Schematic Design for the Improvements to the Sewage Lagoon and Solid Waste Disposal Facility The Hamlet of Kugluktuk, Nunavut

Prepared by

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December 2005

File No: N-O 09755

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NUNA BURNSIDE
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PERMIT TO PRACTICE
Nuna Burnside Engineering and Environmental Ltd.
Signature Jim Walls
Date December 19, 2005
PERMIT NUMBER: P 535
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

December 19, 2005

Government of Nunavut
Project Management Division
Department of Community and Government Services
Kitikmeot Region
P.O. Bag 200
Cambridge Bay, Nunavut X0B 0C0

Attention: **Mr. Navjit Sidhu, E.I.T.**
Project Officer
Community and Government Services – Kitikmeot Region

Re: **Schematic Design Report**
Sewage and Solid Waste Facilities Design
Hamlet of Kugluktuk
File No. N-0 09755

Dear Mr. Sidhu,

Enclosed please find a copy of the above noted report for the Hamlet of Kugluktuk, for your review.

If there are any questions or concerns, please do not hesitate to contact us at the Orangeville office.

Yours truly,

Nuna Burnside Engineering and Environmental Ltd.

Jim Walls

Jim Walls, P.Geo.

REGISTERED PROFESSIONAL GEOLOGIST
Dec. 19, 2005
J.R. WALLS
LICENSEE
NWT/NU

Attachment

JW:mm J:\2005\F\09754\Report\1219sidh.doc

Table of Contents

Tables

Figures

Appendices

1.0 Introduction

Nuna Burnside Engineering and Environmental Ltd. (Nuna Burnside) was retained by the Department of Community and Government Services, Government of Nunavut, to undertake a sewage and solid waste facilities design for the Hamlet of Kugluktuk, Nunavut.

The scope of work for the project was outlined in a proposal by Nuna Burnside entitled "Sewage and Solid Waste Facilities Design, Kugluktuk, Nunavut", dated September 2005. The proposal was prepared in response to a Request for Proposals issued by the Department of Community and Government Services (DCGS) of the Government of Nunavut (GN), dated September 2005. This report outlines the results of the first two and part of the third of the seven project tasks. These are:

- Task 1 – Project Initiation Phase
- Task 2 – Preliminary Design Phase
- Task 3 – Detailed Design Phase – Schematic Design portion.

This report details the work conducted to date, and provides a schematic design for the facilities and issues being evaluated.

The next phase of the project will be to submit this report to the GN and Hamlet of Kugluktuk for review and comment. Following a presentation of the findings to the GN and Hamlet of Kugluktuk, and acceptance of the preferred options from the schematic design, the project will move to detailed design.

2.0 Scope of Work

The scope of work for this project was detailed in a proposal by Nuna Burnside entitled "Sewage and Solid Waste Facilities Design, Kugluktuk, Nunavut", dated September 2005. The proposal was prepared in response to a Request for Proposals entitled "Sewage and Solid Waste Facilities Design, Kugluktuk, Nunavut", dated September 2005, by the Department of Community and Government Services (DCGS) of the Government of Nunavut (GN).

The purpose of the work as outlined in the RFP was to study the existing sewage and solid waste facilities (including bulky metals, hazardous materials site, and land farm site). Following the study, begin development of simple, engineering designs for the construction of new facilities, and/or rehabilitation of existing facilities in a cost effective fashion, cognizant of long term (beyond 20 years) community development, and in compliance with appropriate laws and regulations.

The scope of work outlined in the Nuna Burnside proposal, which was approved by the GN, include seven phases:

- Phase 1 – Project Initiation Phase
- Phase 2 – Preliminary Design
- Phase 3 – Detailed Design Phase
- Phase 4 – Construction Document Phase
- Phase 5 – Bidding or Negotiation Phase
- Phase 6 – Contract Administration and Construction Inspection Phase
- Phase 7 – Warranty Period/Post-Construction Monitoring.

This Schematic Design Report details the work completed to date, including the first two phases and part of the third phase as follows:

Phase 1 – Project Initiation Phase

- Assemble and review background data and previous studies
- Conduct an initial start up meeting via teleconference
- Review the TOR and design parameters
- Schedule site visits.

Phase 2 – Preliminary Design

- Project kick-off meeting in the Hamlet
- Site inspection (survey, sampling, geological study)
- Prepare conceptual design submission
- Submit conceptual design alternative
- Review and approval meeting – via teleconference.

Phase 3 – Detailed Design Phase

- Prepare schematic design submission
- Submit schematic design submission.

The next phase of work will be the presentation of this report, and discussions with the Hamlet and GN to obtain input and select options for detailed design.

3.0 Background and Existing Conditions

3.1 Community Location and Description

The Hamlet of Kugluktuk (formerly known as Coppermine), is situated on Coronation Gulf at the mouth of the Coppermine River. The Hamlet is situated on a rocky area on the west side of the Coppermine River, at latitude 67°49'N, longitude 115°06'W, as shown on Figure 1.

The community has a population of approximately 1,362 (as per the RFP), with an approximate 1.5 percent projected growth rate. Community infrastructure includes:

- A water treatment plant, which draws water from the Coppermine River and stores it for treatment
- Trucked water to holding tanks in each building
- A sewage lagoon which receives trucked sewage collected from holding tanks in each building
- Sewage treatment via an exfiltration lagoon to a wetland discharging north to the ocean
- A solid waste disposal facility, which includes a bulky metals disposal area, a contaminated soil pile, a waste oil and liquid waste storage area, and a battery and other materials storage area
- Several rock and sand quarries
- Diesel powered generators
- Two wind generators (one partially dismantled and the other currently off-line)
- Barge landing area.

The Hamlet is predominately residential with a few small commercial establishments including a hotel, several construction contracting businesses, grocery store, and a variety of other small businesses. Hunting and fishing in the traditional manner is still a prime occupation for many of the inhabitants. Community buildings include a high school, an elementary school, arena, swimming pool, Hamlet office, public works yard, GN offices, and police station.

3.2 Climate

Kugluktuk is affected by Arctic air masses, and experiences a maritime Arctic climate characterized by short cool summers, and long cold winters. The mean annual air temperature is -12°C. Monthly averages range from -31°C in February to 10°C in July. Kugluktuk receives about 249 mm of precipitation per year, of which 134 mm falls as rain between June and September. Prevailing winds are from the east in summer and from the southwest in winter. The mean wind speed is approximately 15 km/hr. Climate details are included in Appendix A.

3.3 Geology and Morphology

3.3.1 Terrain

The terrain surrounding Kugluktuk consists of coastal lowlands of sand and clay plains dotted with shallow lakes.

The ground surface consists of bedrock and glacial deposits. Boulder and cobbles cover some areas. Much of the surface is covered with turf consisting of various grasses, sedges, and moss underlain by a thin (10 cm to 30 cm) layer of topsoil and/or peat.

The land area around Kugluktuk is underlain by permafrost estimated at several hundreds of meters thick. There is no permafrost under major water bodies such as Coronation Gulf. A deep zone of non-permafrost probably exists as a talik beneath the Coppermine River. The depth of the active layer over most of the land area is dependent on vegetation cover, soil type, and moisture conditions. Test pitting in the vicinity of the sewage lagoon and landfill found the top of the permafrost in early October to be approximately 0.9 m below surface.

3.3.2 Bedrock Geology

Figure 3 displays the bedrock geology of Kugluktuk. The bedrock in the area consists of Proterozoic fine grained sedimentary and meta-sedimentary (shale) of the Rae Group. These have been intruded by the Coronation Sills, which are composed primarily of granular gabbro.

A northeast trending ridge of bedrock dominates the topography from Heart Lake to the mouth of the Coppermine River.

Both gabbro and shale have been quarried locally for construction materials.

3.3.3 Surficial Geology

Figure 4 displays the surficial geology of the Kugluktuk area. The area is dominated by the effects of isostatic rebound following the last glaciation, and deposits related to the discharge of the Coppermine River.

East of Kugluktuk (between the sewage lagoon and the ocean) is an area of raised beach ridges comprised of well sorted medium grained sand. More varied fine to coarse sediments are found in the Hamlet and along the west side of the Coppermine River. Sand is quarried at a pit located near the west end of the runway. Another area used for extraction of sandy construction material is located near the east end of the runway.

3.3.4 Local Geological Resources for Construction

As discussed elsewhere in this report, the evaluation of the sewage lagoon and solid waste facility included examining local sand pits and rock quarries. In addition, test pitting was conducted in the area of the facilities, as shown on Figure 5. Test pit logs are included in Appendix G. The results of the geotechnical analysis of selected soil samples are included in Appendix D.

The results of the test pitting and soil testing program indicates that there is approximately 1.0 m of surficial medium grained, well sorted sand overburden, that could be excavated to supply construction material in the immediate vicinity of the facilities. Very little coarse grained material or fine clay rich material was located locally. Local contractors indicate coarse aggregate is available from off shore islands, and must be trucked to the community during the winter from the Seven Mile Island quarry.

Approximately 10,000 m^3 of unsorted blast rock is stockpiled in the Gabro Quarry, approximately 300 m west of the Bulky Metals area, as shown on Figure 3. Appendix B shows details of the quarry (see Photos 6 and 7). The quarry face is in good condition, and there is a huge remaining resource of rock, which could be blasted for production of coarse aggregate or rubble materials.

The well sorted medium sand overburden could be easily pushed into piles on berms using a bulldozer.

Angles of repose of 3:1 to 4:1 slopes should be achievable in this area, providing they were not to be traveled over. Berms created of this material should prove stable with shallow slopes. Berms could be armoured with blast rock to protect the sand from erosion.

An area at the east end the airport reportedly contains finer grained sand with some silt and clay. This resource could be used if finer materials were needed for the interior face of a sewage lagoon.

In summary, there appears to be sufficient geotechnical resources in the immediate proximity of the sewage lagoon and solid waste disposal facility, to meet expected construction needs providing the detailed design takes into account the nature of the local materials.

4.0 Field Program

Nuna Burnside project staff conducted a field program from October 2 through October 6, 2005. Government of Nunavut staff including Navjit Sidhu, Project Officer, and Tom Livingston, Regional Engineer, were present for most of this period.

The field program included the following components:

- Meetings and liaison with Hamlet public works staff
- Recording details of infrastructure and current operational procedures
- Excavation of test pits at various locations
- Mapping soil, rock, surface water flow, and geotechnical resources
- Collection of surface water, groundwater, and soil samples
- GPS surveying of features.

Soil and water samples were shipped to Envirotest Laboratories for analysis. Soil samples for geotechnical testing were shipped to Alston Associates Inc.

5.0 Sewage Lagoon

5.1 Existing Conditions

The existing sewage lagoon is located approximately 4 km west southwest of the community as shown on Figure 2. It is accessed from the community by Coronation Drive, and is located out of sight of the community in close proximity to the solid waste disposal facility, contaminated soil stockpile, and waste oil and hazardous materials storage area (Figure 5).

The sewage is collected from holding tanks within all houses and occupied buildings in the Hamlet by a tanker truck. The truck and a crew of two Hamlet staff collect the sewage from the holding tanks via external discharge ports on an exterior wall of each building. The truck does rounds daily and discharges the sewage into the sewage lagoon. Photos 1 through 5 in Appendix B show the operation and layout of the lagoon. Figures 5 and 6 display details of the lagoon and the surrounding area.

The tanker truck discharges the sewage into one of two sawn in half culverts used as spillway. The spillway prevents bank erosion during discharge.

The sewage is temporarily contained within the lagoon, and discharges via a small intermittent stream along a natural meandering course over 1.5 km to Coronation Gulf as shown on Figure 6. This stream traverses through a naturally occurring wetland, which is currently providing a significant degree of treatment for the effluent discharged from the lagoon. The lagoon is currently providing a high degree of solids retention.

The existing unlined lagoon was constructed in 2003 by Hamlet staff during a heavy equipment operator training course. The lagoon area is approximately 60 m x 40 m with a depth of 2 m, as shown on Figure 10. Estimated interior area is 2,324 m^2 and with a depth of 2.0 m, the volume is estimated to be 4,648 m^3. Due to the permeability of the northeast berm, sewage exfiltrates rapidly from the lagoon during the summer, so water levels in the lagoon are not significantly above the natural surface water level in the drainage stream. Due to the rapid exfiltration the majority of the lagoon volume is unusable.

The sewage lagoon operates under Water License NWB3KUGO308 issued on November 20, 2003. The license expires November 30, 2008. A copy of the license is included in Appendix F. The license includes requirements for regular sampling and reporting. The license also provides sewage quality criteria for the point of discharge.

5.2 Current Sewage Lagoon Concerns

The RFP outlined a number of concerns regarding the sewage lagoon including:

- Lagoon is too small to provide adequate retention of sewage volume
- Sewage volume from the community exceeds lagoon volume
- During the spring thaw the berms over breach and discharge sewage
- During the summer the berm, constructed partially of rock, is too porous and allows rapid flow through and minimal retention
- Discharge is haphazard
- The lagoon does not meet current Nunavut regulations and is not operating in compliance with the Water Board license
- The discharge route crosses a major snowmobile and ATV trail used extensively all year round
- There is no regular sampling or discharge-monitoring program.

The scope of work to address these issues was outlined in the Nuna Burnside proposal dated September 2005.

5.3 Lagoon Requirements in Nunavut

The requirements for the design and operation of lagoons in Nunavut can be found in the following documents:

- G. W. Heinke, D. W. Smith and R. Gerard *Guidelines for Disposal of Wastewater in Coastal communities of the NWT* (1990)

- Nunavut Water Board *Guidelines for the Discharge of Treated Municipal Waste Water in the NWT* (1992)

- *Cold Regions Monograph*, 3rd Ed. (1992)

- G.W. Heinke, D. W. Smith and R. Finch *Guidelines for the Planning, Design and Operation and Maintenance of Wastewater Lagoon Systems in the NWT* (1988).

It should be noted that, although these documents were developed prior to the division of Nunavut from the North West Territories (NWT), they have been generally accepted by the regulatory agencies in Nunavut.

5.4 Previous Work

5.4.1 INAC Inspection Reports

Available INAC Water Use Inspection Reports were obtained and reviewed. Reports for the following dates were available:

- October 29, 1996
- December 1, 1998

- December 1, 2002
- August 26, 2002
- August 3, 2003
- July 19, 2004.

The results were consistent with the recent sampling conducted by Nuna Burnside. Current and historic sampling results compared to the discharge criteria in the Water Board license and the anticipated future Nunavut discharge criteria is displayed in Table 5.

5.4.2 Studies

In 2003 the GN retained FSC Architects & Engineers to conduct a planning study and schematic design for the Kugluktuk sewage treatment facility. The work was documented in a report dated March 8, 2004. The report evaluated the existing facility and proposed a sewage lagoon with two cells joined by a common wall. The first cell (56,800 m^3) would have eight months of storage, including sludge storage, and the second cell (28,400 m^3) would have 4 months storage. The effluent would exfiltrate from the 4 month cell into the wetland draining towards Coronation Gulf.

The report provided nutrient loading calculations and evaluated impacts using Alberta Environmental wetland predictive modeling. A brief evaluation of potential aggregate resources and potential unit costs was conducted with the assistance of a local contractor. The Class C cost estimate to build a new sewage lagoon was $8,870,000.

5.5 Field Assessment

Nuna Burnside staff examined the sewage lagoon and the discharge path through the wetland to Coronation Gulf.

