Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

May 31, 2006

Sarah Gagné, EIT
Technical Advisor
Nunavut Water Board
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PO Box 119
Gjoa Haven, NU X0B 1J0

Dear Ms. Gagne:

Re: Outstanding Water Board Issues for CAM-F (1BR-SAR) and FOX-C (1BR-EKA)

Please find attached the responses and/or clarifications to the outstanding issues identified by the Nunavut Water Board in their letter of May 26, 2006. Please also find attached the supplementary information requirements for hydrocarbon impacted soil storage and landfarm facilities. The responses attached are structured to follow the format of the NWB letter.

Please let me know if you have any questions or concerns.

Sincerely,

Natalie Plato, P.Eng.
Director, Contaminated Sites Program
Iqaluit, NU

Encl: Letter May 31, 2006 from Brad Thompson to Natalie Plato
Letter May 30, 2006 from Barry Fedorak to Brad Thompson
Supplementary Information Requirements for HC Soil, April 18, 2006

Cc: Brad Thompson, PWGSC
Mark Yetman, INAC

Canada

Travaux publics et Services gouvernementaux Canada
Public Works and Government Services Canada

PWGSC
Northern Contaminated Sites Remediation Group

5th Floor, Telus Plaza North
10025 Jasper Avenue
Edmonton, AB
T5J 1S6

May 31, 2006

Natalie Plato
Indian and Northern Affairs Canada
PO Box 2200
Iqaluit, NT X0A 0H0

Dear Natalie:

Re: Outstanding Water Board Issues for CAM-F (1BR-SAR) and FOX-C (1BR-EKA)

Provided are the responses to the outstanding issues identified by the Nunavut Water Board (NWB) in their letter dated May 26, 2006. Public Works and Government Services Canada (PWGSC) have provided some responses below and the remainder of the responses have been provided by UMA Engineering in the attached letter.

1BR-SAR

1. Response provided in the UMA letter, attached.

2. PWGSC and INAC will work together to resolve any inadequacies in the QA/QC plans submitted for CAM-F and FOX-C. Revisions will incorporate recommendations made in the *Quality Assurance (QA) and Quality Control (QC) Guidelines For Use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QAQC Plan* document prepared by INAC (1996). We understand that submission of the revised plan will not delay NWB from issuing the License but it will be a condition of the License.

3. The fuel storage tanks being sent to CAM-F are double-walled tanks. Therefore, there is no need for a bermed containment area as the double walled tanks provide secondary containment.

1BR-EKA

1. Response provided in the UMA letter, attached.

2. Response provided in the UMA letter, attached.

3. Response provided in the UMA letter, attached.

4. All fuel sent to the site is contained in 205 L drums. National Fire Code Regulations do not requirement secondary containment for the temporary storage of drummed fuel. The contractor for the job has included in their plan that an unlined earth berm will be constructed around the drummed fuel storage area. Spill kits will be also be readily accessible in the area should an accidental release occur. A Spill Contingency Response Plan has been submitted to the regulatory authorities detailing the steps the contractor will take in the event of an accidental

release. At the completion of the project in 2007, all remaining drummed fuel from the site will be removed.

5. The landfarm supplementary information package will be provided to the NWB by INAC.

6. Wastewater generated from the waste processing area will be stored in clean 205 L barrels until laboratory analysis confirms that the water meets the discharge criteria for the site. A composite sample will be collected using samples from approximately 10 barrels.

If there are any more questions or comments, please contact either myself or Jared Buchko. Thank you.

Sincerely,

Brad Thompson, P.Eng.
Senior Environmental Engineer

Attachment

UMA Engineering Ltd.
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April 18, 2006 File Name: 2977-301-05-02

Mr. Brad Thompson, P.Eng.
Senior Project Engineer, Western Region
Public Works and Government Services Canada
Telus Tower North
5th Floor, 10025 – Jasper Avenue
Edmonton, AB T5J 1S6

VIA EMAIL: Brad.Thompson@pwgsc.gc.ca

Dear Mr. Thompson:

Re: DEW Line Site Restoration at FOX-C, Ekalugad Fiord, Nunavut
Application for a Water License from the Nunavut Water Board:
Response to the Supplementary Information Requirements for Hydrocarbon-Impacted Soil Storage and Landfarm Treatment Facilities

UMA Engineering Ltd. (UMA) has been retained to provide services to support the application for a Water Use License for the environmental restoration at the FOX-C, Ekalugad Fiord Intermediate DEW Line site. The Nunavut Water Board has provided a landfarm questionnaire entitled "Supplementary Information Requirements for Hydrocarbon-Impacted Soil Storage and Landfarm Treatment Facilities". The purpose of this letter is to provide a response to this landfarm questionnaire. The letter is structured to follow the format of the landfarm questionnaire.

