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VIA EMAIL: Jared.Buchko@pwgsc.gc.ca

Mr. Jared Buchko.
Manager, Environmental Engineering
Public Works and Government Services Canada
Telus Tower North
5th Floor, 10025 – Jasper Avenue
Edmonton, AB T5J 1S6

Dear Mr. Buchko:

Re: Intermediate DEW Line Site Restoration
CAM-F, Sarcpa Lake, Nunavut

As part of the design services for the environmental restoration at the CAM-F, Sarcpa Lake Intermediate DEW Line site, UMA Engineering Ltd. (UMA) has been retained by Public Works and Government Services Canada (PWGSC) to provide services related to the application for a Water Use License.

This purpose of this letter report is to provide a summary of the design rationale for the proposed disposal facilities at CAM-F.

BACKGROUND INFORMATION

UMA was retained by PWGSC in the summer of 2004 to provide engineering design services for the site restoration at the CAM-F, Sarcpa Lake Intermediate DEW Line. The design incorporates the principles outlined in the INAC Protocol, which are summarized in the document "Abandoned Military Site Protocol" by Indian and Northern Affairs Canada (INAC) dated March 2005.

UMA completed the design and submitted tender drawings (Project No. 413334, Drawing No.'s C01 to C12 and S01 to S05) and specifications for the CAM-F restoration project In March 2005. The CAM-F site restoration was tendered in separate contracts for construction and provision of a camp and awarded to Biogenie S.R.D.C. Inc. and Mikim Contacting Ltd., respectively. It is understood that the contractors will incorporate a sewage treatment system for the camp at CAM-F and will not require the use of a sewage lagoon.

The site restoration at CAM-F will incorporate the use of two types of specialized facilities for the disposal of on-site waste generated by the demolition of existing structures, removal of contaminated soils and site debris and landfill excavation. The disposal facilities proposed for CAM-F include a Non-Hazardous Waste Landfill and a Secure Soil Disposal Facility. These types of facilities have been successfully implemented at numerous other DEW Line Clean Up sites.

EBA Engineering Consultants Ltd. have conducted geotechnical investigations for the Clean Up of the CAM-F DEW Line Site and their findings and recommendations are summarized in reports entitled "DEW Line Clean Up Project, CAM-F (Sarcpa Lake) DEW Line Site, Geotechnical Investigation" dated March 2005 and "Geotechnical Evaluation and Preliminary Design, Clean Up of CAM-F DEW Line Site, Sarcpa Lake, NWT dated November 1996.

A summary of the design rationale for the proposed disposal facilities at CAM-F is as follows:

NON-HAZARDOUS WASTE LANDFILL

A Non-Hazardous Waste (NHW) Landfill is required at CAM-F for the disposal of demolition debris, surface debris and excavated debris. The plan and section for the NHW Landfill at CAM-F is shown on Drawings 413334-C03 and 413334-C06, respectively.

The selected location for the NHW Landfill at CAM-F, Sarcpa Lake is east of the station area between two shallow bedrock formations. The NHW landfill footprint covers an area of about 4,500 square meters and construction of this landfill will require the placement of approximately 8,000 cubic meters of suitable borrow material for the perimeter berms and landfill cap. The final landfill surface is sloped to drain to the northeast and uses the shallow bedrock formations to blend into the natural terrain.

The types of wastes acceptable for disposal in the NHW landfills include: non-hazardous debris, Tier I contaminated soils, F3 and F4 fraction hydrocarbon contaminated soils (where applicable), polyethylene-wrapped creosote timbers and double-bagged asbestos. These wastes are placed in 0.5 meter lifts to a maximum of 2 meters in total height. A minimum 0.15 meter thick intermediate cover layer is to be placed and compacted onto each 0.5 meter lift of waste material.

Design considerations and parameters for the NHW Landfill are as follows:

Waste Characterization – The waste materials to be disposed of in the NHW Landfill are to consist of non-hazardous waste only and may include wood, metal, empty crushed barrels, concrete and double bagged asbestos. Native borrow sourced materials and soils with low level contamination are used for intermediate fill.