Site details were tied in using a GPS survey as shown on Figures 5 and 6. Surface water samples were collected at four locations along the discharge path.

Samples were submitted to Envirotest Laboratories and analyzed for:

- Biochemical oxygen demand (BOD)
- Chlorine
- Fecal coliform
- Trace metals
- Major metals
- Ammonia
- Oil and grease
- Phenols
- Total suspended solids (TSS).

Laboratory Certificates of Analysis are included in Appendix C-1. A summary of the results with historic data and guideline criteria is displayed on Table 5.

As part of the evaluation of the area and in anticipation of the potential need to construct a new lagoon or rehabilitate the existing lagoon, a test pitting program was conducted in the area most likely to be used for an expanded facility. Test pit locations are displayed on Figure 5, and test pit logs are included in Appendix G.

Photographs of the area are included in Appendix B.

The overburden in the area around the sewage lagoon was thawed to approximately 0.9 m below surface in October 2005. Permafrost limited excavation to greater depths. Groundwater was observed seeping into the test pits at between 0.4 m and 0.7 m below surface. The overburden was predominately medium grained well sorted sand derived from the series of raised beaches in the area (Figure 4). Coarse aggregate was noted in a limited area near the contaminated soil stockpile.

At the time of the site visit sludge in the lagoon was roughly estimated at approximately 0.2 m. The northeast facing berm constructed primarily of blasted rock from the rock quarry was allowing sewage to escape as rapidly as it was being discharged from the truck into the lagoon. The lagoon is unlined and no significant retention time is being achieved.

The existing lagoon is currently providing limited solids retention and simply allowing the raw sewage to escape into the wetland. It does not meet Nunavut regulations for the operation of a sewage lagoon and wetland treatment system.

The discharge path from the lagoon to Coronation Gulf was walked and examined. At the time of the inspection sewage impacts could be detected (visually and by odours) to approximately half the distance. The noticeably greener vegetation around the stream banks indicated the wetland was reacting positively to the nutrients in the sewage.

The effluent quality standards from Part D of the Water Board license (Appendix F) for all effluent discharged from Sewage Disposal Facilities along with the October 2005 sampling results are displayed on the following table.

Parameter	Units	NWB License Limits	WS-1	WS-2	WS-3	WS-4
BOD	mg/l	120	276	68	81	8
TSS	mg/l	180	95	14	34	7
PH		6 – 9	7.4	7.4	7.5	7.5
Fecal coliform	CFU/100 ml	1,000,000	13,000,000	1,900,000	1,500,000	4,000

The sampling results show the lagoon and wetland treatment area is treating the sewage discharge, however the raw sewage discharge (WS-1) is well above the criteria for BOD and fecal coliform. With the exception of fecal coliform levels, the discharge from the lagoon near the top of the wetland treatment area (WS-2) meets Water Board discharge criteria. Fecal coliform levels do not meet the criteria until some point between WS-3 and WS-4. As shown on Figure 6, this is still well before the discharge into the ocean.

5.6 Sewage Generation Rates

In trucked service communities, it can generally be assumed that the wastewater generated is equivalent to water consumption. Accordingly, the daily and annual wastewater generation rates for the Hamlet of Kugluktuk will be assumed to be equal to water consumption rates.

The Government of the Northwest Territories Department of Municipal and Community Affairs (MACA) has developed a standard for water consumption in communities of less than 2000 residents on trucked services. This consumption rate can be estimated with the following formula:

Water Use (l/person/day) = 100 l/person/day x (1.0 + 0.00023 x population).

Where the factor 0.00023 x population represents the commercial and industrial water use. The rate of 100 l/person/day is used to reflect increasing water usage due to changing life styles in recent years.

Based on this formula, the projected annual volume of sewage generated at the end of 10 years (2016) is 101,578 m^3, while the 20-year (2026) annual volume is 126,113 m^3. Table 3 displays the sewage generation rate for the Hamlet of Kugluktuk.

In order to determine an effective design for the treatment of the sewage, the amount of sludge and concentrations of parameters of regulatory and design concerns are calculated. The following table outlines the assumptions used in the calculations.

Assumptions for the Calculation of Effluent
Concentrations of BOD, TSS, T-PO4, TKN and Fecal Coliforms

Sludge Generation Rate	50 grams/person/day
BOD Generation rate	45 grams/ person/day
TSS Generation rate	48 grams/ person/day
Total PO_4 Generation Rate	2.3 grams/ person/day
TKN Generation Rate	12 grams/ person/day
Fecal Coliform Generation Rate	9.50×10^{10} CFU/100 ml/ person/day

Based on these assumptions, the daily and annual sewage generation throughout the 20-year planning horizon, as well as the projected annual and cumulative sludge volumes and the projected concentrations of Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), Total phosphate ($T\text{-}PO_4$), Total Kjeldahl Nitrogen (TKN) and fecal coliforms in the lagoon effluent can be calculated, as shown on Table 3.

5.7 Lagoon Storage Volumes Required

A lagoon with sufficient capacity to retain the estimated annual sewage volume for year 20 in the future is required.

Although retained volume will need to meet the requirements of the Hamlet for the period October through May, and the lagoon will be discharging to the wetland treatment area during the active biological season of June through September, the lagoon volume will be based on holding the summer sewage over the winter for treatment.

In addition to the volume of wastewater, which is deposited into the lagoon by the Hamlet, the volume of precipitation, and rates of evaporation, must also be considered. It may be assumed that water evaporates from a sewage lagoon at the same rate as from a lake. It is also assumed that sublimation rates are not a significant factor. Additionally, runoff will not be considered in this analysis, as the lagoon berms will be above grade and no surface water runoff should enter the lagoons.

The annual evaporation rate for the Hamlet of Kugluktuk is estimated at approximately 200 mm/year. Climate normal data from the Environment Canada website was obtained, indicating that the average annual precipitation for the Hamlet of Kugluktuk is 249 mm/year (see Appendix A). This net addition of approximately 49 mm/year of precipitation over the surface of the lagoon will contribute to the total volume requirement. For example if an approximate 200 m x 200 m lagoon is used, the surface area would be 40,000 m^2 and the net addition of volume from precipitation would be 1,960 m^3/year. This volume must be accounted for in the lagoon design.

The volume of accumulated sludge must also be considered. Calculations are presented in Table 3. The projected accumulated sludge volume in 2026, is approximately 740 m^3.

The total required annual lagoon volume in year 20, including net precipitation and 20 years of sludge accumulation, is:

- Volume of sewage in year 20 (12 months retention) 126,113 m^3
- Volume of accumulated sludge by year 20 740 m^3
- Volume of precipitation falling into lagoon annually 1,960 m^3
- **Total Volume** **128,813 m^3**

The dimensions of the sewage lagoon may be calculated using the following formula for a prismoid of a given volume:

$V = (d/6) \times (A_t + A_b + 4\ A_m)$

Where:

$A_t = L \times W$
$A_b = (L - 2 \times ES \times d)\ (W - 2 \times SS \times d)$
$A_m = (L - ES \times d)(W - SS \times d)$

Definitions:

V = Volume
D = Depth of the lagoon
A_t = Area of the top of the lagoon
A_b = Area of the bottom of the lagoon
A_m = Area of the midsection of the lagoon
SS = Slope of the sides of the lagoon
ES = Slope of the ends of the lagoon
L = Length of the top of the lagoon
W = Width of the top of the lagoon

Table 4 displays the required lagoon dimensions based on the following assumptions:

- Total required usable volume – 128,813 m^3 (12 months capacity in year 20 accounting for cumulative sludge and precipitation)
- Required free board allowance – 1.0 m
- Average excavation below existing ground surface – 1.0 m
- Berm height above existing ground surface – 3.0 m
- Total depth – 4.0 m
- Width of berm top – 2.0 m.

Figure 10 displays a schematic layout of a lagoon with these dimensions.

5.8 Sewage Treatment System Design Options

The potential options for the treatment and disposal of sewage for the Hamlet of Kugluktuk for a 20 year planning horizon were reviewed. These included:

Do Nothing

Not a viable option, site does not meet the requirements of the Water Board license, and would not be in compliance with Nunavut regulations.

Move the Lagoon

The cost to decommission the existing facility, locate a new site, and construct a new lagoon and wetland treatment area should only be considered if the existing site is found to be unsuitable.

Upgrade the Existing Lagoon

The current sewage lagoon location has been approved by the Hamlet and licensed by the Water Board. This would be the most cost effective option, provided a new sewage lagoon and wetland treatment area can be constructed to meet the requirements of the 20 year planning horizon.

The option to upgrade the sewage lagoon at the current location will be evaluated initially. The other options will be revisited at the end of this section, after evaluating the suitability of constructing a new lagoon with an engineered wetland treatment system at the existing site.

Due to the geographic and climatic constraints facing the Hamlet of Kugluktuk, there are a limited number of options for the treatment and disposal of sewage. Fortunately there are a number of favourable factors that allow for the construction and operation of a simple yet effective system at the existing location, these are:

- The existing location is out of sight of the community in an area set aside by the Hamlet for sewage and solid waste handling
- The closest sensitive receptor is the ocean
- There is approximately 10 ha of a wetland treatment system that is currently providing some treatment to the sewage discharged from a lagoon that offers almost no retention time
- There is sufficient area available for the construction a larger lagoon
- There is additional area available which could be used to develop additional wetland treatment areas when required
- Local soil and a nearby rock quarry can provide building materials
- The existing lagoon has a Water Board license.

The proposed lagoon would be designed to accommodate the estimated 20 year annual sewage volume. The lagoon would discharge to an engineered wetland during the biologically active season (June through September).

A brief review of the projected sewage volumes 40 years into the future (Table 3), and the location of the existing lagoon site (Figures 5 and 6), indicates there is sufficient area to establish additional lagoons if needed in the far future. Regulatory requirements and technological advances may make the current lagoon and wetland treatment system no longer suitable, however for the sake of very long term planning, the site area is capable of hosting additional lagoon capacity beyond the current 20 year planning horizon.

If required, small dams to increase down stream retention times, and encourage braided and meandering flow paths, could be constructed in the future to enhance the effectiveness of the wetland treatment system. In addition, there are other wetland drainage systems in the area, which could be utilized as wetland treatment areas.

The lagoon could be constructed cost effectively using primarily onsite and locally available materials.

5.9 Predicted Effluent Quality

A sewage lagoon for the Hamlet of Kugluktuk will need to be teamed with an appropriately sized wetland treatment area to achieve the final discharge quality dictated by the Water Board license and current Nunavut discharge criteria. Consideration has also been given to potential changes to the discharge criteria over the next few years.

5.9.1 Effluent Quality Prior to Wetland Treatment

The quality of the sewage lagoon effluent is based on the assumption that if a lagoon of sufficient size to retain 12 months of sewage is constructed, it will provide retention time to allow solids settlement and some pre-treatment. The volume of effluent discharge in year 20 is estimated as:

- Volume of sewage in year 20 (12 months retention) 126,113 m^3
- Volume of precipitation falling into lagoon annually 1,960 m^3

Total Year 20 Volume **128,078 m^3**

The predicted sewage chemistry in each year is displayed on Table 3.

5.9.1.1 Year (2006) Sewage Lagoon Effluent Quality

It is expected that initially wastewater levels in the lagoon will be relatively shallow and the retention period will exceed 12 months. Both of these conditions are conducive to relatively high lagoon treatment efficiency. Treatment efficiencies for carbon-based parameters should, conservatively, exceed 70 percent removal. Therefore, effluent quality prior to wetland treatment is expected to be as shown on the following table:

Estimated Effluent Quality Prior to Wetland Treatment,
Assuming a 70 Percent Lagoon Carbon-Removal Efficiency (2006)

Regulatory Parameter	Raw Sewage October 2005	Raw Sewage 2006 (Predicted)	Expected Lagoon Effluent Quality Prior to Wetland Treatment with 70% Carbon Removal
BOD mg/l	276	329.8	< 99
TSS mg/l	95	351.8	< 106
T-PO_4 mg/l	0.25*	16.9	< 5
TKN mg/l	94	87.9	< 26
Fecal Coliforms CFU/100 ml	1.3E07	6.96E07	< 2.3 E07

*July 2004 sampling by FSC.

As displayed on the above table, the actual effluent quality from the October 2005 sampling displays significantly lower concentrations of the parameters regulated under the water license then the predicted concentrations. The current sampling results are consistent with the historic results displayed on Table 5. This indicates the predicted values are very conservative.

5.9.1.2 Year 20 Sewage Lagoon Effluent Quality

As the wastewater volume increases, so will lagoon depth and the volume of sludge accumulation within the lagoon. Treatment efficiencies will be correspondingly reduced. Conservatively, the rates of removal for carbon based parameters would be reduced to as low as 25 percent in year 20 when the lagoon is holding near maximum capacity. Under these conditions, effluent quality prior to wetland treatment is expected to be as shown on the following table:

Estimated Effluent Quality Prior to Wetland Treatment,
Assuming a 25 Percent Lagoon Carbon-Removal Efficiency (2026)

Regulatory Parameter	Raw Sewage 2026 (Predicted)	Expected Lagoon Effluent Quality Prior to Wetland Treatment with 25 Percent Carbon Removal
BOD mg/l	295.6	< 222
TSS mg/l	315.4	< 237
T-PO_4 mg/l	15.1	< 11
TKN mg/l	78.8	< 59

Regulatory Parameter	Raw Sewage 2026 (Predicted)	Expected Lagoon Effluent Quality Prior to Wetland Treatment with 25 Percent Carbon Removal
Fecal Coliforms CFU/100 ml	6.2E07	< E07

As discussed in the previous section, based on historical sampling it is likely that the actual effluent concentrations will be lower then these predicted values, however the predicted concentrations will be used in the calculations for determining the size of the wetland treatment area.

5.9.2 Effluent Quality After Wetland Treatment

Currently the Water Board license for the sewage lagoon does not include a description of a Wetland Treatment Area, it only specifies effluent discharge quality requirements.

Upgrading the lagoon to be in compliance with current Water Board requirements (and anticipated future regulatory requirements), and development of a Wetland Treatment Area is necessary. Recent investigations and sampling have shown that there is a continuous improvement in water quality along the discharge flow path. A Wetland Treatment Area has already developed naturally downstream of the lagoon discharge. Development of additional wetland treatment area should be achievable by controlling the flow path of the discharge.

5.9.2.1 Current Conditions

The current effectiveness of the wetland treatment area is illustrated by the results of the sampling conducted on October 4, 2005 (Appendix C-1). The results for the raw sewage (WS-1), the downgradient surface water in the wetland treatment area (WS-4), and the anticipated regulatory guideline levels are displayed on the following table.

October 4, 2005 Effluent Results Compared to Anticipated Guidelines

Regulatory Parameter	Anticipated Nunavut Water Board Guidelines	WS-1 (Raw Sewage)	WS-4 (Wetland Treatment Area)
BOD (mg/l)	45	276	8
TSS (mg/l)	45	95	7
T-P04 (mg/l)	1.0	0.24 (July 2004 sampling by FSC)	NA
TKN mg/l	10	94	12.4
Faecal	2,000	13,000,000	4,000

Regulatory Parameter	Anticipated Nunavut Water Board Guidelines	WS-1 (Raw Sewage)	WS-4 (Wetland Treatment Area)
Coliforms (CFU/100 ml)			
pH	6.5-9	7.40	7.5

The results indicate that the wetland treatment area is currently providing treatment of raw discharged sewage with almost no retention time. A significant improvement in the effluent entering the wetland treatment area would be experienced if a new lagoon is constructed to provide 12 months of retention time.