GENERAL INFORMATION

To be provided by INAC in Application for Water Use License.

TECHNICAL INFORMATION

Site Assessment Considerations

1. Detailed topographic site survey diagrams, maps and aerial photos:

These are provided in Drawings C01, C02 and C03, which are included with this submission.

a. **Soil, fuel and chemical storage locations:** The Contractor will safely store soil, fuel and chemicals, as required, to complete the work. The project specifications outline suitable requirements for the storage of these materials, including conformance with all applicable environmental laws, regulations and requirements of Federal, Territorial and other regional authorities.

b. **Soil landfarm active treatment location:** Shown on Drawing C01.

c. **Site drainage patterns:** Shown on Drawing C01.

d. **Adjacent surface water bodies that could be affected by the proposed undertaking:** Shown on Drawing C01. The water bodies are no closer than 1000 meters from the proposed landfarm.

e. **Facility site access routes:** Shown on Drawing C01.

f. **Surface and subsurface environmental monitoring sites:** Shown on Drawing C03.

g. **Traditional land use areas:** The traditional land use at FOX-C was described by Gartner Lee and Cantox (1998) and consists of Inuit families residing on the land in tents during the summer months. It is anticipated that the Inuit would engage in traditional activities such as hunting, fishing and gathering. During the site clean up activities, the Contractor would be responsible for site security relative to his construction activities.

2. Slope of land underlying the Facility:

The survey shows that the approximate slope of the natural ground in the landfarm area is 8%.

3. Hydrological / Climatic Assessment of the Site:

a. **Precipitation and temperature profiles for the area:** The climate at Ekalugad Fjord includes long, cold winters and short, mild summers. Average monthly and annual weather data has been measured at a nearby station (CAPE HOOPER, Nunavut, 68° 28' N, 66° 48' W, elevation 390 m, data from 1955 to 2000, Canadian Climate Normals, Environment Canada) and summarized in the following table.

Table 1: Meteorology: Precipitation and Temperature Profiles at FOX-4, Cape Hooper

Month	Daily Maximum (°C)	Daily Minimum (°C)	Daily Mean (°C)	Extreme Maximum (°C)	Extreme Minimum (°C)	Rainfall (mm)	Snowfall (cm)	Snow at Month-end (cm)
January	-22.9	-28	-25.5	-1.7	-40.6	0	6.4	60
February	-24.1	-29.4	-26.7	-0.6	-44.1	0	6.1	59
March	-21.5	-27.3	-24.4	2.3	-42	0	7.9	59
April	-14.8	-20.8	-17.8	6.1	-34	0	19.8	59
May	-5.4	-11	-8.2	11.1	-27.8	0	25.7	38
June	-2.6	-2.7	-0.1	17.8	-10.6	2.1	15.7	5
July	7.3	1	4.1	19.5	-7.8	22.7	9.6	0
August	5.7	0.2	3	17.2	-12.2	26.63	11.4	1
September	-0.1	-3.7	-1.9	12.8	-16.2	6.5	34.9	18
October	-5.9	-10.1	-8	8.5	-26	0.3	43.2	42
November	-13.8	-18.5	-16.2	2.2	-31.1	0	31.5	60
December	-20.2	-25.4	-22.8	3.3	-41.1	0	11.6	60

The ocean freeze up around Baffin Island typically begins in late October and is usually completed by December. Baffin Island typically has snow cover from mid-September to late May.

b. **Details of the local drainage basin:** The landfarm is in a drainage basin that includes a wide flat delta with steep sided mountains at the perimeter. The drainage basin collects at the north flowing river between the freshwater lake and ocean (Ekalugad Fiord).

c. **Likelihood of flood events:** The landfarm is located in an area that will not be affected by flood events.

