indicated that they were not opposed to direct discharge through the permitting process as long as the soil meets the standards of the receiving site and the activity is well defined in the authorization document. However, the acceptable contaminated soils should be limited to contaminants in the established PCOC list. It would also be important to ensure direct discharge is managed with the appropriate controls to ensure quantities and qualities of soils are verified and tracked. Therefore it is recommended to allow this activity so long as the total amount of soil discharged to the soil discharge area (including discharges from the biocell and direct discharge) is restricted to the maximum limit proposed in the application

(100,000 tonnes/year) and all soils accepted for either treatment or direct discharge comply to the same soil acceptance program, including QA/QC for confirmation of incoming soil quality.

If SIA wanted to accept soils contaminated with other parameters apart from those listed in the TAR (i.e. outside of the established PCOC list), the CSR soil relocation requirements would apply as normal. Alternatively, Active Earth could apply for a permit amendment to modify the PCOC list.

Active Earth proposes to accept other industrial wastes for direct discharge in the landfill area. The TAR is relatively vague regarding the range or types of 'other industrial wastes' that were proposed to be accepted at the facility. Therefore, it is recommended to limit the wastes definition to soil with associated ash and exclude the general term "inert industrial waste". Liquids are also excluded from the acceptable wastes. SIA will have to apply for formal permit amendment should they want other types of waste to be accepted at the facility in the future.

As indicated in Section 3.7.1.1, the soil discharge

7.3. Facility Design and Operation

7.3.1. General Considerations

Even though the proposed facility is not considered a secure or a municipal waste landfill, the proponent used design criteria for the siting, construction and operation of its landfill cells, which are similar to those required in the HWR Division 6 and in the LCMSW. The details and exceptions are discussed in the specific sections below. The design of the STMA is based on the draft Protocol 15 (P15) for Contaminated Sites, Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil. A summary table is presented in appendix (Appendix A) of this assessment report and highlights the proposed design versus the relevant design requirements. This comparison provides a good overview of the level of protection proposed. MoE also considered the Wood Waste Landfill Guidelines in its assessment which is the most recently document published by MoE for the design and siting of landfills.

7.3.2. Site Selection

The Site is proposed to be constructed within the actual quarry footprint and expand as the quarry further develops. The justification to construct a soil treatment and a landfill facility at the proposed location is opportunistic as it will allow SIA to conduct additional business and to progressively reclaim the quarry at a reduced cost. As indicated Section 3.7.1 above, the site selection does not meet the siting requirements for HW secure landfills defined under Section 25 (2), (7)(a) and (8) of the HWR. The intent of these sections is to exclude areas where seismic acceleration (and associated probability of occurrence) is considered unacceptable, exclude areas in a designated community water supply watershed (Category I) and areas where record of precipitation statistically exceed evaporation and transpiration.

In their February 15, 2013 letter, Active Earth provided information on the seismic acceleration associated to the Site. The assessment provided (NRCan Online Calculator) indicates that the Site has an estimated peak ground acceleration of 0.307g (30.7%) with a probability of 10% in 50 years. Active Earth mentioned in its letter that only small portions of the Province would meet the requirements stated under Section 25(2) of the HWR.

In regards to Section 25(7)(a) of the HWR, the Site is also located at the headwaters of the Shawnigan Lake Watershed (Community watershed 920.061) which constitutes the drinking source of the Shawnigan Lake and Mill Bay communities through the diversion of surface water from Shawnigan Lake and the Shawnigan Creek (Shawnigan Lake outflow) and through the extraction of groundwater in more rural areas. Data provided by VIHA indicates that more than 12,000 users (approximately 4,000 connections with, in average, 3 users per connection) rely on the Shawnigan Lake watershed as their first drinking water source. More than half of the water is extracted from deep groundwater sources but users relying directly from surface water extracted from Shawnigan Lake are considerable with almost 5,000 users. The typical treatment is limited to disinfection using chlorine with the exception of the Mill Bay Water District and the Shawnigan Lake Recreation Association works. The table provides a summary of the drinking water works within the watershed, the source, treatment and the number of connections.

Table 10 – Community Drinking Water Extraction Works within the Shawnigan Watershed

Community Drinking Water Extraction Works	**Source of water and treatment**	**Estimated number of connections**	**Number of users (based on 3 users per connection)**
Burnum Utility Company (CVRD - in transfer)	Deep well, chlorine	50	150
Carlton Improvement District (CVRD)	Deep well, chlorine	30	90
Cobble Hill Improvement District	Deep well, no treatment	300	900
Dwight International School	Deep and surface water, chlorine	400	1200
Fern ridge Estates WS (CVRD)	Deep well, chlorine	35	105
Keparo Water Society	Deep well, chlorine	30	90
Kerry Village Water System (CVRD)	Deep well, chlorine	100	300
Meredith Road Improvement District	Deep wells, no treatment	40	120
Mill Bay Water District	Deep well, infiltration gallery (sand) and	1000	3000

Community Drinking Water Extraction Works	Source of water and treatment	Estimated number of connections	Number of users (based on 3 users per connection)
	chlorine		
North Shawnigan Lake Community WS (CVRD)	Surface water, chlorine	700	2100
Shawnigan Lake Recreation Association	Surface water, sand and activated carbon filtration, chlorine	100	300
Shawnigan Lake School	Deep well, chlorine	700	2100
Shawnigan Village Water Works	Surface water, chlorine	400	1200
Spectacle Lake Mobile Home Park	Deep wells, chlorine	127	381
Sylvania Improvement District	Deep well, chlorine	30	90
		4042	**12126**

The current HWR precludes the construction of secure landfills within Category 1 community watersheds. Although watershed categories are not used anymore and refer to an outdated guideline (Guidelines for Watershed Management of Crown Lands used as Community Water Supplies), the intent of this clause was to protect community drinking watersheds that may be vulnerable due to their size, population served and the importance of crown land supporting a wide range of activities. Three categories were defined in the guidelines, Category 3 being the least vulnerable watershed category and Category 1 the most vulnerable. The Shawnigan Lake watershed was initially classified as Category 2. Based on a 1978 Water Resources Services document, Category 2 watersheds was limited in number but was considered to be in a category of its own due to the watershed size and the population served (smaller but supporting a relatively dense population). Communications with the Environmental Section Branch (ESB) Clean Technologies Section (email from Ana Tsui 24 January 2012) provided some clarifications of the HWR Section 25 (7)(a)considering that the *Forest and Range Practices Act* is now replacing the outdated guidelines. Ana Tsui suggested that watershed referred to in the HWR Section 25 (7)(a) should now refer to those watersheds designated, established or continued under the *Forest and Range Practices Act*. The Act and Regulations provide tools to protect and manage community watersheds specifically. The interpretation would in theory include all community watersheds, regardless of the categories (1, 2 and 3).