5.9.2.2 Effluent Treatment Via Input

Positioning the new lagoon infiltration as shown on Figure 6, and directing the discharge into the small seasonal ponds which drain into the existing wetland treatment area, would add an additional 5 ha to the wetland treatment area.

The ponding will be enhanced with small berms and ditching to maximize the surface area of the ponds and maximize the length of the flow path. The ponds will be shallow (less than 0.3 m deep) and provide secondary retention of the effluent discharged from the lagoon. The ponding is expected to provide a degree of treatment in two ways:

- Microbial decomposition of sewage in a similar fashion as in the lagoon and in a similar fashion as in the wetland treatment area
- Infiltration of the effluent into the underlying sand overburden and migration through the subsurface.

The area around the sewage lagoon is comprised of well-sorted medium sand from raised beaches. Test pitting in the area revealed groundwater perched on top of the permafrost. (See test pit logs in Appendix G.) Groundwater was intersected between 0.4 m and 0.9 m below surface. Permafrost was intersected approximately 0.9 m below surface.

Ponding observed in the imagery collected on July 1, (Figure 6) had seeped into the ground during the summer. No stressed vegetation was observed suggesting the ponds are of short duration. It is expected that the engineered ponds and wetlands proposed as shown in Figure 6 will encourage infiltration of the standing effluent into the underlying sand. Geotechnical data is included in Appendix D. To determine the approximate hydraulic conductivity of the sand the Hazen d_{10} method is used:

$K = Ad_{10}^2$

The D_{10} value is taken from the grain size gradation curve as determined by sieve analysis. For K in cm/sec and D_{10} in mm, the coefficient A is equal to 1.0. In this case d_{10} for various test pit samples are:

- Test Pit 3 – 0.10
- Test Pit 4 – 0.25
- Test Pit 5 – 0.20
- Test Pit 7 – 0.22

  Average 0.19

The hydraulic conductivity is estimated as 0.036 cm/sec.

This is a very high hydraulic conductivity based on saturated conditions.

It would be expected that a significant portion of the effluent would infiltrate into the subsurface especially in the 6 ha area of the retention ponds. Subsurface flow would occur in the 0.9 m thick active zone and would include dilution into the perched groundwater above the permafrost. The infiltrated effluent will be partially diluted by the groundwater and migrate in a down gradient direction following the topography. It is expected that the base of the active layer through which groundwater flow would occur would mirror surface topography and direct groundwater along a similar path as the surface water drainage system. Horizontal groundwater flow velocity can be calculated as follows:

$$V = \frac{ki}{n}$$

where:

V = average linear velocity
K = hydraulic conductivity
I = hydraulic gradient (change in head over distance)
n = effective porosity (estimated at 0.30)

"i" can be estimated to be similar to topographic gradient as shown in Figure 6. This is the approximate 25 m fall from the lagoon to the ocean, a distance of approximately 1,800 m. Therefore "i" is estimated at 0.014.

$$V = \frac{0.036\ (0.014)}{0.3}$$

V = 0.00168 cm/sec
V = 520 m/year

Although this is a high groundwater velocity, it is slow compared to surface water flow. In Kugluktuk flow would only occur in the active layer for those months of the year (June through September) when the active layer is thawed. The actual flow rate would more likely be approximately 177 m/4 month active season.

Infiltration and migration through the sand provides a long resident time in the subsurface, which will allow natural attenuation processes to treat the effluent even at the low groundwater temperatures in the active layer. There was observed groundwater seepage into the wetland treatment area in October 2005 suggesting groundwater discharge was contributing to the base flow in the stream.

By encouraging effluent infiltration into the subsurface in the area of the prepared wetland treatment ponds, the amount of surface discharge to the wetland area will be reduced. The resulting effect is to create a 5 ha septic bed.

Without site specific studies, it is difficult to determine what amount of the effluent discharge that will infiltrate into the sand from the 5 ha area of the ponds and subsequently move via the groundwater flow path, however a rough prediction can be calculated.

The sandy soil has an estimated hydraulic conductivity (E) of approximately 3.6×10^{-2} cm/sec.

This would correspond to a Percolation Time (T) of 4 – 12 mins/cm. For a leaching bed or absorption trench type septic system load rates of approximately 10 L/m^2/day would be typical. In this case the 5 ha of shallow ponds at the top of the wetland treatment area could potentially allow significant effluent infiltration as follows:

Area (50,000 m^2) x 10 l/day = 500,000 l/day (500 m^3/day).

Through the active season (June to September) of 120 days, infiltration of approximately 60,000 l of effluent could occour. This would move via a subsurface flow path in the sand, and eventually discharge to surface further down the drainage basin,. The process of migrating through the sand will provide a relatively long residence time and allow for effluent treatment by natural attentuative processes.

There was very little literature readily available for review, evaluating the effectiveness of effluent infiltration and treatment through sandy soils in the active layer in Nunavut. This process does have significant potential, and it is recommended that it be monitored for scientific purposes should this type of lagoon and sewage treatment system be constructed at Kugluktuk. At this point in the schematic design, Nuna Burnside proposes that the potential for infiltration of effluent be recognized and monitored, so wetland treatment area requirements are minimized and only developed as needed. The sand

raised beads appear to offer a unique opportunity to treat a significant portion of the sewage lagoon effluent.

5.9.2.3 Wetland Treatment Area Requirements

In order to determine the Wetland Treatment Area that will be needed to effectively treat the effluent from new sewage lagoon, which will provide some retention time and pretreatment, a predictive model developed by the Alberta Department of the Environment (ADE) is used.

The ADE model can be used to determine the wetland area needed to treat a given hydraulic load (design flow) and effluent chemistry, based on achieving specified regulatory guidelines. The ADE model was originally designed for more moderate climates, so a temperature correction factor is applied to the model for a lower average temperature during the period of active discharge. As shown in Appendix A, the average temperature in Kugluktuk for the period June through September is 6.9 ºC. To be conservative 5ºC is used in the ADE model.

A description of the model with assumptions and calculations is included in Appendix E.

A comparison of the results, anticipated guideline criteria, and expected effluent quality is displayed on the following table.

Estimated Wetland Treatment Area Required Based on Effluent Quality at Final Discharge Point Compared to Anticipated Nunavut Water Board Guidelines

Regulatory Parameter	Predicted Lagoon Effluent (2026)	Anticipated Nunavut Water Board Guidelines	Minimum Wetland Area Required to Meet Anticipated Nunavut Water Board Guidelines
BOD mg/l	295.6	45	9.24 ha
TSS mg/l	315.4	45	0.38 ha
T-PO_4 mg/l	15.1	1	31.74 ha
TKN mg/l	78.8	10	13.90 ha
Fecal Coliform CFU/100 ml	6.24E+07	2,000	26.42 ha

The results of the ADE wetland predictive model indicate, that to meet anticipated Water Board guidelines approximately 32 ha of wetland treatment area is required. The existing wetland area (Figure 6) is approximately 10 ha.

5.9.2.4 Additional Wetland Treatment Areas

As shown as Table 5, historic sampling results show sewage effluent concentrations for regulated parameters are significantly less than the predicted effluent quality shown in Table 3 especially for T-PO_4. This suggests that the predicted values in Year 20 are too conservative and hence the required wetland treatment area calculated using the ADE model is very much larger than will be actually needed.

To address this issue we recommend the following strategy:

- Enhance the development of the existing wetland treatment area and proposed additional 5 ha of pond area
- Monitor raw effluent and wetland treatment system final discharge quality as per the requirements of the water license
- Based on the findings of the actual sample results from the new lagoon and wetland treatment system predict the need for additional wetland treatment area and develop the additional area prior to it's being required.
- It is not considered prudent to develop the currently predicted requirement of 32 ha of treatment area based on the application of the ADE model for T-PO_4 because current actual results are significantly less than predicted
- There is currently insufficient effluent discharge to allow for the full 32 ha wetland treatment system to be developed at this time.

As shown on Figure 6 there are several other similar sized natural drainage systems that could be utilized for a wetland treatment area. In addition the low lying areas between the raised beach ridges could be used. This is a large land area that could be utilized to meet the needs of additional wetland treatment area. Hamlet staff has indicated they have no plans for this area and it is acceptable that the areas be set aside for a future wetland treatment area should it be required.

At this point we do not recommend constructing the ditching required to utilize these additional lands. They should be developed only when needed. Costs to create ditches in the raised beach sand are expected to be low and will not require sophisticated engineering.

When needed, a drainage pathway could be established in the low-lying seasonally ponded area between one of the raised beach ridges to direct effluent approximately 700 m to the northwest, into an area with several meandering drainage systems. The drainage systems could be developed into wetland treatment area, to provide the additional area needed to treat the discharge to the anticipated Nunavut Water Board guidelines.

5.10 Wastewater Treatment System Schematic Design Review

As part of the Schematic Design Phase, the following components of the current, and potential, sewage lagoon infrastructure were examined:

- General site layout, including the main entrance location, site access roads, wetland treatment areas
- Surface water management systems including ditching and sedimentation ponds
- Site signage and security fencing
- Current effluent discharge chemistry.

5.10.1 Overview of Options Available

The options available to the Hamlet of Kugluktuk regarding their wastewater treatment operations are as follows:

- Null Option: *Status Quo* is maintained

- Current Facility storage capacity upgraded (berm installation to increase storage capacity, modifications to surface drainage and natural wetland treatment area, and revisions to site O&M procedures), and operations continued in the current Wastewater Treatment Facility location

- Sewage lagoon re-located to an alternate location and the current lagoon site abandoned and remediated.

5.10.2 Option Analysis

5.10.2.1 Null Option

This option is not acceptable from several perspectives. There are significant storage capacity and operational issues at the site, which need to be addressed:

- Storage capacity of the current lagoon in insufficient for the projected sewage volume generational rates during the 20-year planning horizon

- Operational issues related to the timing of lagoon effluent onto the naturally-occurring wetland treatment area, resulting in a potentially decreased rate of assimilation of BOD, TSS, ammonia and phosphates in the effluent, with their corresponding potential deposition into water, in violation of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act and potentially in violation of Section 36 (3) of the Fisheries Act*

- The lagoon is not operating in compliance with the Water Board license (Appendix F).

5.10.2.2 Upgrading of the Current Sewage Lagoon, with Updated Operational and Maintenance Procedures

The option is technically feasible, and deliverable within the timeframe specified in the Request for Proposal documents. The following steps will be required to address the environmental and operations and maintenance issues currently evidenced at the sewage lagoon:

- The development of additional sewage lagoon storage capacity for the projected annual sewage volume during the 20-year planning horizon
- Development of additional wetland treatment area
- Identification of the final effluent discharge point for sampling
- The implementation of a Monitoring Program, to comply with the terms and conditions of NWB3KUG0308
- The provision of proper site signage identifying the sewage lagoon, wetland treatment area boundaries, and the Final Discharge Point of the Facility
- The development of operational and maintenance procedures related to the rate and timing of the release of lagoon effluent onto the naturally-occurring wetland treatment area, resulting in an optimization of rates of assimilation of BOD, TSS, ammonia and phosphates in the effluent by the treatment wetland, so as to prevent the un-controlled release of deleterious substances into water in violation of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act and Section 36(3) of the Fisheries Act*
- Anticipate the development of additional wetland treatment areas based on the monitoring results and extrapolation of actual results to make future predictions
- Monitor the effectiveness of effluent treatment through infiltration.

5.10.2.3 Sewage Lagoon Relocation

The option is technically feasible, and deliverable within the timeframe specified in the Request for Proposal documents. The following steps will be required:

- The development of sufficient sewage lagoon storage capacity for the projected sewage volume generational rates during the 20-year planning horizon
- The implementation of a Monitoring Program, to comply with the terms and conditions of NWB3KUG0308

- The provision of proper site signage identifying the sewage lagoon, wetland treatment area boundaries, and the Final Discharge Point of the Facility

- The development of operational and maintenance procedures related to the rate and timing the release of lagoon effluent onto an appropriate naturally-occurring wetland treatment area, resulting in an optimization of rates of assimilation of BOD, TSS, ammonia and phosphates in the effluent by the treatment wetland, so as to prevent the un-controlled release of deleterious substances into water in violation of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act and Section 36(3) of the Fisheries Act*.

5.11 Recommended Option

Based on assessment of the existing sewage lagoon and wetland treatment area carried out by Nuna Burnside personnel on October 2-6, 2005, no compelling reasons currently exist that would warrant the relocation of the sewage lagoon to an alternate location. Sufficient setbacks from adjacent properties, areas of current recreational and traditional use, watercourses and surface water bodies presently exist. Additionally, a sufficient area of well-developed, acclimated wetland below the sewage lagoon is currently providing some secondary treatment (BOD, TSS, ammonia, phosphate and fecal coliform reduction) for the currently generated sewage volume. Additional wetland area has been identified to meet the total wetland requirements for the 20-year planning horizon.

The existing site area is suitable for the following reasons:

- The existing sewage lagoon is out of sight of the community, and in an area set aside for community infrastructure such as the Solid Waste Disposal Facility

- There are sufficient material resources on site and locally to construct a lagoon of sufficient size

- There is sufficient area should another lagoon be needed to meet the 40 year planning needs, and additional near by wetland drainage system for effluent treatment.

In the absence of any compelling reason to move the sewage lagoon it is recommended that a new lagoon be constructed adjacent to the existing lagoon.

5.11.1 Class C Cost Estimate

The dimensions and berm requirements for a new sewage lagoon adjacent to the existing lagoon was calculated. A schematic layout is displayed on Figure 10. The exact location, orientation, and shape will be part of the detailed design.

Class C costing will include constructing the lagoon, as shown on Figure 10, with the following details:

- Minor roadwork will be needed to reach the discharge point on the new lagoon
- The 3:1 interior side slopes will be covered with a 40 mil HDPE Arctic liner keyed into the permafrost at the base and draped over the top of the berm
- The purpose of the liner is to prevent exfiltration through the sand berms at least until permafrost has re-aggraded into the berms
- The liner will be held in place on the top of the berm by blast rock
- Blast rock will be used to armour the outside face of the berm
- The existing lagoon will remain in place until the new lagoon is built
- Approximately 1,000 linear metres of ditching will be constructed around the lagoon to divert surface water
- No fencing will be required
- No material fees for on site soil and locally obtained rock
- Excavation of 1.0 m if overburden from the bottom interior footprint of 39,601 m^2 will provide 39,601 m^3 of material for berm construction
- Approximately 900 linear metres of berm will be constructed
- Berm construction will require approximately 28,544 m^3 of material
- Excess material (approximately 11,057 m^3) could be used for landfill cover, road base or graded into the natural landscape
- Blast rock to hold the liner in place and armour the outside slope face of the berms will be placed 0.2 m deep.

Costs for the construction of the new lagoon are based on machine and material costs provided by local contractors. Machine time of $250/hr. is based on mobilizingD-6 bulldozer and excavator and using other equipment currently available in the community. A cost of $250/hr. is assumed for a team of two tandem dump trucks to move material locally.