4. A description of the soil underlying the site:

a. **The physical and chemical characteristics of the soil underlying the facility:** The terrain and respective soil conditions at FOX-C are varied. The soil conditions observed at this site include: fine grained soils in the outwash valley at the Beach Area; coarse grained sandy soils, becoming more granular with elevation between the lake and the glacier; and weathered bedrock outcrops. The latter two conditions are dominant at the upper site. The soils around the site can be generally classified as Regosolic and Cryosolic in nature, and mostly consist of sand and gravel, with small amounts of clay and organic material in some areas.

Four shallow testpits were excavated in the area of the landfarm (TP-04, TP-12, TP-13 and TP-14). The testpits indicated that the surficial soils at the proposed landfarm site consisted primarily of clayey silt with an occasional interval of silty sand and an occasional cobble or boulder. Moisture contents measured in the upper soils ranged from 16.4 to 24.3%.

b. **Depth of the permafrost active layer:** Geotechnical investigations were carried out between August 20 and September 1, 2004, by EBA Engineering Consultants Ltd. Four shallow testpits were excavated in the area of the landfarm (TP-04, TP-12, TP-13 and TP-14). The depth of active (thawed) material in the testpits ranged from 0.75 m to 1.1 m and all testpits were terminated in frozen ground. Ice was present in the frozen soil in the base of TP-14, and stratified ice and soil (Vs = 20 to 40%) were present in two of the other testpits. Permafrost is continuous and widespread in the Quaternary deposits which mantle Baffin Island. For the landfarm, the placement of material over the existing ground will cause the permafrost to aggrade rather than deteriorate.

c. **Permafrost characteristics that may impact the construction and operation of the Facility:** Excavation of the active layer is to be minimized to reduce the risk of thaw settlement of the underlying ice-rich permafrost. The landfarm is constructed primarily above existing grade, with only the lowest portion of the collection ditch excavated slightly below existing grade (< 0.3 m).

5. Municipal Zoning or Land Use Planning Ordinances:

The proposed landfarm at FOX-C, Ekalugad Fiord is situated on Inuit Owned Lands, as defined in the Nunavut Land Claims Agreement (NCLA).

Soil Storage and Landfarm Treatment Design Considerations

1. Details of Design and Construction of Soil Storage and Landfarm Treatment Facility:

UMA has submitted the design for a hydrocarbon soils treatment facility (landfarm) as part of the Tender Drawings for the site restoration at FOX-C, Ekalugad Fiord. The landfarm site is located at least 100 m away from any water body in an area free of ponded water. The location is relatively free of boulders and is generally level, which provides for the convenient access of equipment. The landfarm is located at least 300 m from the construction camp, offices, and laboratory. Development, operation and closure of the landfarm will involve the following work:

- Ground preparation, such as removal of boulders and placement of granular bedding material, to facilitate treatment options, as required;
- Construction and maintenance of roadways required to support treatment operations;
- Construction of exterior berms and drainage ditches;
- Placement of soil contaminated with F1/F2 hydrocarbon fractions in the landfarm;
- Specific activities for landfarming operations, including nutrient application, tilling and moisture conditioning;
- Final grading to promote drainage away from the site and to match the surrounding terrain,
- Supply and installation of temporary groundwater monitoring wells at the perimeter of the landfarm, to be sampled and tested during landfarming operations.
- Closure of the landfarrm following confirmation that treatment has remediated the contaminated soil.

At the FOX-C site, there is only about 400 m^3 of hydrocarbon soil that requires treatment, and as such, the landfarm footprint is quite small, at about 2,500 m^2. The landfarm is sized to allow the hydrocarbon soils to be spread out to a thickness of 400 mm, to facilitate suitable aeration for treatment. If additional hydrocarbon soils requiring treatment are identified during construction, an additional landfarm cell can be constructed adjacent to the existing landfarm.

a. **Retaining Structures:** The containment for the landfarm will consist of perimeter berms constructed with select borrow material (Type 4 Granular Fill), with a minimum of 20% fines (materials sizes less than 0.08 mm). A granular leveling course will be constructed over the base of the landfarm interior to provide a working surface for treatment activities. The compacted base comprising the levelling course will promote runoff to the sump in the landfarm.