Section 25(8) of the HWR also precludes the construction of secure landfills where record of precipitation statistically exceeds evaporation and transpiration. This assessment was not done for this site as the proposed facility was not considered a secure landfill, as defined by the HWR. However, as indicated in sections above, the proposed facility is designed to divert runoff not originating from the Site away from contaminated materials and to collect, convey and treat

contact water prior to release. The proposed closure profile is also designed to ensure that water will flow away from the landfill area and ultimately prevent the generation of leachate. Additionally, activities conducted at the Site are proposed to be limited to the dryer months (i.e. between May and October) to limit the potential generation of runoff.

That being said, the proposed facility does not meet the definition of a secure landfill as defined under the HWR and is not proposed to be authorized for HW treatment or landfilling. The non-leachable nature of the material proposed to be accepted at the facility and the engineering and administrative controls presented in the TAR meet the existing legal requirements and provide the level of environmental protection required by MoE. Therefore, the construction of the facility at that specific location meets the requirements. Key engineering controls include the diversion of clean stormwater runoff away from active areas where contaminated soils may be present in order to limit the generation of leachate and the treatment of any contact water (including leachate that may be generated) prior to be released to the receiving environment. These controls are further discussed in the sections below. Risks to surface water and groundwater resources are discussed below (Section 7.5). The Emergency Response Plan (ERP) requested by MoE as part of the application and previously discussed in section 3.6.7 provide an additional level of protection in the event of an unexpected situation.

The Wood Waste Landfill Guidelines (2011) has more specific requirements regarding distances from various features. However, the guideline indicates that if the proponent cannot meet conditions set in the guideline, the proponent *"can request a substitution under section 8 of the Waste Discharge Regulation and the company must follow the process outlined in that section. The company applying for the substitution must demonstrate that any substituted requirement meets the intent of the code."*

As described in the TAR, Section 2.6, the Site bounded on the south by land zoned as Community Land Stewardship (CLS-1). The closest residence is located approximately at 350 m and the closest drinking water well is approximately 250 m, cross gradient. The proposed landfill boundary, as presented in the Figure 8, the minimum distance from the landfill to the property boundary is 5 meters while a 30 meter buffer is proposed to be maintained with the Shawnigan Creek protection covenant, which ensures a 20 meter buffer on either sides of the creek bed.

Although these distances are less than those prescribed by the Wood Waste Landfill Guideline, the risks are mitigated by the facility design and site specific conditions.

7.3.3. Soil Management and Treatment Area

The STMA is proposed to be built on a lined asphalt pad. The design of the STMA is based on the draft Protocol 15 for Contaminated Sites, Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil referred to as P15 below. For the most part, the STMA design exceeds the P15 requirements with the exception of two relatively minor operational requirements related to contaminated soil segregation and to soil turning

frequency. P15 in fact requires that soil of different types be segregated in order to optimize the bioremediation process. The draft protocol also requires soil tilling to be conducted at least every 4 weeks. The bioremediation process is discussed in the TAR, however, specific consideration and conformance with these two aspects is less clear. However, the optimization of the bioremediation process is to the advantage of the proponent and these variances are not considered critical to ensure environmental protection. That said, the integration of operational requirements in the authorization should be considered. Operational requirements are proposed to be documented and integrated into the authorization through the preparation of a thorough EPM. The scope and content of the EPM is further discussed below. The EPM should be submitted within 90 days after the permit is issued and shall be to the satisfaction of the Director and should be conditional to the receiving of contaminated soils at the Site.

A portion of the STMA is destined to the management of incoming material and includes designated sorting and holding areas. These areas will allow for the management of incoming materials, as discussed in the proposed Soil Acceptance Plan presented in the TAR. Similarly to the EPM, the Soil Acceptance Plan is expected to form an integral part of the authorization and it is recommended to specifically refer to it in the permit. It is also recommended to have the document submitted to the acceptance of the Director before the authorization is issued. The plan should refer to sorting and segregation requirements to avoid mixing of incompatible materials together, to prevent liner damage and to facilitate soil compaction, particularly for material to be placed in landfill cells. It is recommended to include a 'Prohibition of Blending' clause.

The entire STMA is proposed to drain to catch basins located within the paved area and report to the water treatment system which is discussed below. As required under P15, clean surface water runoff will be isolated from the STMA through diversion channels located around the soil treatment facility boundary. The design also includes a leak detection system proposed to be installed above the quarry floor and below the liner and asphalt bad, within a road base layer. The leak detection system will ultimately be tied to a catch basin in the event of high water levels. After discussion with Active Earth, cleaning ports will be installed during construction at regular intervals to facilitate inspection and cleaning routines. This modification aligns with the HWR requirements for secure landfills.

Treated soil is proposed to either be used as final cover material or landfilled in engineered cells within the landfill area.

Weather protection and stormwater management aspects are discussed below in greater details.