• Mobilize/demobilize equipment and over winter standby	$ 250,000.
• Strip topsoil – 200 machine hours @ $250/hr	$ 50,000.
• Berm forming – 900 machine hrs. @ $250/hr.	$ 225,000.
• Drainage ditch construction – 200 machine hrs. @ $250/hr.	$ 50,000.
• Discharge culverts (supply and install)	$ 20,000.
• Discharge outlet piping and valving	$ 20,000.
• 40 mil HDPE Artic liner – 12,000 m^2 @ $40/m (installed)	$ 480,000.
• Liner shipping	$ 10,000.
• Rock placement (to hold liner and armour outside of berm) – 200 machine hrs. @ $250/hr.	$ 50,000.
• Excavation and transportation of rock – 100 machine hrs. @ $250/hr.	$ 25,000.
• Access road and turnaround -100 machine hrs. @ $250/hr.	$ 25,000.

• Amending contours and wetland treatment area modifications – 100 machine hrs. @ $250/hr.	$ 25,000.
• Signage, bollards and protective railing at discharge	$ 10,000.
Subtotal	**$1,240,000.**
Contingency (approximately 15 percent)	$ 190,000.
Total	**$1,426,000.**

The following costs were evaluated, but in our opinion at the schematic design stage it is not anticipated that these costs will be incurred:

- If the entire lagoon was lined, the liner costs would increase significantly. At this point it is not anticipated it will be required. The costs for a 40 mil HDPE liner for the entire lagoon would be 60,000 m^2 @ $40/m (installed) = $2,400,000.

- If ditching to the proposed future wetland treatment area is required at this time the cost for an estimated at 1,200 linear metres of ditching and contouring of the raised beach ridges is estimated at $50,000.

6.0 Solid Waste Disposal Facility

6.1 Existing Conditions

The Hamlet of Kugluktuk Solid Waste Disposal Facility consists of two components:

- The Bulky Materials Disposal Area
- Municipal Solid Waste Disposal Area (landfill).

The facility has been in use for approximately 15 years, and currently operates under Water Board License NWB3KUGO308 issued November 20, 2003. The license expires November 30, 2008. A copy is included in Appendix F.

The license contains a number of terms and conditions regarding the operations of the Solid Waste Disposal facility, a number of which are not in compliance, including:

- Annual reporting
- Operation and maintenance manual
- Appropriate hazardous waste storage and handling.

Hamlet Public Works staff responsible for the waste disposal facility have done an effective job in segregating material for reuse and recycling. This has resulted in creating two distinct disposal areas, the Bulky Metals Disposal Area, which accepts vehicles, tanks, drums, and metals of all nature (Figure 8), and the Municipal Solid Waste Disposal Area (Figure 9).

6.2 Bulky Metals Disposal Area

6.2.1 Existing Conditions

As shown on Figure 8 and in Photos 8 through 12 in Appendix B, the Bulky Metals Disposal Area has been a repository for vehicles, heavy equipment, tanks, piping, drums, boats, and miscellaneous metal materials for over 15 years. Recently Hamlet staff have created segregated areas to encourage reuse/recycling. This includes areas for tires, appliances, bicycles, ATV's, and snowmobiles. Public use of the facility for reuse and recycling is encouraged. An examination of the site revealed very little materials that should have been stored or disposed of elsewhere. Staff indicated that most of the vehicles were not drained of fluids prior to being stored on site, however there was no evidence (staining, odours, vegetation stress, etc.) to suggest the site is causing a significant environmental impact. Given the location of the site it is unlikely oil, grease, and other contaminants that might wash off the equipment will impact a sensitive receptor down stream of the site.

The Bulky Metals Disposal Area is a necessary part of the Hamlet waste disposal planning, and historically it has not been cost effective to remove scrap metal from the community by barge to a southern scrap yard or metal recycling facility.

The approximate footprint of the metals area, as displayed on Figure 8, is estimated at 6,340 m^2. Photographs of the materials are included in Appendix B.

Based on visual observations, the following volume and weights have been roughly estimated:

- 6,340 m^2 with an average depth/density if the metals were compacted in place to a depth of approximately 0.2 m would be approximately 1,268 m^3
- Approximately 1,268 m^2 of predominantly steel at a specific gravity of 7.8 tonnes/m^3 would weight approximately 10,000 tonnes.

An on site inspection suggested a metal breakdown as follows:

- Steel – 60 percent
- Aluminum – 30 percent
- Other – 10 percent.

The site has been in use for approximately 15 years and covers a footprint of approximately 6,340 m^2. There is a deliberate effort not to pack the materials together too tightly to allow access for reuse and recycling by the public.

Based on the historic rate of stockpiling, the Bulky Metals Disposal Area expands by approximately 423 m^2/year as more materials are brought in. This corresponds to a historic annual height brought to the site of approximately 667 tonnes/year.

6.2.2 Options Analysis

Options for the future of the area are presented in the following table.

Options Analysis
Bulky Metals Disposal Area

	Option	Environmental Impact	Cost	Logistics and Comments
1	Do Nothing	Low to Moderate	$0	• Doing nothing may be a viable option for the short term, however from a community esthetics viewpoint site size should be limited • Once the materials have been deemed to have no future reuse/recycle potential they become a "waste" and must be disposed of as per regulations • As a minimum, fluids should be drained from all vehicles and equipment once they have been deemed as having no further reuse value
2	Remove from Community	Low	High ($2M)	• With the current price of scrap metal it is not cost effective to backhaul the metal
3	Compact and Bury	Low	Low	• Once materials have been deemed to have no future reuse/recycling potential, they can be compacted and buried. Burial would be considered long term subsurface storage until it is cost effective to ship it out of the community. This reduces the visible stockpile area. Burial of waste metal must be in an approved area

6.2.3 Class C Cost Estimates

6.2.4.1 Remove from the Site

Discussions with contractors has indicated the cost of scrap metal back haul from Nunavut is not cost effective. Consultations with UMA Engineering Ltd. (which is currently providing project oversight for the on-going DND DEW Line remediation occurring throughout Nunavut) has indicated that the scrap metal has not been backhauled from any of the DEW Line sites, because of the cost and the fact that it is usually not a significant environmental concern. Just the shipping cost alone for the 10,000 tonnes @ $225/tonne would be $2,250,000, not including any onsite handling etc.

Discussions with contractors indicate, that to prepare the scrap metal for burial specialized equipment will have to be mobilize to the community. Costs are estimated as follows:

• Equipment mobilization/demobilization and over winter standby	$ 150,000.
• 325 excavator with shear – 300 hrs. @ $250/hr.	$ 75,000.
• Two 325 excavators with thumb bucket or grapple – 600 hrs. @ 250 hr.	$ 150,000.
• Four tandem dump trucks to travel from the Bulky Metals Area, 5.5 km to the barge ramp – 250 hrs. @ $100/hr.	$ 100,000.
• Barge preparation	$ 10,000.
• Shipping – 10,000 tonnes @ $225/tonne	$2,250,000.
• Estimated scrape value – 10,000 tonnes @ $80/tonne	($ 800,000.)
Subtotal	**$1,935,000.**
Contingency (15 percent)	$ 290,000.
Total	**$2,225,000.**

6.2.4.2 Bury in a Cell Next to Site

Cost to bury the metals in a cell next to the site would require less preparation time and effort, less concern with reducing volumes as it does not have to move far, and space is not a significant issue. It will require the burial area to be included in the Water Board license for the landfill.

The estimated volume at 30 percent compaction is 4,200 m^3. This would be the space required in the cell. The cost, calculated on assuming that the volumetric area for disposal is prepared during landfill rehabilitation and development, is as follows:

- Assuming excavation equipment on site during landfill rehabilitation
- Excavation of berms through bulldozing a fill area and pushing soil from around the fill area
- 1 meter depth below existing ground
- 2 meters berm height above existing ground
- only final cover material required on top after burial.

A volume of 4,200 m^3 buried to a depth of approximately 3.0 m would require a footprint of 1,400 m^2. This would be approximately 37.5 m x 37.5 m. Figure 11 displays the possible location of a Bulky Metals Disposal cell.

• Mobilize/demobilize special equipment (shears)	$ 50,000.
• Construction of fill area, 200 linear metres of berm with a D-65 dozer and excavator – 200 hrs. @ $250/hr.	$ 50,000.
• Construction of approximately 200 linear meters of Surface water diversion ditching – 40 machine hrs. @ $250/hr.	$ 10,000.

- Cost to prepare, move, compact, and cover metal materials using dozer and excavator – 200 hrs @ $250 hr. $ 50,000.
  Subtotal **$160,000.**
  Contingency (approximately 15 percent) $ 25,000.
  Total Cost Estimate **$185,000.**

This cost assumes the material can be pushed into the cell by the dozer and berms can be pushed up and over for final cover.

It must be noted, this effort only addresses the existing stockpile. A larger stockpile will need to be disposed of at the end of the 20 year planning cycle. A proposed cell for hosting the next 20 years of bulky metals is displayed on Figure 11. It is recommended that the cell only be constructed when needed at the end of 20 years, so it is not costed at this time.

6.2.4 Recommended Option

The Bulky Metals Disposal Area is out of sight of the community in an area set aside for waste handling and disposal (Figure 5). The site is well managed and there is no evidence of a current significant environmental impact. The only environmentally protective measure would be to ensure oils, antifreeze, and other liquids are drained from the equipment once it has been decided they have no future reuse value. The materials could be compacted and buried to reduce the visual impact. Our recommendation is to continue to operate the site as it is being operated, and let the Hamlet decide if there is a need to reduce the amount that is visible by burying it at the landfill site across the road. To be in compliance with the Water Board License, burial must take place in an area approved for waste disposal. Costs will be directly related to the amount buried.

Although the rough estimate of metal volume was 1,268 m^3, this was based on achieving a theoretical 100 percent compaction. In all probability, compaction would be much poorer and be closer to 30 percent. The estimated compacted volume that would need to be buried at some point would be in the order of 4,200 m^3. The amount, if any, that is planned for subsurface disposal (burial) will be determined by the Hamlet based on an assessment of what may be potentially needed as part of reuse/recycling efforts.

Based on the volume of metal produced over the past 15 years, an estimated 280 m^3 of 30 percent compacted metal mass is produced annually. If burial at the landfill site is a desired option, both the historically acquired mass and the annual volume of metal produced each year must be buried.

If burial is considered, it is recommended that the metal be buried at the licensed municipal solid waste disposal area, but in a distinctly separate part of the site. Burial should be considered temporary subsurface storage of the metal and not mixed with the

regular waste. At some point when it becomes more economically viable, the metal could be excavated and shipped to a recycling facility. This would be easier to achieve if it was kept physically separate from the municipal solid waste disposal area.

6.3 Municipal Solid Waste Disposal Area

6.3.1 Existing Conditions

The Municipal Solid Waste Disposal Area is located west of the Hamlet in the area of the sewage lagoon as shown on Figure 5.

The facility consists of a fenced enclosure with two un-gated access points off the road to the sewage lagoon. Site details are displayed on Figure 9.

The site has been in use for approximately 15 years, and operates under GN Water Board License NWB3KUG0308 issued November 20, 2003. The license expires November 30, 2008.

Hamlet staff have been effectively conducting pre-disposal segregation of bulky metals and hazardous materials. The bulky metals are deposited in the Bulky Metals Disposal Area, and hazardous materials unsuitable for the waste disposal site are stored in the Waste Oil and Hazardous Material Storage Area next to the sewage lagoon (Figure 5). The Municipal Solid Waste Disposal Area is approximately 75 m x 150 m in size, with a fenced area of approximately 12,390 m^2. Fencing consists of approximately 1.5 m high post and wire fencing that is in good condition. There are no gates at the two access points. Site layout is shown on Figure 9.

The site was originally constructed by fencing the area and filling waste directly on the surface, starting on the south side and filling northwards down a shallow slope. As filling progressed down slope, a tipping face gradually developed at the face of the waste footprint. The current waste footprint is approximately 8,220 m^2 as shown on Figure 9. Waste thickness over the footprint is estimated to average approximately 1.5 m. This translates to approximately 12,330 m^3 of waste deposited in the site.

Cover material has been added sporadically and much of the waste area is exposed. The site operates by tipping waste off of a ramp constructed from a dump truck box into a small burn pit. See Photos 14 through 19 in Appendix B. A new ramp of metal pipe is currently under construction by Hamlet staff to be installed in the near future. Waste is collected in the Hamlet by a Hamlet side loading garbage truck. The waste is dumped from the ramp into an approximate 1.5 m deep pit prepared in front of the ramp. The waste is burned, and the remainder crushed and pushed out of the pit to another area of the site by a loader on a regular basis.

Waste diversion and burning have been very effective in reducing the volume of waste. Burning and the climate conditions keep odours to a minimum. Burning and fencing have limited the amount of wind blown litter. At the time of the site visit, very little evidence was found of litter beyond the confines of the site. Hamlet staff indicate that they pick up litter from the tundra occasionally, but reduce the chance for blown litter by keeping the waste in the pit and burning it regularly (daily). The contents of the exposed waste was examined and the majority of the materials were found to be ash, metal, glass, and the typical content of burned primarily domestic waste. There was no evidence of hazardous materials or items of environmental concern.

Waste is compacted through the process of moving it around the site with a loader and pushing outwards towards the tipping face at the edge of the waste footprint.

Cover is applied irregularly and an inspection of the waste indicates cover materials (soil) may be only approximately 10 percent of the waste content. No cover material was stockpiled on site at the time of the site visit. Hamlet staff indicated they had no significant problems with operating the site, and no concern about blown litter, scavengers, surface water flow, or other issues.

An inspection of the site and surrounding area indicated that the natural topography and road side ditching was effective at directing surface water flow away from the fill area. There was no surface water observed on or near the landfilling area, and no evidence of a significant flow path.

An inspection of the toe of the waste and the down slope area beyond the site showed no evidence of leachate seeps, surficial staining, odours, or vegetation stress.

6.3.2 Soil and Groundwater Investigation

To further evaluate the potential impact the landfill is having on the environment, two test pits were excavated to permafrost as shown on Figure 9. Test pit logs are included in Appendix G. Photographs are included in Appendix B. There was no visual evidence of a landfill impact to the sandy soil in the test pits. The test pits partially infilled with groundwater as shown on the logs in Appendix G. Groundwater samples were collected from each test pit and submitted to Envirotest Laboratories for analysis for VOC's, petroleum hydrocarbons, metals, and anions. Laboratory Certificates of Analysis are included in Appendix C-2. The results for the VOC's and petroleum hydrocarbons in groundwater were all below laboratory detection limits. The metals and anion results were compared to the Table 2 Standards as per Ontario Regulation 153. These are stringent groundwater standards for a potable groundwater condition. The results were all below this criteria. There was no evidence of an off site impact to the shallow groundwater downgradient of the landfill site.

As noted previously there were no surface water body's downgradient in the immediate proximity of the landfill (Figure 5). The nearest surface water body downgradient is the intermittent stream that drains the sewage lagoon (Figures 5 and 6). Distance from the site boundary to the stream is approximately 150 m. Seasonal ponds exist during run-off in the spring, but there are no large ponds immediately down gradient of the landfill. As shown on Figure 6, the pathway to the ocean for surface water borne contaminants would follow the sewage lagoon discharge stream. Sampling of the stream at several locations showed no evidence of landfill related impacts.

Based on the findings of the current study, there is no evidence the landfill is causing a significant off site impact to the environment. Based on a review of the materials on site and the current operational method, which has been used for approximately 15 years, there is no evidence that the site will cause a significant off site environmental impact in the foreseeable future.