Surface Water run-on and run-off control – The final surface of the NHW Landfill is to be graded to provide positive drainage to prevent ponding and infiltration. The slope of the landfill is designed to minimize the potential for erosion of the landfill cover.

Leachate Control – Because the landfill contents will consist of non-hazardous debris, the design intent is to control the leachate in a NHW Landfill rather than completely eliminate it. The design factors contributing to the control of leachate include:

- Only "Dry Waste" will be placed in the NHW Landfill;
- The short arctic summer will limit the time that any potential water infiltration can occur;
- The landfill cover will be compacted and graded to promote surface runoff, and
- Proposed NHW Landfills have been sited in areas where natural overland runoff is minimal.

Frost Jacking – Frost jacking occurs when debris in landfilled materials are subject to freeze thaw cycles; intermediate soil layers include frost susceptible soils such as fine sand or silt and there is access to free water. In order to minimize the potential for frost jacking, the NHW landfills are designed using good drainage practices and intermediate and cover materials are specified to be frost stable materials.

Biological Odour and Methane Gas Control – Odour and methane gas are typically generated in municipal landfills in the south and are the result of biological decomposition of domestic waste. The potential for the generation of odour and methane gas at a DEW Line Landfill is considered low because the volume of domestic waste to be landfilled is typically small and the waste is generally at a lower temperature under arctic conditions.

Settlement of Landfill Surface – In order to minimize settlement and ground subsidence, the debris in the NHW Landfill is crushed during placement and intermediate soil layers are placed within the debris to minimize void spaces in the landfill. Upon completion of placement of debris and intermediate fill, the landfill is capped with a minimum 1.0 m thickness of cover consisting of compacted granular fill.

Siting – Potential sites for a non-hazardous waste landfill were identified and evaluated in the geotechnical investigation undertaken by EBA Engineering Consultants Ltd. The sites were evaluated based on several factors, including: size of the area available, proximity to demolition areas and borrow sources, suitability of soil and groundwater conditions, surface water run-on potential and drainage conditions, topographic conditions, and setback distances from natural water bodies.

Granular Borrow Construction Materials – Potential granular borrow areas were identified and evaluated in the geotechnical investigations undertaken by EBA Engineering Consultants Ltd. EBA also provides gradation requirements for all granular materials to be used for the construction of the landfills. If the native borrow materials do not meet the gradation limits specified, then selective mining or processing of these materials will be required. The gradation requirements are provided to ensure suitable landfill performance based on the desired soil properties related to compaction, stability, erosion resistance, settlement, etc.

Landfill Design Parameters – A typical NHW Landfill for a DEW Line site restoration project consists of perimeter berm and cap constructed with granular borrow materials. The perimeter berm has maximum exterior and interior slopes of 3H:1V and 1.5H:1V, respectively, with a minimum top width of 2 meters. When the landfill is filled, a minimum 1.0 meter thick cap is provided. The berm and final cap are placed in thin lifts (less than 300 mm loose thickness) and compacted to a minimum of 95% of standard proctor maximum dry density. The final cap surface is sloped to between 2% and 4% and contoured to match existing topography. No liner is required since the design intent is to control the generation of leachate from a NHW disposal facility. Permanent monitoring wells will be installed around the perimeter of the NHW Landfill to allow for future environmental monitoring in these areas to confirm the design parameters.

Landfill Operation – A long term operation and maintenance program will be developed for the CAM-F landfills during site restoration activities. An operation and maintenance manual will be provided and finalized upon completion and closure of the landfills and will include record drawings for these facilities.

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SECURE SOIL DISPOSAL FACILITY

The INAC Protocol requires soil exceeding the Tier II contamination criteria to be isolated from the Arctic ecosystem. In this regard, UMA has provided the design of a Secure Soil Disposal Facility for Tier II contaminated soils. The plan and sections for the Secure Soil Disposal Facility at CAM-F is shown on Drawings 413334-C04, 413334-C07 and 413334-C08, respectively. A Secure Soil Disposal Facility provides three levels of containment for contaminated soils using a synthetic liner system and the permafrost regime in the high arctic.