7.3.4. Landfill Area

The landfill area is the area where landfill cells are proposed to be constructed. The area will ultimately cover the whole soil treatment facility as shown on Figure 8 of the TAR. The landfill area will initially be limited to an active area where landfill cells will be constructed. The active

area is proposed to drain initially to the WTS. As mining progresses and material is delivered and treated at the Site, landfill cells will be completed, sealed, covered and progressively disconnected from the stormwater conveyance system draining to the WTS. Figure 8B of the TAR refers to the typical development of a "Phased stormwater conveyance system" planned to be constructed as the landfill increases in size. Disconnected areas will drain to the perimeter ditches and then to the settling pond to remove solids prior to discharge offsite. It is important to note that conditions under which the disconnection of areas will be acceptable are to be thoroughly documented and reviewed as part of the closure plan development.

The active area is proposed to be limited to the smallest area practicable in order to limit the generation of leachate and erosion. Additional controls include setting up drainage networks required to collect surface water runoff emanating from the active area at all times, limiting cells construction to the dry season and covering exposed active area using tarps as required. The use of tarps will be dependent on weather conditions and on the type of soils being landfilled.

The design of the landfill cells is discussed in the section below.

7.3.5. Landfill Cells

Landfill cells design details are presented in Figure 10 and 10B of the TAR and have been described in the basic design section above (Section 3.7.1). For the most part, the proposed design meets all HWR requirements for secure landfills with the exception of some specific monitoring and reporting requirements. For instance, Active Earth has not highlighted specific groundwater monitoring parameters that would be used as indicators to detect a potential breach of the containment infrastructure. However, Active Earth proposed a monitoring program and a list of parameters relevant to the type of contaminants expected to be received at the site. Similarly, Active Earth indicated in the TAR that leachate and leak detection sumps would be inspected regularly but did not specify they would also record volumes collected. It is recommended that these aspects be included in the EPM. As stated in the HWR, reporting of any liner leaks or groundwater monitoring wells exceedances should be communicated within a period of 72 hours. Immediate reporting requirement of Liner leaks and non-compliant surface water and/or groundwater monitoring results is proposed to be included in an emergency procedures clause in the authorization.

Landfill cells are expected to vary in size to accommodate a variety of factors and provide the flexibility required to fill the quarry. However, it is expected that cells will be built on top of each other to a maximum thickness of 10 meters. The physical properties of the material may also vary as indicated in the TAR and make consolidation difficult and possibly inconsistent. This is particularly important considering the differential settling potential that could result from uneven compaction. It is also important to ensure that drainage layers (horizontal layers and chimneys) maintain their ability to collect leachate that may be generated as the effectiveness of the detection system will depend on the continuity of the drainage layers set at the base of each cells. Active Earth indicated in the TAR that, due to heterogeneity of the

material, compaction of the encapsulated material may not meet specific compaction tests. In their February 15, 2013 letter, Active Earth indicated that compaction of the material would be maximized by limiting lifts to 0.6 m thick and systematically run tow passes with a 'sheep's-foot roller. Based on comments from Active Earth, this is expected to be adequate to provide a stable foundation. Considering the importance of obtaining optimal compaction in the cells, it is recommended that the site specific compaction method be specified in the EPM and improved based on field experience.

The cells will be constructed on a sloped surface (3%) that will allow flow from the west to the east, where the water treatment system and lowest point will be. Active Earth proposes to use a combination of local and imported material having a conductivity of less than $1x10^{-8}$ m/s. In the TAR, Active Earth referred to clay and/or till material. In order to maintain the 3% grade over the whole site, it is expected that minimum thickness will be at the eastern end of the facility.

As proposed by Active Earth, the specific design and construction of every cell should be signed off by a Qualified Professional. Design drawings, notes and information should be kept as records. This requirement is proposed to be included in the Records section of the authorization.

7.3.6. Bedrock Integrity and Risk Assessment

Additional precautions should be taken prior to the construction of the first landfill rise (i.e. the first cells constructed on the quarry floor). Specifically, a bedrock inspection should be conducted by a qualified professional to assess the bedrock integrity and to identify any apparent groundwater seepages, open fractures or fractures that may be subject to convey water. In the event that any anomaly is noticed during the bedrock inspection, it is recommended that inspection results be communicated to MoE and that cell construction be put on hold until a specific mitigating plan is developed, reviewed and approved by the Director. A specific 'Bedrock Integrity' clause should be included in the permit. General requirements to conduct bedrock integrity preconstruction inspection and mitigating measures should be defined out in the EPM.

7.3.7. Erosion Control and Stormwater Management

The proposed stormwater management system intends to limit the generation of leachate and the contamination of clean surface water runoff. The system also proposes to limit surface water releases from the Site to one location. More specifically, Active Earth proposes to achieve these objectives by constructing a perimeter diversion ditch that will convey clean runoff water to the sediment settling pond prior to be discharged. This clean surface runoff will bypass the WTS but both discharges (settling pond and the WTS) will combine at the settling pond outfall.

The maximum discharge flows at the settling pond discharge is estimated to be 42,500 m^3/d based on the 1 in 10 year 24-hour storm event calculation (TAR, Section 8.4.5, Table K). The additional discharge from WTS (maximum discharge rate of 274 m^3/d) in comparison will be negligible in flooding or normal runoff conditions.

Soil erosion is proposed to be minimized by the installation of erosion control devices (check dams, straw bales, etc) according to industry best practices. It is recommended that Best Management Practices as defined under MEM Aggregate Operators Best Management Practices Handbook be referred to in the EPM. Active Earth did indicate the need to clean the settling pond, i.e. remove accumulated sediments, when the pond is a third full (TAR, Figure 8B). Active Earth also stipulated that a 50 cm freeboard would be maintained at all times according to the Draft Guidance for assessing the design, size and operation of sedimentation ponds used in mining. As per the pond design, this results in a storage capacity of 300 m^3. It is recommended that these requirements be included in the EPM. This is particularly important considering that MoE is now working on a guidance document regarding erosion and sediment control. This new guidance document is being developed by MoE, in consultation with MEM.