6.3.3 Landfill Capacity

Based on the current method of filling and the approximate site area that has not been filled, the landfill capacity is estimated as follows:

- Current fenced approved fill area 12,400 m^2
- Current waste footprint filled to an average of 1.5 m depth above ground surface 8,220 m^2
- Site capacity calculated if the entire fenced area was filled to 1.5 m would be 18,600 m^3
- Current fill volume based on the existing footprint filled to 1.5 m above ground surface 12,330 m^3.

The remaining capacity is estimated as 6,270 m^3. Using the predicted annual volume of waste and cover displayed on Table 2, the landfill is estimated to have less than 4 years of remaining capacity.

These calculations of capacity do not take into account the option of increasing the waste thickness by adding another lift of waste on top of the existing waste or other site volume maximization strategies such as increasing compaction.

6.3.4 Calculated Waste Volume by Population

Since a detailed waste audit of the Hamlet has not been conducted and there is no weigh scales or other method to monitor waste generation, disposal estimates are made based on production and previous studies of similar communities

Based on the population growth rate of 1.5 percent per year (Nunavut Bureau of Statistics) and the Government of the Northwest Territories Department of Municipal and

Community Affairs (MACA) waste generation rate of 0.014 m^3 per capita, per day, the cumulative volume of combusted waste to be land-filled over the 20-year planning horizon (to 2026) is estimated to be 48,045 m^3, compacted and covered (see Table 2). To determine the design volume required for the 20-year planning horizon, the following assumptions were made:

- 84 percent combustible waste stream
- 16 percent non combustible waste stream
- Open burning of waste resulting in a combustible waste volume reduction of 50 percent
- 3:1 compaction ratio (moderate compaction)
- Ratio of compacted waste to soil cover of 5:1.

Table 2 presents the waste volumes, volumes of waste after open burning, volume of compacted waste, and the cumulative volume of compacted and covered, post-combustion, waste.

Table 2 also presents the cumulative volume of waste, should regulatory agencies and/or the Hamlet determine that the open combustion of waste is no longer desirable or permissible. When conducting the detailed design of the solid waste facility, facility sizing, and operational procedures will include appropriate contingencies to account for the possibility that the Facility may eventually be operated as a conventional area fill, trench fill, or balefill solid waste disposal facility without burning. As shown on Table 2, the cumulative volume of waste without burning is approximately 207,111 m^3. At a 3:1 compaction ratio the volume would be approximately 69,030 m^3. Including cover material (1,386 m^3) at a 5:1 ratio, the total landfill capacity required for the 20 year planning period if the waste is not burned is 70,416 m^3.

For the sake of long term planning, solid waste projections are shown for up to 40 years into the future. The purpose is to allow an initial appraisal of the site, to determine if it will be required to be moved in the future. A brief review of the site and surrounding area (Figure 9), and the volume of waste expected over 40 years (Table 2), suggests that the current landfill has the potential to be expanded in the immediate area to meet long term needs.

6.3.5 Solid Waste Composition

Relatively few studies examining the composition of solid waste have been undertaken in Nunavut. However, a study of particular pertinence to the current study, authored by Heinke and Wong (1989), has been identified. The study examined the waste composition in Iqualuit, Pangnirtung, and Broughton Island (Qikiqtarjuaq) through actual waste stream characterization and volume/weight measurement. Qikiqtarjuaq is slightly smaller and at a higher latitude than Kugluktuk, but with a similar waste stream. This study is, to the best of our knowledge, the only study of waste stream composition

completed in Nunavut. The study provides comparisons of the data collected in the selected communities to studies completed in southern Canada, and is extremely beneficial in furthering our current understanding of the composition of the waste stream in the Hamlet of Kugluktuk.

The study included the following waste composition estimate:

Waste Component/Category	Percentage by Weight (percent)
Food	21.4
Cardboard	14.4
Newsprint	5.0
Other Paper Products	18.5
Cans	5.4
Other Metal products	4.0
Plastic, Rubber, Leather	13.3
Glass, Ceramics	3.1
Textiles	3.5
Wood	4.5
Dirt	3.4
Diapers	3.5
Total	**100**

A preliminary waste audit was carried out by Nuna Burnside staff during the site visit on approximately one garbage truck load of waste dumped in the burn pit at the landfill. The examination of a truckload of waste at Kugluktuk appeared to contain approximately 50 percent materials, which would be consumed by burning. Waste audit results obtained (as percentage by weight of the total waste volume) appeared to be generally consistent with the Heinke and Wong study, with several exceptions. Newsprint comprised only 2.5 percent (approximately) of the total waste stream, while other paper products comprised only 7 percent (approximately) of the waste steam. Other metal products comprised approximately 25 percent of the waste steam, and were composed primarily of surplus parts of a snowmobile engine and pieces of electrical cabling. The other categories feel within predicted ranges. The presence of significant numbers of empty oil containers (some containing greater than 200 ml waste oil) was noted. It should be noted the sampling volume was very small, and this served only to provide a snapshot of the current waste stream. The results of the sampling undertaken does, however, clearly illustrate the need for further efforts in the diversion of household hazardous waste from the waste stream deposited in the Solid Waste Disposal Facility operated by The Hamlet of Kugluktuk. Photographs in Appendix B show the composition of the resulting combusted waste.

6.3.6 Options Analysis

Discussions with Hamlet administration staff, including the public works staff responsible for the solid waste disposal facility, revealed no major concerns with site location or it's operation. The site is out of sight of the community, and Hamlet staff indicate no desire to move the location. The following table provides a review of potential options.

Options Analysis
Municipal Solid Waste Disposal Area (Landfill)

Option	Environmental Impact	Cost	Logistics and Comments
Do nothing	Low	$0	• Doing nothing will result in the site reaching capacity in approximately 5 years. While current operations are not causing a significant environmental impact, operational procedures (covering of waste, and maximizing site capacity/need revision).
Expand and rehabilitate the site for continued use for approximately 20 years. Develop effective operational procedures to maximize site efficiency and handling hazardous waste and contaminated soil	Low to Moderate	Moderate (depending on detailed design)	• Expanding the diversion of the current footprint of the fill area would provide capacity for the next 20 years. • Assuming burning of combustible waste will continue. • An effective operational procedure guide will provide Hamlet staff a cost effective program for maximizing the efficiency of the site and minimizing environmental impacts. • The landfill site should be the facility where hazardous wastes and contaminated soil is properly stored and handled.
Move the site	Unknown	High ($300,000 to $400,000 depending on location)	• No reason to move the site. • Hamlet does not see a need to move the site • Costs would include closure of the existing site and locating a new site.

Option	Environmental Impact	Cost	Logistics and Comments
Incineration or other disposal technology	Low	High (in excess of $1M for all capital costs, permitting, etc.)	• A review of the use of incinerators for a community in Nunavut the size of Kugluktuk indicates capital costs and operating costs make the technologies cost prohibitive. • Should the technology become viable the existing buried waste could be excavated and incinerated.

6.3.7 Recommended Option

A review of the possible options indicates quite clearly that expansion and modification of the existing site to accommodate waste disposal for a minimum of the next 20 years is the recommended option.

The exact details of site modifications and operational methodology will be part of the detailed design. The detailed design would likely include:

- Establishment of earth berms with the fencing set on top of the berms to increase the effectiveness of litter control and visual impacts
- Covering of waste regularly, and limiting the size of the active area to reduce blown litter and visual impacts
- More refined burning techniques
- Increased compaction prior to covering.

The development of a Community Solid Waste Management Plan to provide a document (and by-laws if required), by which the Hamlet can manage its entire flow of waste from generation to disposal is recommended. This would include the handling, storage, and disposal of the solid waste stream (combusted and non-combustible), waste oils, hazardous waste, bulky metals, etc. This plan would also include the procedures for handling wastes generated by private business and contractors, and address limitations to unauthorized site access and uncontrolled disposal.

6.3.8 Alternative Site Layouts

The cumulative required landfill volume in year 20 is 48,045 m^3. This is based on current practices of waste disposal including burning, compaction, and cover application (Table 2). The landfill volume required will be considerably larger should it be decided to cease burning. The current remaining capacity is estimated at 6,270 m^3. The

requirements to meet the 20-year design criteria would require approximately 41,775 m^3 of additional landfill volume.

This additional capacity can be developed in various ways.

It could be added as additional lifts to the existing fenced landfill footprint of 12,400 m^2. This would add an additional approximate 3.5 m of height to the existing footprint (accounting for side slopes). It is probably not operationally practical at this time, to raise the fill to such a height above current filling levels.

If the landfill footprint was expanded the expanded footprint area would depend on depth of a fill as follows:

- 41,775 m^3 @ 1.0 m thick would require 41,775 m^2 (approximately 204 m x 204 m)
- 41,775 m^3 @ 1.5 m thick would require 27,850 m^2 (approximately 167 m x 167 m)
- 41,775 m^3 @ 2.0 m thick would require 20,888 m^2 (approximately 145 m x 145 m)
- 41,775 m^3 @ 2.5 m thick would require 16,710 m^2 (approximately 129 m x 129 m)
- 41,775 m^3 @ 3.0 m thick would require 13,925 m^2 (approximately 118 m x 118 m).

In our experience, an average of 3.0 m waste thickness is an effective waste thickness for this site. It allows for effective waste management without creating a steep high finished contour, and yet maximizes the waste footprint and limits landfill sprawl.

If the existing 12,400 m^2 footprint was raised approximately 1.5 m to an average of 3.0 m, the current site would contain approximately 18,600 m^3 of waste. Waste would be contoured higher in the center to maintain stable side slopes and promote runoff. This would require an additional area to handle the remaining 23,175 m^3 of waste volume. With a fill thickness averaging 3.0 m, approximately 7,725 m^2 of additional site area would be required. Figure 11 displays an effective layout around the existing fill area.

6.3.9 Class C Cost Estimate

Assumptions

The options analysis and conversations with Hamlet staff indicate, the most cost effective viable option for solid waste disposal is to rehabilitate and expand the existing landfill site.

For the purposes of long term planning, waste quantities have been projected up to 40 years in the future. The area of the existing site is capable of hosting a landfill of sufficient size to meet this very long-term future need. The exact layout and operational plan for the expanded facility will be determined during the detailed design phase of this study.

Class C costing has been developed assuming the following:

- Costs for the solid waste disposal area expansion are for capital construction and do not include other community waste management costs, such as operational costs, training, waste collection, regular cover material application, etc.
- Costs are based on using equipment and manpower currently available in the community
- The costs for creating a cell for the disposal for the existing stockpile of bulky metals is included with the Bulky Metals Area costs in Section 6.2.4
- Cover material and berm materials will be acquired locally on site and in the immediate surrounding area.

Site expansion and rehabilitation will be conducted as shown on Figure 11 and as follows:

- Construction of 3 m high berms around the required 20 year fill area
- Berms would be constructed using a bulldozer to excavate the cell to a depth of 1.0 m
- Berms would be approximately 3 m high consisting of 1 m below existing grade and 2 m above existing grade
- Berms would have approximately 3:1 slopes and flat tops
- 1.5 m high fencing would be constructed on top of the berms
- Surface water drainage ditching would be constructed to divert run off away from the fill area
- A thin layer of interim cover would be applied to the existing exposed waste
- A hazardous waste depot and waste oil storage facility would be established to handle waste batteries, waste oil, and materials not suitable for the landfill or the Bulky Metals Area.

Construction Costs

The following costs are provided to expand and rehabilitate the site as outlined above:

- Forming 450 lineal meters of 3 m high berms with approximately 3:1 side slopes and a flat top – 450 machine hrs. @ $250/hr. $112,500.
- Constructing 450 linear meters of 2 m high post and wire fencing

along the tops of the berms @ $40/m	$ 18,000.
• Construction of approximately 450 lineal metres of surface water diversion ditching – 100 machine hrs. @ $250/hr.	$ 25,000.
• Application of thin cover over existing exposed waste – 20 machine hrs. @ $250/hr.	$ 5,000.
• Hazardous waste depot and waste oil storage facility	$ 50,000.
• Signage (for landfill and waste depot)	$ 5,000.
Subtotal	**$215,000.**
Contingency (approximately 15 percent)	$ 35,000.
Total	**$250,000.**

Other Issues

It is strongly recommended that funding be identified for site operator and manager training. It is our experience that staff training is the most effective way to manage a landfill in an environmentally sound and cost-effective manner. Costs for training are usually recovered rapidly through improved site operation.

It is also recommended that funding be identified for the creation of a Community Solid Waste Management Plan. This plan would outline the proper organization and handling of all wastes in the Hamlet from both the public and private sector. It is an important component of environmental protection. It could also be the basis for developing Hamlet Solid Waste By-Laws, and a fee structure for commercial and industrial wastes so the costs are not borne by the Hamlet.

7.0 Contaminated Soil Stockpile

7.1 Background and Current Conditions

Just west of the sewage lagoon (Figure 2) is a pile of hydrocarbon-impacted soil, sometimes described as a "Land Farm". According to the RFP, in 1999 a “Land Farm” was designed and built according to the standards of the day. It was designed to accept contaminated soil from the old tank farm and old pipelines that were in the process of being decommissioned.

The site consists of an approximate 30 ml HDPE lines and geotextile cloth placed directly on the tundra or in a shallow excavation. Hydrocarbon contaminated soil was added on top of the liner. An approximate 20 ml HDPE cover was placed over the soil. Since 1999 additional soil has been added without authorization. Current conditions are shown on Photos 22 through 24 in Appendix B. The dimensions and layout of the contaminated soil stockpile are shown on Figure 10.

Currently the top cover has partially blown off and been shredded by the wind. Permafrost has re-aggraded into the pile, so less that 1 m of the surficial layer was thawed in early October 2005.

Based on measured dimensions and the assumption that the soil is piled on a liner placed on the original ground surface, the contaminated soil volume is estimated at 620 m^3.

Hamlet and GN staff indicated an area in the Hamlet that has been contaminated by a fuel spill from the old pipeline. Information provided by GN staff indicates there is approximately 500 m^3 of contaminated soil in this location that requires removal and disposal.

7.2 Contaminated Soil Assessment

To evaluate the contaminated soil quality, four composite samples were collected from shallow excavations in the stockpile. A front-end loader was used to dig the holes. The excavations were restricted by permafrost to less than 1.0 m depth.

The soil was a mixture of sand and gravel, and appeared to consist of truckloads excavated from several locations. No staining or odours were apparent. There was no evidence of seepage or staining on the surrounding tundra or vegetative stress.

Four composite soil samples (LF-l through LF-4) were collected and sent to Envirotest Laboratories to be analyzed for:

- Volatile organic compounds (VOC's)
- Petroleum Hydrocarbons (Fl to F4).

Laboratory Certificates of Analysis are included in Appendix C-2.

The results were compared to CCME criteria for petroleum hydrocarbons and the Table 2 Standards (for a potable groundwater condition) for both residential/parkland/industrial property use and industrial/commercial/ community property use, as outlined in Ontario Regulation 153 for the VOC's. The levels for petroleum hydrocarbons are the same in both comparative criteria. The results were all below the criteria. These results indicate that the upper layer of the contaminated soil stockpile contains low levels of petroleum hydrocarbons that are below the stringent O.Reg. 153 Table 2 Standards and below the CCME criteria. The soil would be suitable for use as landfill cover.

The characteristics of the soil below, approximately 1.0 m below surface, remains unknown as it is currently below the level of permafrost and could not be sampled.

7.3 Environmental Impact

The area around the soil stockpile was examined for evidence of an environmental impact. No odours, staining, vegetative stress, or other signs of impact were noted.