b. **Geo-synthetic liners:** No geosynthetic liner will be used for the landfarm at FOX-C.

c. **Devices used to manage excess runoff water and/or leachate:** The landfarm will be graded to drain to a ditch and collect in a sump at the southeast corner of the facility, (refer to Drawing C03). Excess runoff in the sump will be tested and, if it meets the requirements for discharge, it will be pumped and released appropriately. Landfarm runoff that does not meet the criteria for discharge will be treated to meet the requirements, or, if the runoff cannot be treated, it will be containerized and disposed off-site as hazardous waste.

d. **Existing and proposed drainage modifications:** The landfarm includes the construction of perimeter berms and a leveling course to facilitate a treatment area for the hydrocarbon contaminated soil from the nearby Beach POL area. Ditches and berms are provided to re-direct drainage and minimize run-on from outside of the landfarm and control runoff from within the landfarm. Diversion ditches will be built outside the landfarm, if required.

e. **Water quality and environmental monitoring stations:** Groundwater monitoring wells will be provided to facilitate environmental monitoring during landfarming activities. Four groundwater monitoring wells will be installed around the perimeter of the landfarm. One well will be located upgradient of the facility and will be used as a background well. (Refer to Drawings CO3 and C04 for the proposed locations and installation details for the temporary monitoring wells.)

2. Installation of barriers to prevent access to the site:

Signage will be erected at access points to the landfarm area. Signage will be visible from all sides of the landfarm area. The English version of the sign shall read:

"CAUTION: CONTAMINTATED SOIL LANDFARM AREA
AUTHORIZED PERSONNEL ONLY"

A similar sign in the language of the local dialect will also be posted.

3. Placement of the Facility in relation to water bodies:

The site for this landfarm was recommended by EBA Engineering Consultants Ltd. in their geotechnical investigation report for FOX-C. The landfarm site is approximately 1000 m away from the ocean (Ekalugad Fiord) and in excess of 1500 m away from the fresh water lake.

4. Flood risks/maximum probably precipitation events in regards to the Facility placement and design: The landfarm facility is not in the flood plain of any watercourse or lake.

5. Alternative methods of soil storage or remediation, in the event that circumstances are not suitable, for example because of environmental constraints, available human resources, etc.: Not applicable.

Operations and Maintenance Considerations

1. Procedures to determine if soils may be accepted at the Landfarm:

a. **Chemical, physical and biological characterization of the soils and the associated hydrocarbon and metal contaminant concentrations:** The FOX-C Landfarm provides a treatment facility for the hydrocarbon contaminated soil from the Beach Area POL Storage Tanks, which was investigated and delineated by Earth Tech in 2004. The testing at the Beach POL Area shows exceedances in the F2 hydrocarbon fraction, with concentrations ranging from <10 to 2,890 ppm. The testing of the Beach POL soils did not show any exceedances for metals or PCB's.

b. **Treatibility studies, to determine the viability of landfarm treatment:** Since 1985, numerous environmental and risk assessments have been completed at the FOX-C site. In 2006, the Analytical Services Unit at Queen's University in Kingston, Ontario, prepared a report titled: "The Potential for Landfarming of Diesel Contaminated Soil at Ekalugad Fjord", in preparation for the remediation of hydrocarbon contaminated soils.

   The experimental design attempted to simulate a landfarm and examined the contributions of aeration and bioremediation. The addition of fertilizer and the frequency of rotation were varied. As was expected, temperature was an important factor, with the reactors at 18°C remediating more diesel that the 8°C or the 5°C situations. However, at colder temperatures, the soils were successfully remediated with a rotation frequency of four days and the addition of fertilizer. At 5°C, in particular, aeration improved results and clear evidence of bioremediation was observed.

   The data from the laboratory experiments indicate that landfarming at Ekalugad Fjord has the potential to successfully remediate the diesel contaminated soils. This study recommended that the landfarm be set up in the warmest possible location, at low elevation and be south-facing. Fertilizer is to be added and the landfarm should be tilled frequently. The moisture content of the soil has to be controlled, otherwise the soil will dry out and bioremediation would be adversely affected. The moisture content should be maintained between 10 and 15%, in order to promote bioremediation.

c. **Sampling frequency and number of samples per volume of soil accepted:** The frequency of sampling will be determined by the Engineer. A typical program for an arctic landfarm would include dividing the landfarm into 10 m squares for the purpose of sampling. One discrete sample is collected from a random location within each 10 m square, which corresponds to about 4 m^3 of F1/F2 contaminated soil. The sample is collected from the bottom 10 cm of soil (approximately 30-40 cm depth).