In their February 15, 2013 letter, Active Earth indicated that the water quality discharged at the settling pond would have a TSS concentration of less than 25 mg/L. It is important to mention that the size of the settling pond itself has not been changed and this commitment from Active Earth to meet a more stringent TSS value is based on improvement discussed in Section 3. A higher TSS limit recommended for periods of high flows (i.e. greater than 1 in 10 years 24-hours storm event). The high flow TSS is proposed is 35 mg/L as previously adopted in other effluent permits within the West Coast region. However, should the effluent exceed a TSS concentration of 25 mg/L on ongoing basis, MoE could request the proponent to make modifications to its erosion and sedimentation control infrastructures.

This higher limit should only be applicable to the settling pond and not to the WTS. The rational is based on the fact that the WTS will in effect remove contaminants such as dioxins, furans and PCBs which are known to be hydrophobic compounds and bound preferably to particulate matter rather than dissolve in water or groundwater. Therefore, particulate matter removal efficiency shall not be compromised at any point in time.

Potentially contaminated surface runoff, referred to as contact water, coming from the STMA and any active areas of the landfill area is proposed to be directed to the WTS which is described below.

As discussed above in Section 7.1, sediments and sludge collected in the settling pond and the WTS should be managed as suspect soils and managed accordingly.

7.3.8. *Water Treatment System*

The proposed WTS incorporates catch basins, piping, dedicated reservoirs, pH control, a flocculent injection system, a three chamber settling tank, two bag filters activated carbon filter vessels and a flow meter. Proposed dedicated reservoirs that will feed the WTS are a leachate detection reservoir, a leak detection reservoir and a reservoir for all water collected within the STMA. MoE had discussed with Active Earth to consider isolating water or leachate coming from the holding area to limit the risk to the WTS. However, Active Earth indicated by email that it believed the risk to be very low considering the controls already proposed. Apart from the WTS ability to treat a wide range of contaminants, Active Earth highlighted the various controls proposed, i.e. the Soil Acceptance Plan, the protection of the soil piles from the elements while stored and the low chance of receiving leachable materials at the Site.

Based on Active Earth, the WTS was designed to meet the BCAWWQG for drinking water. Active Earth also indicated that the proposed WTS had the ability to be expanded and improved significantly based on the effluent water quality. Therefore, should the water quality be unsatisfactory, the WTS removal efficiency could be improved by adding components or increasing the size of reaction and settling tanks.

That being said, Active Earth also indicated that it would be operating the WTS in batch and would have the ability to test the effluent prior to releasing water to the settling pond. It is recommended that the operation of the WTS be detailed in the EPM to ensure that the WTS is operated to its maximum capacity to achieve the best effluent water quality possible.

7.3.9. *Vapour Emissions*

In the absence of formal standards from MoE or from the local government regarding odour generation and more particularly regarding VOC emissions, Active Earth used the Contaminated Site Regulation (CSR) Schedule 11, Column III RL standards. These standards were established to assess air quality within the STMA breathing zone. The standards used are considered conservative for this application.

In order to assess the potential generation of VOC emissions, Active Earth used the partitioning equation developed by the Science Advisory Board for Contaminated Sites prepared for the MoE. The partitioning equation is used to predict air quality in the breathing zone near subsurface sources specifically. There is no guidance document adapted for soil treatment piles as proposed by SIA but, as indicated in the TAR, using the partitioning equation for subsurface sources is considered a conservative approach. The approach is considered conservative as it assumes soil concentrations to be at the maximum contaminant concentration acceptable at the site (based on HWR leachate quality standards in Schedule 4, Table 1, column 2) normally measured at the site where the contaminated soil comes from.

In the absence of leachate quality standards for VPH and Naphtalene, Active Earth used 10X the maximum CSR Schedule 4 IL standards and 100 mg/kg for Tetrachloroethylene. The approach

neglects the inevitable attenuation resulting from the soil handling that would occur between the site of origin and the disposal site. However, Active Earth applied an attenuation factor of 10000, as prescribed in the CSR TG4 for subsurface sources located at less than 1.0m depth. Active Earth prepared predicted vapour concentrations for BTEX, Naphtalene, VPH, Tetrachloroethylene and Trichloroethylene adjacent to the breathing zone within the STMA. Results from this assessment show that Benzene, Xylene, VPHv, Tetrachloroethylene and Trichloroethylene may exceed the CSR IL and / or RL standards immediately adjacent to the contaminated soil stockpile. The results are presented in details in the TAR (Section 7.2.1, Table J, p. 75).

These results led Active Earth to model the vapor emissions using TSCREEN, a model developed by the EPA. The model does not allow for site specific elevations and is also limited in terms of its ability to modify atmospheric inputs. The results obtained were considered again very conservative and Active Earth concluded that, without data from the actual site in operation, it would be very hard to obtain meaningful predictions of the air quality and that more sophisticated models were not justified considering risk level. Active Earth recommended to utilize actual site data from the facility once built to re-run the model.

However, Active Earth proposes to implement preventive and mitigating measures when soils having the potential to generate VOCs are present in the STMA and / or being turned or aerated.

These measures include:

- Monitor wind direction using a windsock and restrict activities when wind is no favorable
- Use correlation between PID readings and Summa Canister ® results to establish site specific threshold and restrict activities as required
- Cease activity if PID reading exceeds 100 ppb
- Cover the soil in STMA with a non-permeable polyethylene sheeting or cap clean soil

It is recommended to include the preventive and mitigating measures in the EPM. Active Earth also proposes to adjust its mitigating measures based on actual monitoring information. This aspect is discussed in the monitoring requirements section below.

7.3.10. Weather Protection

Weather protection is relevant to both the STMA and any active areas within the landfill area. The implementation of proper weather protection measures is important to minimize the generation of leachate and is also a component of the erosion control and stormwater management plan. In the TAR, Active Earth discusses about the possibility of constructing a permanent roof over the soil management and holding area but does not initially commit to it (personal communications with Matt Pye) due to financial consideration. However, it is

proposed to cover the soil stored in the management area during the winter months (i.e. November to March inclusive) and when necessary to prevent dust and leachate generation. In the event that suspect soils are received at the site, the soils will be temporarily located in the holding area and covered with a tarp immediately regardless of the time of the year.