A leachate collection and monitoring system is not generally incorporated into the design of a high arctic landfill since they do not function well in a permafrost environment. As such, the first level of containment for a Secure Soil Disposal Facility is a high-density polyethylene (HDPE) liner which is installed to prevent migration of water in or out of this landfill. The liner is placed on the base and interior sideslopes of the facility and the Tier II contaminated soils are then placed within the lined area. Once the facility is full, a liner is placed over the top of the contaminated soils to completely encapsulate this waste. All edges are either heat sealed or solvent welded to provide a watertight seal around the contaminated soil. A layer of bedding sand and a non-woven geotextile is placed above and below the liner for protection relative to liner puncture.

The second and third levels of containment utilize the permafrost regime to maintain the contained contaminated soils and perimeter berms in a perennially frozen state. Freezeback of the contaminated soils and perimeter berms is achieved by placing a sufficient thickness of granular cover to raise the permafrost to the desired level. The design of Secure Soil Disposal Facility considers the characteristics of the contaminants, geothermal properties of the area and the local permafrost regime.

A cover thickness of 2.3 meters has been utilized for the Secure Disposal Facility at CAM-F to maintain the active layer within the cover material during mean and warm years and provide a safety factor for uncertainties in the thermal model. The complete geothermal analysis is presented in Appendix E of the 1996 EBA Report. The results of this analysis predict the active layer to be 1.6 meters during a mean year and 2.1 meters during a warm year. A similar cover thickness design has been provided for the two closest DND DEW Line sites and developed using a more detailed analysis. Thermistor cables will be installed to facilitate monitoring of the ground temperature at depth to confirm that suitable freezeback is achieved.

The third level of containment incorporates the use of saturated soils for berm construction. The berms are placed and compacted in such a manner to achieve a minimum degree of saturation of 90%. When these berms freeze, they become low permeable "ice-saturated" containment barriers. A key trench is excavated to saturated ground or ice saturated permafrost in berm construction areas in order to facilitate continuous containment of the saturated berms.

Three potential sites were identified for a Secure Soil Disposal Facility at CAM-F and evaluated in the geotechnical investigation undertaken by EBA Engineering Consultants Ltd. The sites were evaluated based on several factors, including: size of the area available, proximity to contaminated soil excavation areas and borrow sources, suitability of soil and groundwater conditions, surface water run-on potential and drainage conditions, topographic conditions, and setback distances from natural water bodies

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The selected location for the Secure Soil Disposal Facility at CAM-F is an area southeast of the station area. This site is close to an available borrow source, near the majority of the contaminated soil and has suitable soil and groundwater conditions. The landfill footprint covers an area of about 7,500 square meters and construction of this landfill will require the placement of approximately 18,000 cubic meters of suitable borrow material for the perimeter berms and landfill cap and approximately 3,500 square meters of HDPE Liner. The final landfill surface is sloped to drain to the southwest. Permanent monitoring wells will be installed around the perimeter of the Secure Soil Disposal Facility to allow for future environmental monitoring in this area to confirm the design parameters.

The material to be disposed of in the Secure Soil Disposal Facility includes Tier II and hydrocarbon contaminated soils (BTEX, F1 and F2). These wastes are placed in 0.3 meter lifts to a maximum of 2 meters in total height. A minimum 0.15 meter thick Intermediate cover layer is to be placed after each 0.3 meter lift of waste material.

The thickness of cover above the contaminated soil will be a minimum of 2.3 meters. All cover material will be compacted to minimum of 95% of the Standard Proctor Density, graded to between 2% and 4%, and contoured to match existing topography. The perimeter berm will have maximum exterior and interior slopes of 3H:1V, with a minimum top width of 3 meters.

CLOSURE

We trust this meets your current requirements. If you require additional information or clarification, please call myself or Rudy Schmidtke at 780-486-7000.

Respectfully Submitted,

UMA Engineering Ltd.

Barry Fedorak

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BWF:mr

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