2. Procedures to be utilized during active landfarming operations in the active treatment cells:

The treatment of the F1/F2 hydrocarbon contaminated soils in the landfarm will include the application of nutrients, along with tilling and moisture conditioning of the treatment soils. These activities are essential to ensure that adequate conditions for microbial growth are achieved. Granular nutrients will be applied uniformly to the contaminated soils at a rate sufficient to achieve the optimum nitrogen loading, as determined by testing during treatment. Fresh water will be sprayed over the soil to achieve the optimum moisture. Tilling of the contaminated soil is specified to occur at 10 days intervals and at 5 day intervals, should periods of warm or dry weather be encountered.

a. **Treatment cell development and material placement therein:** The treatment cell development will consist of the placement of specified granular materials for the perimeter berms and interior leveling course and the excavation of a perimeter ditch and sump on the east side of the facility. Once the landfarm is complete, F1/F2 hydrocarbon contaminated soil will be transported from the Beach Area to the Landfarm Area, such that no soil or liquid will be spilled during transport.

b. **Contaminated soil thickness in treatment cells:** The landfarm at FOX-C is designed to accommodate the F1/F2 contaminated soil spread to a maximum loose thickness of 400 mm.

c. **Method of mechanical aeration in treatment cells:** The treatment soils are typically tilled with an earthworks disc unit or rake attachment pulled by a farm tractor or bulldozer.

d. **Oversize material management:** The intent for oversize material management is to separate the boulders from the contaminated soil during excavation, manually remove organic and contaminated soil and use the boulders as backfill for the excavations. Any boulders observed in the landfarm, which could hinder the tilling operation, will be removed from the treatment area, cleaned and buried on-site.

e. **Surface water management, leachate containment and/or treatment, and site grade planning:** During periods of wet weather, tilling will be delayed until the treatment soils have adequately dried out. The landfarm is graded to drain and collect excess runoff in a sump at the low end of the facility.

   Runoff that collects in the landfarm sump is considered contact water and can only be discharged if it is tested to have a maximum concentration for Oil and Grease of 5 mg/L, with none visible. The storage in the sump is limited and the Contractor is required to make provisions for testing, treatment (as required) and controlled discharge of the contact water. If the contact water does not meet the criteria for Oil and Grease indicated previously, the Contractor must treat the water to meet the criteria or containerize it as hazardous waste for off-site disposal.

f. **Process water management and treatment prior to discharge:** All surface water and process water that is collected in the landfarm sump is considered contact water and subject to the discharge requirements indicated in the previous section.

g. **Dust control programs:** The suppression of dust, generated during landfarm operations, will be done with a water spray. The use of oil for dust control is prohibited.

h. **Staff operational training programs:** All activities involving the handling and treatment of hydrocarbon contaminated soil shall be directly supervised by Construction Contractor's personnel, who have successfully completed a 40 hour training course for Hazardous Waste Activities, in compliance with OSHA 29 CFR 1910.120 or other approved equivalent training courses such as the Canadian Hazardous Waste Workers Program. It is the responsibility of the Contractor to provide suitable training for operational staff.

3. Soil Quality Remediation Objective:

The Soil Quality Remediation Objectives are summarized in the INAC document: "Abandoned Military Site Remediation Protocol", dated March 2005. The remediation objectives include the treatment of contaminated soils from the Beach POL at FOX-C by landfarming to meet the criteria of 260 ppm for the PHC F1 fraction and 900 ppm for the PHC F2 fraction, as outlined in the Canada Wide Standards for Petroleum Hydrocarbons. If these levels are met, the contaminated soils are considered remediated, and can be left in place. It the criteria is not met, further tilling and confirmatory sampling is necessary.