Lastly, Active Earth proposes to cover any active landfill area during the winter months and when necessary considering the nature of soils being encapsulated.

A specific weather protection clause is recommended to be added to the authorization.

7.3.11. Maintenance

This aspect is recommended to be covered by a standard clause in the authorization. Maintenance and inspection records should also be specifically listed in the Records section of the authorization.

7.3.12. Closure Plan and security bond

MoE has requested SIA and its consultant Active Earth to prepare a conceptual closure plan, estimate associated closure costs to inform the decision making process and to post an adequate security bond to mitigate any additional liabilities resulting from the proposed activity. The final TAR (Sections 12 and 14) defines the key components of the closure plan, the estimated costs and the proposed financial security.

The proposed final cover design and closure plan considers the HWR and LCMSW but exceeds the requirements considering the thickness of the proposed soil cover layer specifications (1 meter thick, $K<1x10^{-7}m/s$) and the one meter growth medium layer. The closure activities are listed in the TAR (Section 14, Table N) as:

- Closure of cells
- Closure the STMA
- Construction of final cover
- Long term monitoring requirements

The total closure cost provided of $527,500 includes the entire amount required to close the facility and to conduct monitoring for a period of 25 years considering its maximum forecasted liability. This initial approach does not reflect the progressive increase in liability as the facility grows in size and receives more material to treat and landfill. MoE discussed the amount and the method used to calculate the closure cost and suggested Active Earth to consider an internal guidance document, yet unofficial, prepared by the MoE Kamloops office. The guidance document was intended to be added to the internal policy 1.03.01 – Financial Security Policy and Procedures to assist Active Earth staff in assessing closure plans and defining security amounts for landfills specifically. MoE also referred the proponent to Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia. Part 10 specifies reclamation and

closure requirements for mining operations across the province. That being said, the current quarry operation is authorized under the *Mines Act* permit Q-8-094 and is already subject to these requirements. However, the existing security bond issued for the site, and recently reviewed as part of the recent permit amendment, only addresses liabilities associated to the quarry operation and does not take into account any of the additional liabilities that would result from the construction of the proposed soil treatment and landfill facility.

Active Earth reviewed the liability associated to the operation in their letter to MoE dated February 15, 2013 (Table 9 below). In that letter, the calculated liability associated to the landfill area is tied to the completion of established phases. The proposed phases are independent to the mining phases and were based on a set tonnage (300,000 tonnes) received at the facility. This equates to phases of about 3 to 5 years based on forecasted disposal and treatment rates. Following additional discussions with Active Earth, the estimated closure cost was reviewed and resubmitted on February 19, 2013 to clarify the proposed security amount for the first phase. The details are available in the document titled *Bonding Costs – February 2013*.
The key components of the estimate are as follow:

Table 11 – Security cost estimate (Phase 1)

Item	Estimated cost
Closure of open encapsulation cell (management of 2500 m^3 of soil)	$23,500
Closure of STMA (removal of asphalt pad and seeding of a 5000 m^2 area)	$17,500
Construction of final cover (2500 m^2 area)	$26,100
Long term monitoring (1/15th of the total long term cost)	$15,500
Subtotal	$82,600
Contingency (20%)	$17,720
Total	**$106,320**

The total estimated long term monitoring costs (for a period of 25 years) was assessed by Active Earth to be $232,500 and includes lab analysis, engineering, sampling and reporting aspects. Active Earth proposed to progressively apply these costs in their security calculation above. The cost is applied proportionally over time (number of phases completed versus the total number of phases projected). It is expected that the long term monitoring needs will increase over time. However, it is hard to predict at which rate it will increase and Active Earth proposal is considered reasonable in this context.

That said, it is recommended to include a clause in the authorization that would require the preparation and review of a closure plan as well as the posting of an appropriate security. The review is proposed to be done every 5 years.

7.4. Baseline Conditions

7.4.1. Surface Water

Surface water sampling was conducted at five locations upstream and downstream of the proposed facility. Results have been compared to the CSR standards and to the BCAWWQG and are summarized below. The monitoring sites are referred to in Figure 4 of the TAR:

Table 12 – Surface water baseline monitoring results summary

Site ID	Short Description	Baseline Condition Summary (Water Quality)
SW-1	Surface water onsite (future location of the settling pond discharge)	13-Feb-12 ▪ Chromium (0.0052 mg/L) > BCAWQG 3-July-12 ▪ Nitrate (34.9 mg/L) > CSR DW and the BCAWQG ▪ Barium (0.034 mg/L) > BCAWQG ▪ Iron (2.47 mg/L) > BCAWQG
SW-2	Head of tributary (Creek 2 upstream)	3-July-12 ▪ Iron (2.74 mg/L) > BCAWQG ▪ Toluene (0.00167 mg/L) >BCAWQG
SW-3	Tributary to the North (Creek 2 downstream)	No exceedances recorded
SW-4	Shawnigan Creek (upstream)	No exceedances recorded
SW-5	Shawnigan Creek (downstream)	No exceedances recorded

Sites SW-4 and SW-5 have been collected every quarter since Q3-2011 while SW-1, 2 and 3 have collected since Q1-2012 following a request from Active Earth. Therefore, the current baseline condition assessment is based on 3 sampling events for SW-4 and 5 while only 2 sampling events were considered for SW-3, 4 and 5. However, quarterly monitoring at these sites has been maintained by SIA and will be added to the baseline information when data becomes available.

Water Quality Objectives (WQO) have been developed for the Shawnigan Lake in 2007 and the WQO attainment monitoring program is currently under review. The second WQO attainment monitoring round normally conducted every five years is planned for 2013 and will include additional monitoring parameters (total and dissolved metals) as well as an additional sampling site, at the mouth of the Shawnigan Creek, where it discharges into Shawnigan Lake. The additional parameters and monitoring sites will allow for a better understanding of the inputs to Shawnigan Lake and will also assist in refining the lake nutrient balance.