To evaluate the environmental impact of the soil stockpile, a test pit was excavated down gradient of the pile as shown on Figure 10.

The sandy soil was exposed to approximately 1.0 m below surface, where permafrost was intersected. Perched groundwater flowed into the test pit to approximately 0.5 m below surface. One groundwater sample (CON-1) was collected and submitted to Envirotest Laboratories for analysis of VOC's, petroleum hydrocarbons, and metals. The results are included in Appendix C-1. The results were compared to the Table 2 Standards (for a potable groundwater condition) as per Ontario Regulation 153.

The results were well below the standards. No VOCs or petroleum hydrocarbons were detected.

The results indicate the contaminated soil stockpile is not currently causing a significant environmental impact to the surrounding land.

7.4 Options for Decommissioning the Contaminated Stockpile

Natural attenuation of hydrocarbon contaminated soil by microbial decomposition of hydrocarbons is a very slow process in the Arctic. The soil must be in the active layer, where it is thawed for the maximum length of time each year. Currently the majority of the stockpile is permafrost and therefore not biologically active.

The most effective natural remedial methodology is to layout the soil in thin (0.3 m) layers, where it can be subjected to the maximum effects of natural biological processes.

There are a number of potential options, as shown on the following table.

Options Analysis
Contaminated Soil Stockpile

	Option	Environmental Impact	Cost	Comments
1	Do Nothing (Null Option)	Low – currently no significant impact	$0	• No mechanism for stopping unauthorized disposal • Contaminated soil (waste) remains in an unlicensed area
2	Ship Out of Community	None	High	• Not necessary as contamination is not currently, and if handled properly, not likely to cause a significant environmental impact • Would require loading on a barge and shipping south to a licensed facility
3	Use at Landfill as Cover Material	Low	Low	• Dig and haul top layer to the landfill and use as cover material • Test and remove underlying layers as the permafrost melts back each summer until it is all removed

7.5 Recommended Option

The most cost effective and environmental proactive option would be to remove the top 1.0 m of soil and use it for landfill cover. The underlying layer of soil should be tested when thawed, and if found acceptable, also placed on the landfill as cover.

This may take three summer seasons to accomplish as the permafrost thaws. Alternatively the material could be torn up with a ripper blade and moved during construction of the new sewage lagoon.

As shown on Table 2, the landfill is expected to require approximately 350 m^3 of cover material annually over the next few years. The 620 m^3 stockpile of contaminated soil could produce over a year's supply of cover material.

Development of a new sewage lagoon in the area may require excavation and removal to the landfill in one season. The costs to excavate the soil and move it to the landfill would be included in new lagoon earthworks costs.

In the future, hydrocarbon contaminated soil should be evaluated, and based on the level of contamination, handled in the following manner:

- Low level contamination – moved at the landfill as cover material
- Moderately contaminated – stockpiled on the landfill on top of a liner and land farmed over an inactive area of the site until levels are reduced, so it can be used as cover material
- Highly contaminated – stockpiled in a lined facility at the landfill until a suitable remedial strategy can be devised.

This issue can be more formally laid out in a Community Waste Management Plan that should be prepared as part of the rehabilitation of the landfill.

The 500 m^3 of hydrocarbon contaminated soil outlined by GN staff in the Hamlet should be handled as per the evaluation criteria noted above. It is assumed the soil is moderately contaminated and will need to be landfarmed at the landfill. This work should not be undertaken until there is a suitable receiving area available a the landfill site for storage and/or landfarming.

7.6 Class C Cost Estimate

The costs for excavating and moving the impacted soil would be minimal, as it is close to the landfill and would be the same as having to excavate local clean soil to apply to the landfill as cover materials. If it is required to move as part of a new lagoon development, the excavation costs would be carried in the lagoon construction costs.

A contingency of $5,000 for the analysis and evaluation of soil samples from inside the stockpile is recommended to confirm the quality of the soil prior to excavation and removal to the landfill as cover material. This cost assumes that the landfill needs cover material, and the soil chemistry deep in the pile is similar to the soil chemistry noted during the site assessment. Cost of moving the soil to the landfill is assumed to be part of landfill operations.

8.0 Waste Oil and Hazardous Materials Storage Area

8.1 Current Conditions

Effective segregation and stockpiling by Hamlet staff have kept a number of hazardous materials out of the landfill, and liquid wastes effectively contained in one area awaiting disposal. Figure 10 shows the layout of this area. The site is not fenced or controlled. The area is contained by a shallow earth berm, and partly contained within an area underlain by HDPE liner as part of the contaminated soil stockpile. Photos are included in Appendix B. Approximately 500 – 205 liter (45 gal) drums are stacked on pallets. The drums consist primarily of waste oil from the Hamlet's works yard. Some drums are reported to contain waste antifreeze. Approximately 40 drums of unknown origin have been dropped off by other parties. Most appear to be oil and/or antifreeze. No actual hazardous materials are known to be stored at the site.

Approximately 40 smaller (10 to 25 liter in size) pails of paint, hazardous oil, and lubricating oil are stored next to the drums.

Total volume of liquid oil, excluding paint (some of the drums are only half full), is estimated at 100,000 liters. Approximately 200 used batteries of various sizes are stored in an old truck box and stocked on pallets nearby (see Photos 25 through 27 in Appendix B). There is no current plan for disposal of the materials. They have been accumulating for over 10 years.

8.2 Options Analysis

This area does not have any regulatory approval for the storage of waste oils and hazardous materials. It is open to unauthorized dumping and use. There is no protection from vandalism.

Once the materials have been removed, an alternative disposal/storage protocol is needed for materials generating in the future that is environmental sound and meets regulatory requirements.

Due to the isolated location of the Hamlet and the low volume of materials accumulated, regular shipment out of the community is probably not viable. Proper storage and stockpiling until a sufficient volume is accumulated to fill a shipping crate is necessary.

The following table outlines the potential options for disposal, and a program for future storage and handling of these materials.

Options Analysis
Drums of Oil and Hazardous Materials

	Drums of Oil (including hydraulic fluid and similar materials)	Environmental Impact	Cost	Logistics and Comments
1	Do Nothing	High Potential for an Environmental Impact	$0	• Not an option • Violates regulations • Significant potential for an environmental impact
2	Stockpile in Community	Moderate Potential Depending on Storage	Approximately $150,000 for adequate storage and annual (maintenance and a regular increase in storage volume would be required)	• Short term solution • Cost of an adequate storage facility and ongoing maintenance costs would be prohibitive
3	Ship Out on Barge	Low to Moderate	High (approximately $250,000)	• Drums would have to be secured in over packs or the materials pumped into acceptable shipping containers • Temporary storage would be needed until a stockpile accumulates to warrant another shipment • Hazardous materials shipping permits would be required • May require a Nunavut Impact Review Board Approval • Lab analysis would be required on all drums prior to shipping and off site disposal
4	Consume in Waste Oil Furnace	Low	Approximately $150,000 plus an additional $50,000 to retrofit a building. Cost of approximately $50,000 to ship non-burnable	• Long term solution to consuming waste oil in the community • Will require only a small storage facility • Has potential problems with permitting and ensuring only suitable waste oil goes into the furnace

	Drums of Oil (including hydraulic fluid and similar materials)	Environmental Impact	Cost	Logistics and Comments
			materials out of the community	• Cannot handle glycol and other materials mixed with the oil • Need to find a suitable building
5	Consume Using a Waste Oil Incinerator	Low	Approximately $150,000	• Mobilization of a waste oil incinerator, and consuming stored waste oils • Incinerator can handle mixed glycol and water in the oil • Incinerator must be remobilized every few years • Cost $1.50/l based on existing quality of stockpiled oil of 100,000 l
	Waste Batteries	Environmental Impact	Cost	Logistics and Comments
1	Do Nothing	High Potential for Impact	$0	• Not acceptable option • Does not meet regulatory requirements
2	Stockpile at the Solid Waste Disposal Facility	Low to Moderate	$20,000 for a container of sufficient size	• Moderate potential for impact • Will require an appropriate lockable container with spill containment • Ongoing maintenance would be needed
3	Ship Out on Barge to a Recycling Facility	Low	Moderate to High	• The materials can never be deemed acceptable to stay in the community • Shipping out must be done in the most cost effective manner • A storage facility should be used until a sufficient volume has been accumulated to achieve maximum cost effective backhaul south, perhaps once every 5 years

	Waste Paint	Environmental Impact	Cost	Logistics and Comments
1	Do Nothing	Moderate	$0	• Does not meet regulations and there is potential for an impact
2	Ship Out on Barge	Low	High	• Materials will need to be placed in an appropriate shipping container for backhaul south
3	Treat and Dispose in Landfill	Low	Low	• Containers should be taken to a secure area at the landfill and stored for reuse/recycle by the community members • Once there is no potential for reuse the tops should be opened and the paint allowed to dry out to a solid • Solid materials can be disposed of in the landfill
	Other Hazardous Materials	Environmental Impact	Cost	Logistics and Comments
1	Do Nothing	High	$0	• Does not meet Nunavut regulations • Potential for environmental impact is high
2	Stockpile and Ship Out of Community	Low to Moderate	High $50,000 (for waste oil, batteries, and hazardous materials)	• A proper facility (container) with spill containment, and security is required to segregate and stockpile all materials that cannot got into the landfill or be reused/ recycled • Backhaul out of the community should be conducted on an as needed basis depending on the nature of the materials accumulated • A Community Waste Management Plan is required to outline how this protocol will be followed

8.3 Recommended Option

The recommended options for handling these materials are:

- Drums of Oil – consume in a waste oil incinerator
- Waste Batteries – store in a secure container at the Solid Waste Disposal Facility until a cost effective load can be accumulated for backhaul
- Waste Paint – offer for reuse, and if not wanted open and dry out. Residue can go to the landfill
- Other Hazardous Materials – stockpile in a secure manner at the landfill site until cost effective shipment south can be arranged.

A Community Waste Management Plan is recommended to create a formal process to handle these materials. This should be prepared as part of the rehabilitation of the landfill.

8.4 Class C Costs

Class C costs are estimated as follows:

Drums of Oil

Cost provided by contractor (Hazco) to mobilize an incinerator to the site and incinerate approximately 100,000 liter of stored oils @ $1.50/liter is $150,000. Project includes all costs and can be done in approximately 1.5 months in the summer. Drums will go to the Bulky Metals Area.

Waste Paint

Encourage reuse and recycle. Open cans not reused in a secure area at the landfill and allow to dry. Dried paint and cans can be landfilled. Work can be done by public works staff looking after the landfill at no appreciable cost.

Waste Batteries

- Cost to stockpile and prepare 200 waste batteries for shipment is approximately $10 per battery – $2,000.

- Cost for a shipping container with spill containment and acid neutralization, and shipment south by barge is based by weight. Each battery weight approximately 20 kg. Total battery weight is approximately 4,000 kg.

- Backhaul costs by weight is $225/tonne – approximately $1,000.

- Shipping container, transportation of dangerous goods, and coordination with receiver would be approximately $4,000. Battery value as scrap is approximately the value of disposal, so there is no profit

- Total cost estimate $7,000.

9.0 Conclusions

9.1 Sewage Lagoon

The exiting lagoon and current operational methods are not currently causing a significant environmental impact beyond, if the wetland area is considered part of the treatment facility. However, the existing facilities and operations are not in compliance with the Water Board license and Nunavut regulations.

A review of potential options included:

- Do nothing – not legal and environmental negligent
- Move the facility – costly and no compelling reason to move locations
- Upgrade the existing lagoon with a new larger lagoon, and incorporate the wetland treatment area as part of the treatment system – most cost effective and environmentally proactive option that will comply with Nunavut regulations.

The new lagoon designed for full annual sewage value retention in year 20 (2026) of the planning process, will be approximately 223 m x 223 m in size with a depth of 3.0 m. The Class C costs estimate for constructing the facility is $1,426,000.

9.2 Solid Waste Disposal Facility

9.2.1 Bulky Metals Area

The Bulky Metals Area is not currently or expected to, cause a significant environmental impact. It is operating in compliance with Nunavut regulations. The growing site of the facility is a concern from a planning and esthetics viewpoint. A review of potential options included:

- Nothing – a potentially viable option depending on the desires of the Hamlet site will continue to expand
- Move the facility – expensive and there is no completing reason to move
- Ship scrap out of Hamlet – prohibitively costly
- Burn some or all at the landfill – a cost effective, practical, and environmentally proactive solution in accordance with Nunavut regulations.

The Class C costs for burial of all of the current metal stockpile in a cell adjacent to the Bulky Metals Area is $185,000.

9.2.2 Municipal Solid Waste Disposal Area

An investigation of the existing landfill site indicates it is not causing a significant environmental impact, but has only a few years capacity remaining at the current operational filling practice. Several aspects are out of compliance with the Water Board license. A review of potential options included:

- Do nothing – does not meet Water Board license requirements and Nunavut regulations
- Move the site – expensive and no compelling reason to move site
- Expand and rehabilitate the existing site – most cost effective option to meet 20 year planning requirements in an environmentally proactive fashion in compliance with Nunavut regulations.

The Class C cost estimate to conduct the recommended works is $250,000.

9.3 Contaminated Soil Stockpile

An investigation of the contaminated soil stockpile revealed that permafrost has re-aggraded into the pile. Sampling of near surface soil indicates low levels of petroleum hydrocarbons. The stockpile is not currently causing a significant environmental impact. The site is not controlled and not a licensed waste disposal site. Sample results indicate the soil would be acceptable as landfill cover. Options evaluated included:

- Do nothing – site is uncontrolled and not licensed
- Move the stockpile to another site – should only be moved once to its final destination
- Ship soil out of Hamlet – cost prohibitive and not necessary
- Move soil to landfill as cover material – cost effective environmentally proactive option that meets Nunavut regulations.

9.4 Waste Oil and Hazardous Materials Area

Hamlet staff have done a good job segregating waste oil and hazardous materials, and stockpiling them. The area is unsecured and open to unauthorized dumping. Although there is currently no evidence of a significant environmental impact, the site is very vulnerable to a spill and the ratio of a significant impact. The facility is not licensed or secured in accordance with regulations. The options evaluated included:

- Do nothing – not acceptable from a regulatory and environmental protection view point

- Move facility – moving wastes to a more secure facility is an excellent short term solution, but provides no long term solution

- Ship out of community – the simplest and most environmental sound option, but is not cost effective or necessary for all materials

- On site treatment – suitable for some materials such as waste oil and paint, but not suitable for other material such as batteries.

The most cost effective and environmentally proactive option in accordance with Nunavut regulations would be to:

- Incinerate oil and glycol in a waste oil incinerator

- Reuse and recycle waste paint, and dry out remainder, then landfill

- Ship waste batteries out of the Hamlet to a southern recycling facility.

To handle these wastes in the future, a Hazardous Waste Depot cost has been included in the rehabilitation of the landfill site costing. The facility would be operated within the controlled area of the Solid Waste Disposal Site and under the Water Board license.