4. Conceptual Decommissioning and Reclamation Plan:

a. **Details regarding the ultimate deposition of any treated soils:** When the hydrocarbon contaminated soils at FOX-C Landfarm have been tested to show that the remediation objectives have been met, the following tasks are specified to close the landfarm:

- Consolidate the treated contaminated soil within the landfarm to a maximum depth of 1.0 m. Grade this consolidation area allow a final slope of 2 to 4%.
- All granular fill is to be compacted to 95% Maximum Dry Density;
- Excavate granular material from the perimeter berms outside the consolidation area and place this material, as cover, to a minimum depth of 30 cm, over the consolidated treated soil area.
- Decommission the groundwater monitoring wells, including backfilling with appropriate grout, removal of the protective casing, lockable cap and well pipe to within 300 mm from the ground surface, and backfill and compact all voids with granular fill material.

The Construction Contractor is required to complete the cleanup and to remediate all of the areas in which his/her activities took place, as described in the project specifications.

b. **Disposal plan for soils contaminated with bioremediation-unsuitable compounds, or for soils that do not respond well to the proposed landfarming treatment:** All soils contaminated with bioremediation-unsuitable compounds, or soils that do not respond well to the proposed landfarming treatment will be containerized and disposed off-site.

Surface and Groundwater Monitoring Programs

1. Locations of all proposed Monitoring Stations:

The proposed locations of the four monitoring wells are shown on Drawing C03 attached. All locations are to be field confirmed by the Engineer. The monitoring wells will be surveyed after installation.

2. Chemical, physical and biological parameters to be monitored:

A typical groundwater testing program for a temporary landfarm would include field testing for pH, turbidity, temperature and conductivity and analytical testing (at an accredited lab) for Total Petroleum Hydrocarbons in each of the Fractions (F1 to F4) identified in the Canada Wide Standards.

3. Sampling frequency:

A typical groundwater monitoring program would include annual sampling and testing of water from temporary monitoring wells. The samples would be taken at maximum thaw (late August or September) during active soil treatment operations.

4. Baseline Monitoring Programs:

A contemplated Baseline Monitoring Program would include representative sampling and testing of soil prior to the construction of the landfarm.

5. QA/QC Programs to be implemented as part of the Monitoring Program:

Construction monitoring and quality control is required to ensure satisfactory performance of the landfarm at FOX-C. It is the intent of INAC to procure qualified engineering staff to ensure that the design intent, including all requirements of the specification, is suitably met.

CLOSURE

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

Respectfully Submitted,

UMA Engineering Ltd.

Dara McDonald, B.Sc.
Environmental Technician
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Reviewed By,

UMA Engineering Ltd.

Barry Fedorak, P.Eng.
Senior Project Engineer
barry.fedorak@uma.aecom.com

BWF:mr

cc: Jared Buchko, PWGSC - via email: jared.buchko@pwgsc.gc.ca

Encl: References, Drawings C01, C02, C03, C04

REFERENCES:

Earth Tech Canada Inc. (Earth Tech 2004) FOX-C DEW Line Site Assessment and Waste Audit, Final Report, January 2005.

EBA Engineering Consultants Limited (EBA 2004) DEW Line Clean Up Project, FOX-C (Ekalugad Fjord) DEW Line Site, 2004 Geotechnical Investigation, November 2004.

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Indian and Northern Affairs Canada (INAC 2005a) Abandoned Military Site Remediation Protocol, March 2005.

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Nunavut Water Board (NWB 2004) Guidelines for Spill Contingency Planning, Draft, November 2005

Queen's University – Analytical Services Unit (Queen's 2006) The Potential for Landfarming of Diesel Contaminated Soil at Ekalugad Fjord, March 2006.

Sinanni Inc. and Qikiqaaluk Corporation (Sinanni 2001) Engineering Design (95% submission) and Cost Estimates for the Clean up of Ekalugad Fjord (FOX-C): Intermediate Dew Line Site, March 2001 (Revision-1 October 2001).

UMA Engineering Ltd (UMA 2004) Submission to the Nunavut Impact Review Board for the Clean Up of the CAM-3, Shepherd Bay DEW Line Site on Behalf of Defence Construction Canada, August 2004.

UMA Engineering Ltd (UMA 2005) Specifications for the Clean Up of FOX-C, Ekalugad Fiord Intermediate DEW Line Site, Tender Submission, March 2005.