The Shawnigan Creek flows were not part of the baseline data collection scope. However, Active Earth indicated that it would monitor Creek 1 and Shawnigan Creek flows as part of the ongoing receiving environment monitoring program.

7.4.2. Baseline Groundwater

Groundwater sampling was conducted on a quarterly basis at four monitoring wells located upstream and within the proposed facility. Two of the monitoring wells (MW-1 an MW-3) are nested wells with a deep and a shallow well. Results have been compared to the CSR Aquatic Life and to the drinking water standards and are summarized below. The monitoring sites are located on Figure 4 and 5 of the TAR.

Table 13 – Groundwater baseline monitoring results summary

Site ID	Short Description	Baseline Condition Summary (Water Quality)
MW-1S (shallow)	Onsite upstream of the WTS (screened at 50 m bgs)	3-July-12 Sodium (482 mg/L) > CSR DW
MW-1D (deep)	On site upstream of the WTS (screened at 84 m bgs)	17-Mar-11 and 3-July-12 Dissolved Cadmium (0.00285 and 0.00198 mg/L) > CSR AL
MW-2	Edge of the western property boundary line, North (screened at 43 m bgs).	3-July-12 Total Manganese (0.625 mg/L) > CSR DW
MW-3S (shallow)	Edge of the western property line, South (screened at 21 m bgs)	No exceedances recorded
MW-3D (deep)	Edge of the western property line, South (screened at 46 m bgs)	17-Mar-11 Dissolved Cadmium (0.00071 mg/L) > CSR AL
GW12-1 MoE well (83527)	Active Earth monitoring well located up gradient and temporarily used by Active Earth (Screened in the lower bedrock at approximately 90 m bgs.	No exceedances recorded
MW-4 (proposed)	Located up gradient of the facility, Southeast corner of the Site.	Not constructed yet. MW-4 will replace GW12-1 Active Earth well.
MW-5 (proposed)	Located down gradient of the facility, North of the Site	Not constructed yet.

The new monitoring wells were drilled using a conventional rotary drill and did not allow the collection of the rock samples that could be used to document fractures. That being said, Active Earth indicated that additional groundwater monitoring wells would be installed once an authorization would be issued and the use of a diamond drill would be considered then. The diamond drill method will allow to collect rock cores and to identify any relevant structural features. It is recommended to have those monitoring wells drilled, interpreted and sampled before receiving material at the site. Design of the additional monitoring wells shall also be to the satisfaction of the Director.

In discussion with Active Earth, it is possible that MW-1(S/D) be decommissioned in the future as the site expands. However, it is recommended that MW-1(S/D) be included in the authorization and be later removed as needed. It is also recommended to state a minimum number of monitoring wells needed in the authorization to be available at all times.

All screens are of standard lengths (i.e. 3 meters (10') length). Deep monitoring wells and GW12-1 were all installed within the lower bedrock which is considered here to be the regional aquifer. The shallow wells were installed in the upper bedrock, where sufficient water was found to accommodate sampling.

The two proposed monitoring wells (MW-4 and MW-5) will complete the initial groundwater monitoring and sampling facilities. The exact location of the wells is not yet determined but it is understood that they will be installed up-gradient and down-gradient of the proposed facility. The up-gradient monitoring well, MW-4, will replace the well #83527. It is therefore recommended to not refer specifically to this last well in the authorization.

Surface soil quality has not been considered in this baseline condition assessment as the facility is proposed to be constructed directly on the quarry floor, i.e. on bedrock. This is also briefly discussed in Section 3.4.2 of this document.

7.5. Potential for Impacts

Potential impacts from the proposed activities are discussed below for surface water, groundwater and air quality (vapour and dust generation). Considering the types of material proposed to be received at the site and the engineering and administrative controls discussed above, the risk to groundwater quality appears to be limited. However, the contamination risk is by default transferred to surface water, through the erosion and sedimentation control and of stormwater runoff management.

7.5.1. Surface Water

Proposed effluent discharge from the site will be composed of potentially sediment laden stormwater runoff coming from the stormwater diversion channels and from treated effluent released from the WTS. It is expected that most of the sediments will be trapped in the sedimentation control infrastructures upstream of the pond or in the settling pond itself.

However, the cleaning and maintenance of the diversion channels, sedimentation controls and settling pond are considered key to reduce the entrainment of solids off site through stormwater runoff.

The WTS effluent is not expected to represent a significant risk considering the level of treatment proposed and the batch treatment process proposed by Active Earth. The batch treatment will in fact allow the operator to validate the water quality prior to discharging the water. The operator may decide to recycle the effluent through the WTS to achieve better end of pipe results. In order to remain effective, every component of the treatment system, including the associated ditches, catch basins and sumps will have to be operated and maintained adequately. The preparation and application of a detailed EPM, as discussed in the assessment section, is expected to increase the system's reliability and efficiency and should be reviewed for acceptance by MoE prior to receiving material at the Site.

7.5.2. Groundwater

As mentioned above, impacts to groundwater resulting from the operation of the proposed facility are not expected to occur considering the engineering and administrative controls proposed. These include the type of materials proposed to be accepted at the Site, inspection and monitoring routines, the level of protection (including weather protection, surface water diversion infrastructures, containment and detection systems), the physical characteristics of the bedrock and the local hydrogeology.

In the case of the STMA and the landfill area, the type of material proposed to be accepted at the Site has similar properties and excludes HW and liquids. As discussed in Section 5.1, restrictions are spelled out to better define the material that is acceptable to be landfilled. The two designs include leachate minimization strategies including containment berms, diversion channels (site and facility perimeter swales/ditches) and weather protection. The leachate minimization strategy is key to prevent contamination of the groundwater as it effectively limits the amount of contaminated water that can be generated at the site and enter the groundwater (or surface water) should the containment systems fail.