Class C cost estimate are:

• Disposal of waste oil via incineration	$150,000.
• Disposal of waste paint	$ 0.00
• Disposal of waste batteries	$ 7,000.
Total	**$157,000.**

9.5 Summary of Class C Cost Estimates

The total Class C costs for the recommended work is as follows:

• Sewage lagoon	$1,426,000.
• Solid Waste Disposal facility	
- Bulky Metals	$ 185,000
- Municipal Solid Waste Disposal Area	$ 250,000.
Subtotal	**$ 435,000.**
• Contaminated soil stockpile	$ 0.00

- Waste oil and hazardous wastes

- Waste oil	$ 150,000.
- Paint	$ 0.00
- Waste batteries	$ 7,000.
Subtotal	**$ 157,000.**
Total Class C Cost Estimate	**$1,161,400.**

9.6 Community Waste Management Plan

This schematic design report addresses the need to deal with the issues outlined in the RFP. There is however, an additional need to prevent the creation of future issues, and provide the Hamlet with a process to deal with wastes. A Community Waste Management Plan is needed to:

- Provide a step by step procedure to handle any and all wastes generated in the community or may be brought to the community from the surrounding area (i.e. military sites, mines, tourist camps, etc.)
- Provide a procedure for determining the process to handle privately generated wastes (from contractors and business) and community generated water
- Outline a methodology for the safe handling of household hazardous wastes, liquid wastes, and biomedical wastes
- Provide a flow chart showing waste segregation and handling procedures
- Determine the "real" costs for waste disposal so fees can be approximately charged to private business so the community is not burdened with the cost
- Provide an emergency response plan to handle spills and contaminated soil
- Develop the plan as a stand alone document accessible to all community members
- The plan should be prepared in conjunction with creation of a new Development and Operations Plan for the rehabilitated landfill site
- Determine the need to incorporate the plan into Hamlet bylaws for the control of wastes.

The plan would provide an easy to use document that will ensure environmentally proactive and cost effective handling of waste in the Hamlet.

10.0 Recommendations

Nuna Burnside provides the following recommendation based on the findings of this study:

1. This report should be reviewed by the Hamlet of Kugluktuk and Government of Nunavut, and their input and comments incorporated into the decision-making process.

2. Following the incorporation of the input of the Hamlet of Kugluktuk and Government of Nunavut, the project should move into the Detailed Design Phase so that tendering and construction can take place in 2006.

3. Prepare a Community Waste Management Plan that will layout a step by step process for handling and disposal of all (private and public) wastes in the Hamlet. This could be the basis for creating Hamlet waste by-laws and a disposal fee structure.

11.0 References

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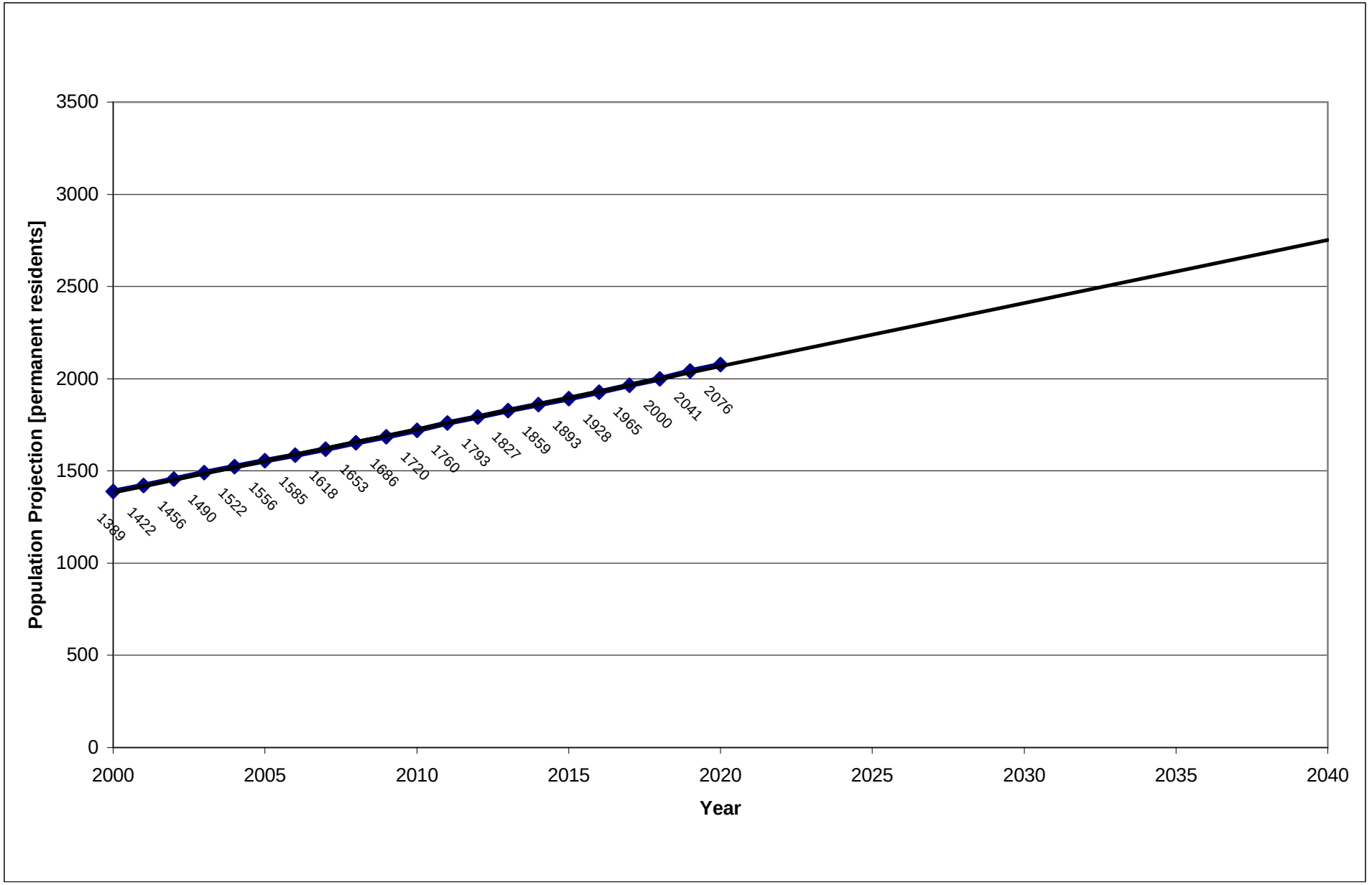
Tables

Table 1
Population Projection for the Hamlet of Kugluktuk, Nunavut



Population Data from the Nunavut Bureau of Statistics, March 2000

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Table 2
Projected Waste Volume for the Hamlet of Kugluktuk, Nunavut

Year	Calendar Year	Projected Population (people)	Annual Volume of Solid Waste (m^3)	Cumulative Volume of Solid Waste (m^3)	Annual Volume of Combustible Solid Waste (m^3)	Annual Volume of Combustible Solid Waste After Burning (m^3)	Annual Volume of Uncombustible Solid Waste (m^3)	Total Annual Volume of Uncombustible and Combusted (Burned) Solid Waste (m^3)	Annual Volume of Compacted Waste (m^3)	Annual Volume of Cover Material (m^3)	Total Annual Volume of Compacted Waste and Cover Material (m^3)	Cumulative Landfill Volume (m^3)
0	2006	1585	8099.4	8099.4	6803.5	3401.7	1295.9	4697.6	1565.7	313.1	1878.9	1878.9
	2007	1618	8268.0	16367.4	6945.1	3472.6	1322.9	4795.4	1598.3	319.7	1918.0	3796.9
	2008	1653	8446.8	24814.2	7095.3	3547.7	1351.5	4899.2	1632.9	326.6	1959.5	5756.3
	2009	1686	8615.5	33429.7	7237.0	3618.5	1378.5	4997.0	1665.5	333.1	1998.6	7754.9
	2010	1720	8789.2	42218.9	7382.9	3691.5	1406.3	5097.7	1699.1	339.8	2038.9	9793.8
5	2011	1760	8993.6	51212.5	7554.6	3777.3	1439.0	5216.3	1738.6	347.7	2086.3	11880.1
	2012	1793	9162.2	60374.7	7696.3	3848.1	1466.0	5314.1	1771.2	354.2	2125.4	14005.6
	2013	1827	9336.0	69710.7	7842.2	3921.1	1493.8	5414.9	1804.8	361.0	2165.7	16171.3
	2014	1859	9499.5	79210.2	7979.6	3989.8	1519.9	5509.7	1836.4	367.3	2203.7	18374.9
	2015	1893	9673.2	88883.4	8125.5	4062.8	1547.7	5610.5	1870.0	374.0	2244.0	20618.9
10	2016	1928	9852.1	98735.5	8275.7	4137.9	1576.3	5714.2	1904.5	380.9	2285.5	22904.4
	2017	1965	10041.2	108776.6	8434.6	4217.3	1606.6	5823.9	1941.1	388.2	2329.3	25233.7
	2018	2000	10220.0	118996.6	8584.8	4292.4	1635.2	5927.6	1975.7	395.1	2370.8	27604.5
	2019	2041	10429.5	129426.1	8760.8	4380.4	1668.7	6049.1	2016.2	403.2	2419.4	30023.9
	2020	2076	10608.4	140034.5	8911.0	4455.5	1697.3	6152.8	2050.7	410.1	2460.9	32484.8
15	2021	2107	10767.5	150802.0	9044.7	4522.3	1722.8	6245.1	2081.5	416.3	2497.8	34982.6
	2022	2139	10929.0	161731.0	9180.4	4590.2	1748.6	6338.8	2112.7	422.5	2535.3	37517.9
	2023	2171	11092.9	172823.9	9318.1	4659.0	1774.9	6433.9	2144.4	428.9	2573.3	40091.2
	2024	2203	11259.3	184083.2	9457.8	4728.9	1801.5	6530.4	2176.6	435.3	2611.9	42703.1
	2025	2236	11428.2	195511.4	9599.7	4799.9	1828.5	6628.4	2209.2	441.8	2651.1	45354.1
20	2026	2270	11599.6	207111.1	9743.7	4871.8	1855.9	6727.8	2242.4	448.5	2690.8	48045.0
	2027	2304	11773.6	218884.7	9889.9	4944.9	1883.8	6828.7	2276.0	455.2	2731.2	50776.2
	2028	2339	11950.2	230835.0	10038.2	5019.1	1912.0	6931.1	2310.1	462.0	2772.2	53548.4
	2029	2374	12129.5	242964.5	10188.8	5094.4	1940.7	7035.1	2344.8	469.0	2813.8	56362.1
	2030	2409	12311.4	255275.9	10341.6	5170.8	1969.8	7140.6	2380.0	476.0	2856.0	59218.1
25	2031	2445	12496.1	267772.0	10496.7	5248.4	1999.4	7247.7	2415.7	483.1	2898.8	62116.9
	2032	2482	12683.5	280455.5	10654.2	5327.1	2029.4	7356.5	2451.9	490.4	2942.3	65059.2
	2033	2519	12873.8	293329.3	10814.0	5407.0	2059.8	7466.8	2488.7	497.7	2986.4	68045.6
	2034	2557	13066.9	306396.3	10976.2	5488.1	2090.7	7578.8	2526.0	505.2	3031.2	71076.8
	2035	2595	13262.9	319659.2	11140.8	5570.4	2122.1	7692.5	2563.9	512.8	3076.7	74153.5
30	2036	2634	13461.9	333121.0	11308.0	5654.0	2153.9	7807.9	2602.4	520.5	3122.8	77276.4
	2037	2674	13663.8	346784.8	11477.6	5738.8	2186.2	7925.0	2641.4	528.3	3169.7	80446.1
	2038	2714	13868.7	360653.5	11649.7	5824.9	2219.0	8043.9	2681.0	536.2	3217.2	83663.3
	2039	2755	14076.8	374730.3	11824.5	5912.2	2252.3	8164.5	2721.2	544.2	3265.5	86928.8
	2040	2796	14287.9	389018.2	12001.9	6000.9	2286.1	8287.0	2762.1	552.4	3314.5	90243.2
35	2041	2838	14502.2	403520.5	12181.9	6090.9	2320.4	8411.3	2803.5	560.7	3364.2	93607.4
	2042	2881	14719.8	418240.3	12364.6	6182.3	2355.2	8537.5	2845.5	569.1	3414.6	97022.1
	2043	2924	14940.6	433180.8	12550.1	6275.0	2390.5	8665.5	2888.2	577.6	3465.9	100487.9
	2044	2968	15164.7	448345.5	12738.3	6369.2	2426.3	8795.5	2931.5	586.3	3517.9	104005.8
	2045	3012	15392.2	463737.7	12929.4	6464.7	2462.7	8927.4	2975.5	595.1	3570.6	107576.4
40	2046	3057	15623.0	479360.7	13123.3	6561.7	2499.7	9061.4	3020.2	604.0	3624.2	111200.6