That being said, due to the differences in design and the nature of the two facilities, groundwater contamination scenarios would vary slightly depending on the facility:

STMA

- The STMA includes the following engineering protection measures:
- Sloped (2-5%) 50 mm asphalt pad
- Catch basins reporting to the WTS placed within the contained surface
- Synthetic liner
- Leak detection system installed below the asphalt pad in a permeable layer above the bedrock
- Leak detection system inspection routine
- Bedrock and local hydrogeology

- Receiving environment (groundwater and surface water) monitoring

Landfill

- Top synthetic liner (2-5% sloped)
- Leachate detection system installed below the final cover liner and landfill cell liner
- Leachate detection system inspection routine
- Landfill cell liner
- Base liner
- Leak detection system installed below the base layer in a permeable layer above the till and clay layer.
- Leak detection system inspection
- Clay and/or till layer (2-5% sloped)
- Bedrock and hydrogeology
- Receiving environment (groundwater and surface water) monitoring

It is expected that leachate will be generated at both the STMA and the landfill facilities. The leachate will be collected through a series of pipes and sumps. Therefore, the integrity of these infrastructures is also critical to prevent groundwater contamination. Therefore, the installation, design and maintenance of the pipes and sumps have to be seen as part of the containment infrastructure. The preparation and application of a detailed EPM, as discussed in the assessment section, is expected to increase the system's reliability and efficiency.

In the event of the containment system failure (liner), the leak and leachate detection systems inspection routines would trigger a prompt response from the operator. Should both the containment and the detection systems fail, the receiving environment monitoring program for the monitoring of groundwater and surface water would indicate a problem and suggest the implementation of appropriate contingency measures.

Engineering and administrative controls during the construction of the landfill cells and the STMA are critical, hence their inclusion in the authorization. These controls include typical QA/QC construction measures as well as bedrock integrity inspection and risk assessment prior to the construction of the first landfill cells lift. However, the long term effectiveness of the engineering controls largely depends on the maintenance of these infrastructures over time. Therefore, the authorization should not only include words on construction QA/QC requirement but also include requirements for the maintenance of the authorized works. Similarly, the effectiveness of operational and administrative controls (including inspection and monitoring routines) often depends on the diligence of the operator and its consultant. The implementation of an environmental management system where a typical plan-do-check-act loop is spelled out is highly recommended to be referred to in the authorization. The key elements of the management system are expected to be included in the EPM as proposed in the authorization. This is expected to provide MoE with enough operational and management information needed to complete thorough compliance reviews and site inspections.

Additionally a progressive change in the groundwater vertical gradient may also be observed over time. The gradient will be calculated (piezometric elevations collected) at every groundwater monitoring and sampling events and reported in the quarterly and annual reports.

7.5.3. Air

Air quality monitoring and associated preventive and mitigating measures proposed in the TAR for vapour and fugitives dust is considered appropriate considering the level of risk involved. Vapour and fugitive dust aspects are discussed below.

7.5.3.1. Vapor Generation

The potential for generation vapour has been assessed using the partitioning equation referred to in the CSR technical guidance 4 (CSR TG4) and the Report of Screening Level Risk Assessment (August 2005), submitted by the Science Advisory Board for Contaminated Sites in BC. Based on the results discussed in the assessment section and on the preventive and mitigating measures proposed by Active Earth, the impacts beyond the property line due to VOC vapours coming from the Site are expected to be either avoided or quickly managed and mitigated.

A specific clause on odour control is recommended to be included in the authorization. The clause should specify when the contingency measures are expected to be implemented and include a statement leaving the Director the ability to require additional controls.

7.5.3.2. Fugitive Dust

The potential for generation of fugitive dust appears to be appropriately addressed in the technical assessment, with the recognition of protective measures (paving, weather protection) and a plan for sweeping or watering if issues are observed. A standard dust control clause is recommended to be included in the authorization to ensure the ministry can follow up on dust issues if they arise. Fugitive dust results should be compared to the BC Ambient Air Quality Residential Objectives of 1.7 mg/d^2-d for an averaging period of 2 weeks at the property boundary.

7.6. Proposed Monitoring Requirements

7.6.1. Surface Water

Active Earth proposed to monitor the effluent discharge from the settling pond and the WTS monthly and every 2000 m^3 for the WTS. Additionally, Active Earth indicated in its TAR (Section 6.8.1) that it would also monitor the collection reservoirs similarly to the WTS effluent (i.e. monthly and every 2000m^3). Each collection reservoirs (STMA reservoir, leachate collected by the leachate and the leak detection systems) are proposed to be sampled independently. Additionally and as proposed by Active Earth, the settling pond will be sampled bi-weekly

between October and May and after storm events exceeding 13 mm. This requirement is proposed to be included in the EPM.

The table below summarizes the receiving environment monitoring proposed for the Site. In addition to monitoring for the PCOC, Active Earth indicated that it would be monitoring the ephemeral creeks and Shawnigan Creek flows while conducting it routine monitoring:

Table 14 – Receiving environment monitoring (Surface water)

Receiving Waters	Monitoring Locations		Frequency
Surface Water	Up Stream Down Stream	(SW-4) Shawnigan Creek (SW-2) Ephemeral Creek 2 (SW-5) Shawnigan Creek (SW-3) Ephemeral Creek 2	5 in 30 (2 times/year, conducted during fall first flush event and in the summer low flow)

It is recommended that receiving environment samples be collected according to the 5 in 30 approach in order to compare analytical results with the WQG. Active Earth proposed in its TAR to sample the receiving environment sites for surface water on monthly basis and weekly during the fall flush and summer low flows. Due to the ephemeral nature of some of the creeks, the first 5 in 30 sample should be collected when the ground has first been saturated.

7.6.2. Groundwater

Groundwater was proposed to be monitored twice per year in the TAR. However, the recommendation is to conduct groundwater sampling and monitoring every quarter as required under HWR for all groundwater sampling facilities, including the two additional groundwater monitoring wells proposed to be added to the five existing sampling facilities (3 monitoring wells, including two nested wells).

Table 15 – Receiving environment monitoring (Groundwater)

Receiving Waters	Monitoring Locations		Frequency
Groundwater	Up Gradient	(MW-4) Southeast property corner	Quarterly
	Down Gradient	(MW-5) North of the site	

7.6.3. *Vapour Emissions*

As discussed in the assessment section (Section 5.2.9), Active Earth proposes to implement an ambient air monitoring program depending on the volatile contaminants concentrations in the soil managed in the STMA. The program states that, when soils with measurable volatile contaminant are being managed or treated at the STMA, Active Earth will collect 24-hour ambient air samples using Summa® Canisters at the property downwind of the STMA and submit the samples for VOC analysis. The results will then be compared to CSR Schedule 11 RL. Samples are proposed to be collected monthly during the active period (i.e. between April and October) if soils with measurable volatile contaminants are present in the STMA. If the results exceed the standards, Active Earth proposes to implement contingency measures to mitigate the risks of exposure.

Additionally, Active Earth proposes to use a handheld PID to measure total VOC concentrations at the STMA daily. If results exceeds 100 ppb (isobutyl units), additional measurements will be taken at the property boundary downwind of the source. Should the measurement at the property boundary exceeds 100 ppb as well, a 24-hour ambient air sample using Summa® Canisters is proposed to be collected, analyzed and compared to the CSR Schedule 11 RL standards as stated above.

Active Earth expects to validate the TSCREEN model based on actual results collected through its air monitoring program and propose site, and expects to use soil specific thresholds to improve vapour / odour management at the site over time.

The use of a handheld PID unit to measure total VOC concentrations at the STMA is not included in the authorization but will be included in the EPM.

Similarly, monitoring is proposed to be conducted at the landfill area using vapour probes. Results will also be compared with the CSR Schedule 11 Column III RL standards. In the event that these exceed the standards, SIA would apply for an air discharge permit.

7.6.4. *Fugitive Dust Emissions*

Active Earth is proposing to monitor dust emissions when dry or windy condition exist or when dust is observed to be migrating off-site. Dust will be monitored using handheld equipment called HAZ-DUST ® to measure dust levels at the downwind property line.

In addition, mitigating measures will be implemented as needed:

- Use of dust suppression as required
- Cover of fine grained loads
- Cover of fine grained soils stockpiles

It is recommended to include the preventive and mitigating measures in the EPM.

7.6.5. *Leak and Leachate Detection Sumps*

Active Earth indicated that catch basins, leak and leachate detection sumps would be visually inspected on weekly basis and cleaned out as necessary (Section 6.8.1, table H). It also indicated that samples will be collected monthly and every 2000m^3 from the three specific reservoirs collecting water from the STMA and leak and leachate from the landfill detection sumps.

It is recommended to include the recording of any volume of water collected in the leak and leachate detection sumps on a weekly basis and to include these requirements in the EPM.

7.7. Proposed Reporting Requirements

7.7.1. *Reporting to MoE*

The authorization requires the proponent to report on a range of activities and situations. These include obligations to report on non-compliance, bedrock integrity inspection and risk assessment, spills and on overall site environmental performance.

The reporting requirements are covered in the following clauses:

- Subsection 2.4 – Bedrock Integrity Inspection and Risk Assessment
- Subsection 2.11 – Spills Reporting
- Subsection 2.12 – Maintenance of Works and Emergency Procedures
- Subsection 2.14 – Advisory Committee
- Subsection 5.2 – Quarterly Report
- Subsection 5.3 – Annual Report

7.7.2. *Reporting to the Agencies, the Public and Interest Groups*

Considering the high level of interest shown from the agencies, the public and interest groups regarding the proposed facility, the authorization includes an obligation to disclose environmental monitoring results including interpretation and conclusions as worded in Subsections 5.2 and 5.3 of the authorization.

More specifically, the proponent will have to publish its quarterly and annual reports online following the same timeline as the one specified for Active Earth. Additionally, the annual report will have to be made available at the local library for general public consultation. An advisory committee will have to be formed by the proponent to the satisfaction of the Director. A specific clause in the authorization is proposed.

7.8. Fees

7.8.1. *Refuse Permit*

The proposed discharge is for refuse which at the time of this assessment has a variable rate of $0.74 / tonne. There are currently no contaminant-based fees for refuse. The maximum discharge proposed for the facility is 100,000 tonnes / year with a soil density between 1.5 and 1.8 tonnes/m^3. The annual fee for the discharge of refuse is therefore set to a total of $74,000 per year.

7.8.2. *Effluent Permit*

The proposed discharge is for an effluent discharge from a settling pond draining non contact runoff water and treated water from facility. The estimated maximum flow from the WTS is 274 m^3/d and the average flow is 12.1 m^3/d while the maximum flow expected at the settling pond discharge is approximately 42,500 m^3/d, based on 1 in 10 year 24-hour storm event calculation. The parameters considered to calculate the permit fees are representative of the PCOC list discussed above and include dissolved and total metals, BTEX, styrene, MTBE, VPHs, LEPHs/HEPHs, PAHs, Chlorinated Hydrocarbons, Phenolic Substances and Glycols. As per the Permit fee Regulation Section 7(3), any fees associated to the total suspended solids loading from the settling pond shall be set to zero as a current security bond was issued under the *Mines Act* and an additional security is requested under the *EMA*. Therefore, the total annual fee for the settling pond discharge is 229.34$/a.

The total permit fee, including the annual base fee of $100/a, is $74,329.34.

8. RECOMMENDATIONS

I recommend a permit be granted for SIA's proposed soil remediation and landfill facility on Stebbings Road, with permit wording generally based on recent soil remediation permits issued in the West Coast Region (PR-18231, PE-18266 and PR-105241). Site specific recommendations for SIA's application were noted throughout this document in bold:

Luc Lachance, PENG
Senior Environmental Protection Officer
Coast Region

(I agree with recommendations)
Hubert Bunce
Head, Business Standard
Coast Region