Table 3
Sewage Generation Rate for the Hamlet of Kugluktuk, Nunavut

Sewage Generation Rate 100 lpcd

Planning Year	Calendar Year	Total Population	Projected Sewage generation (lpcd)	Projected Volume (litres/day)	Projected Volume (litres/year)	Projected Sludge Volume (m^3/annum)	Cumulative Sludge Volume (m^3)	BOD (mg/l)	TSS (mg/l)	T-PO_4 (mg/l)	TKN (mg/l)	Faecal Coliforms (C.F.U./100ml)
0	2006	1585	136.5	216,281	78,942,629	28.9	28.9	329.8	351.8	16.9	87.9	6.96E+07
	2007	1618	137.2	222,012	81,034,472	29.5	58.4	328.0	349.8	16.8	87.5	6.92E+07
	2008	1653	138.0	228,145	83,273,074	30.2	88.6	326.0	347.8	16.7	86.9	6.88E+07
	2009	1686	138.8	233,980	85,402,593	30.8	119.4	324.3	345.9	16.6	86.5	6.85E+07
	2010	1720	139.6	240,043	87,615,768	31.4	150.8	322.4	343.9	16.5	86.0	6.81E+07
5	2011	1760	140.5	247,245	90,244,352	32.1	182.9	320.3	341.7	16.4	85.4	6.76E+07
	2012	1793	141.2	253,242	92,433,157	32.7	215.6	318.6	339.8	16.3	85.0	6.73E+07
	2013	1827	142.0	259,472	94,707,414	33.3	248.9	316.9	338.0	16.2	84.5	6.69E+07
	2014	1859	142.8	265,385	96,865,621	33.9	282.9	315.2	336.2	16.1	84.1	6.65E+07
	2015	1893	143.5	271,719	99,177,554	34.5	317.4	313.5	334.4	16.0	83.6	6.62E+07
10	2016	1928	144.3	278,295	101,577,760	35.2	352.6	311.8	332.5	15.9	83.1	6.58E+07
	2017	1965	145.2	285,308	104,137,484	35.9	388.5	309.9	330.6	15.8	82.6	6.54E+07
	2018	2000	146.0	292,000	106,580,000	36.5	425.0	308.2	328.8	15.8	82.2	6.51E+07
	2019	2041	146.9	299,911	109,467,392	37.2	462.2	306.2	326.7	15.7	81.7	6.47E+07
	2020	2076	147.7	306,725	111,954,570	37.9	500.1	304.6	324.9	15.6	81.2	6.43E+07
15	2021	2107	148.5	312,835	114,184,737	38.5	538.6	303.1	323.3	15.5	80.8	6.40E+07
	2022	2139	149.2	319,082	116,465,007	39.0	577.6	301.6	321.7	15.4	80.4	6.37E+07
	2023	2171	149.9	325,470	118,796,633	39.6	617.2	300.1	320.2	15.3	80.0	6.34E+07
	2024	2203	150.7	332,002	121,180,905	40.2	657.4	298.7	318.6	15.3	79.6	6.30E+07
	2025	2236	151.4	338,683	123,619,146	40.8	698.2	297.2	317.0	15.2	79.2	6.27E+07
20	2026	2270	152.2	345,514	126,112,716	41.4	739.7	295.6	315.4	15.1	78.8	6.24E+07
	2027	2304	153.0	352,501	128,663,012	42.0	781.7	294.1	313.7	15.0	78.4	6.21E+07
	2028	2339	153.8	359,648	131,271,469	42.7	824.4	292.6	312.1	15.0	78.0	6.18E+07
	2029	2374	154.6	366,958	133,939,561	43.3	867.7	291.1	310.5	14.9	77.6	6.15E+07
	2030	2409	155.4	374,435	136,668,802	44.0	911.7	289.6	308.9	14.8	77.2	6.11E+07
25	2031	2445	156.2	382,084	139,460,748	44.6	956.3	288.0	307.2	14.7	76.8	6.08E+07
	2032	2482	157.1	389,910	142,316,997	45.3	1001.6	286.5	305.6	14.6	76.4	6.05E+07
	2033	2519	157.9	397,916	145,239,193	46.0	1047.6	284.9	303.9	14.6	76.0	6.01E+07
	2034	2557	158.8	406,107	148,229,021	46.7	1094.2	283.4	302.2	14.5	75.6	5.98E+07
	2035	2595	159.7	414,488	151,288,217	47.4	1141.6	281.8	300.6	14.4	75.1	5.95E+07
30	2036	2634	160.6	423,065	154,418,562	48.1	1189.7	280.2	298.9	14.3	74.7	5.92E+07
	2037	2674	161.5	431,841	157,621,886	48.8	1238.5	278.6	297.2	14.2	74.3	5.88E+07
	2038	2714	162.4	440,822	160,900,071	49.5	1288.0	277.1	295.5	14.2	73.9	5.85E+07
	2039	2755	163.4	450,014	164,255,050	50.3	1338.3	275.5	293.8	14.1	73.5	5.82E+07
	2040	2796	164.3	459,421	167,688,810	51.0	1389.3	273.9	292.1	14.0	73.0	5.78E+07
35	2041	2838	165.3	469,050	171,203,393	51.8	1441.1	272.3	290.4	13.9	72.6	5.75E+07
	2042	2881	166.3	478,907	174,800,897	52.6	1493.7	270.7	288.7	13.8	72.2	5.71E+07
	2043	2924	167.2	488,996	178,483,478	53.4	1547.0	269.1	287.0	13.8	71.8	5.68E+07
	2044	2968	168.3	499,324	182,253,354	54.2	1601.2	267.4	285.3	13.7	71.3	5.65E+07
	2045	3012	169.3	509,898	186,112,803	55.0	1656.2	265.8	283.6	13.6	70.9	5.61E+07
40	2046	3057	170.3	520,724	190,064,166	55.8	1712.0	264.2	281.8	13.5	70.5	5.58E+07

Table 4
Calculated Sewage Lagoon Dimensions

SEWAGE NEW LAGOON DIMENSIONS				**USABLE LAGOON CAPACITY DIMENSIONS**			
d = depth of the lagoon	=	4	m	Usable Depth =	=	3	m
SS = slope of the sides of the lagoon	=	3		Top Length, L	=	217	m
ES = slope of the ends of the lagoon	=	3		Top Width, L	=	217	m
L = Length of the top of the lagoon	=	223	m	Bottom Length, BL	=	199	m
W = Width of the top of the lagoon	=	223	m	Bottom Width, BW	=	199	m
F = Freeboard Allowance	=	1	m				
Calculations				***Calculations***			
A_t = L x W	=	49729	m^2	A_t = L x W	=	47089	m^2
A_b = (L - 2 x ES x d) (W - 2 x SS x d)	=	39601	m^2	A_b = (L - 2 x ES x d) (W - 2 x SS x d)	=	39601	m^2
A_m = (L - ES x d)(W - SS x d)	=	44521	m^2	A_m = (L - ES x d)(W - SS x d)	=	43264	m^2
V = Total Volume New Lagoon	=	178276	m^3	V = Total Usable Volume	=	**129873**	**m^3**

Assume

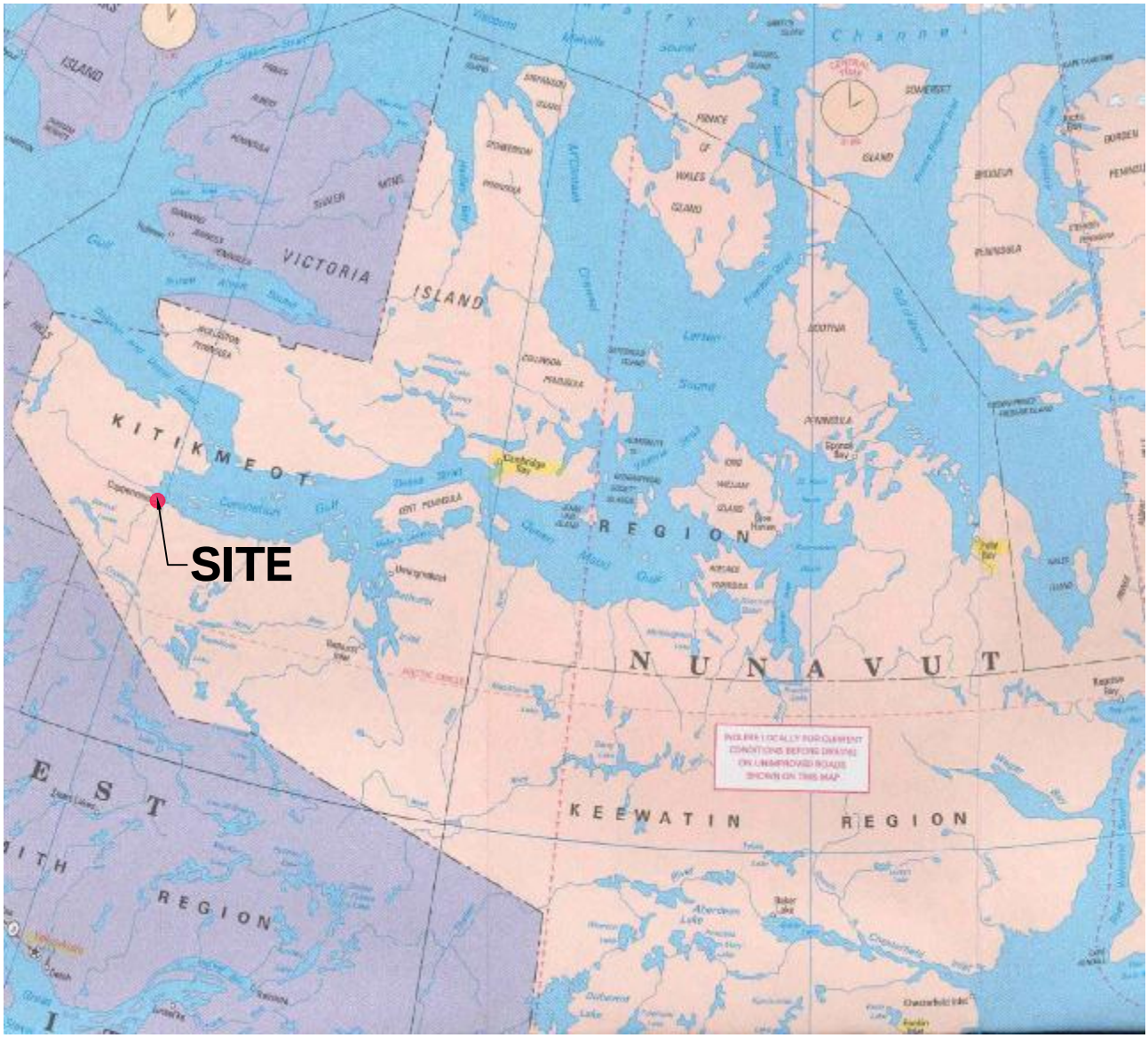
2 m Berm top width around perimeter

BERM DETAILS	=	32	[metres^2]/m
Length Berm	=	7136	m^3
Width Berm	=	7136	m^3
Total Berm	=	28544	m^3

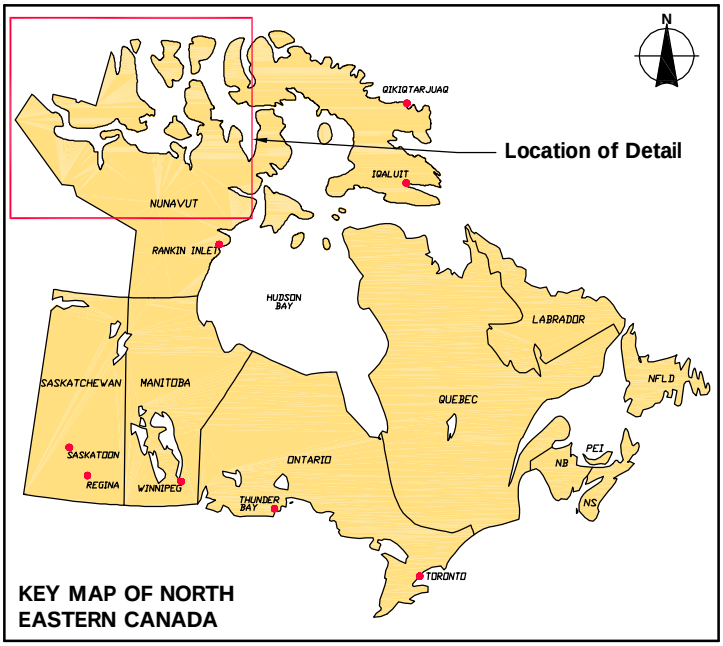
Table 5:
Summary of Sewage Report Data for the Hamlet of Kugluktuk, Nunavut

Parameter	Units	Historic Data														Current Data				Nunavut Requirements	
Sample Date		21-Sep-96	21-Sep-96	21-Sep-96	21-Aug-96	28-Aug-98	8-Jul-98	26-Aug-02	22-Jul-04	14-Oct-04	14-Oct-04	10-Aug-04	10-Aug-04	9-Sep-04	9-Sep-04	23-Jun-04	23-Jun-04	4-Oct-05	4-Oct-05	4-Oct-05	4-Oct-05	Existing	Proposed
Sample ID		1526-2c	1526-2b	1526-2a	1526-1	@ ocean	@ cornation			KUG-2	KUG-4	KUG-2	KUG-4	KUG-2	KUG-4	KUG-2	KUG-4	WS1	WS2	WS3	WS4	Criteria	Criteria
Total Metals - CCME																					
Total Trace Metals																					
Silver	mg/L								nd									nd	nd	nd	nd		
Aluminum	mg/L								75									1.78	0.2	0.21	0.1		
Arsenic	mg/L								nd	4	nd	nd	1	2	3	nd	nd	0.0015	0.0008	0.0012	0.0012		
Boron	mg/L																	0.14	0.05	0.06	nd		
Barium	mg/L								10.4									0.016	0.019	0.023	0.013		
Beryllium	mg/L								nd									nd	nd	nd	nd		
Cadmium	mg/L								nd	0.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		
Cobalt	mg/L								0.4									nd	nd	nd	nd		
Chromium	mg/L								nd	5.7	2.5	0.6	0.8	0.6	nd	0.5	1.2	nd	nd	nd	nd		
Copper	mg/L								3.3	49.2	8.9	2.6	1.7	4.6	7.6	3.3	4.1	0.075	0.016	0.021	0.003		
Mercury	mg/L								nd	nd	nd	0.04	nd	nd	nd	nd	nd	nd	nd	nd	nd		
Lithium	mg/L								1.5									nd	nd	nd	nd		
Molybdenum	mg/L								nd									nd	nd	nd	nd		
Nickel	mg/L								0.6	9.7	2.2	1.5	2.4	2	2.7	0.8	1.8	h	0.002	0.003	0.003		
Lead	mg/L								0.1	4.7	0.4	0.1	0.2	0.2	1.4	0.2	0.6	0.0026	0.0006	0.0007	0.0002		
Antimony	mg/L								0.5									0.0023	0.0012	0.0007	nd		
Selenium	mg/L								nd									0.0009	nd	nd	nd		
Tin	mg/L																	nd	nd	nd	nd		
Titanium	mg/L								2.8									0.01	0.011	0.015	0.003		
Thallium	mg/L								0.4									nd	nd	nd	nd		
Uranium	mg/L								nd									0.0001	nd	nd	nd		
Vanadium	mg/L								0.5									0.002	nd	nd	0.001		
Zinc	mg/L								nd	63	20	nd	nd	nd	22	11		0.14	0.018	0.022	nd		
Total Major Metals																					
Calcium	mg/L				5.14				8.5	251	14	38.1	25.6	15.9	45.6	30	6.6	19.9	17	18.1	19		
Potassium	mg/L				0.42				1.3	7.6	3.6	1.66	2.86	2.3	2	1.97	2.08	23	6.9	13.2	4.8		
Magnesium	mg/L				2.15				7.1	118	10.8	21.2	12.1	11.5	21.1	12.3	4.9	10.6	11.8	12.3	13.9		
Sodium	mg/L				0.58				16.7	106	30.8	19.2	31.2	28.2	18.5	12.6	14.8	95	46	57	40		
Iron	mg/L								1810	11500	3550	262	2530	1550	5050	809	2391	1.16	1.42	4.82	6.14		
Manganese	mg/L								122									0.143	0.153	0.225	0.551		
Ammonia-N	mg/L					4.68	0.003	9.8	1.21	7	14	0.018	4.34	6.1	0.006	0.006	2.68	94	22.5	34.3	12.4		
Bio Oxygen Demand (BOD)	mg/L	18	24	138			35			19	11	3	4	4	4	5	8	276	68	81	8	120	45
MF - Fecal Coli forms	CFU/100mL	30	3000	1.10E+06					150	900	500	8	56	7240	119	240	3400	1.30E+07	1.90E+06	1.50E+06	4.00E+03	1.00E+06	2.00E+03
Oil and Grease	mg/L									nd	nd	nd	nd			nd	nd	22		7	nd	No visible sheen	
Phenols	mg/L								nd	1.1	1.6	nd	0.5			4.4		0.465	0.098	0.119	0.029		
Total Suspended Solids	mg/L					4	5	20	6	1540	4	nd	4	14	6	6	18	95	14	34	7	180	45
pH	pH				7.61				7.69	7.54	7.25	8.22	7.49	7.22	7.51	7.61	7.2	7.4	7.4	7.5	7.5	between 6 and 9	
Total Phosphorous (T-PO4)	mg/L							0.197	0.24														1
Total Kjeldahl Nitrogen (TKN)	mg/L																						10

Figures



Map Reference:
Map of Canada
Published by the CAA



KEY MAP OF NORTH EASTERN CANADA

FIGURE 1 - SITE LOCATION MAP

THE HAMLET OF KUGLUKTUK, NUNAVUT

SCHEMATIC DESIGN

October 2005
Project Number: N-O 09755.0

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 SD SL.DWG

FIGURE 2

HAMLET OF KUGLUKTUK
SCHEMATIC DESIGN

COMMUNITY PLAN

Image Platform: Quick Bird (Satellite)
Image Acquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 200 400 600 800 1000 1200 1400 1600
Meters

1:20,000
October 2005
Project Number: N-O 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 SD COMMUNITY PLAN.DWG

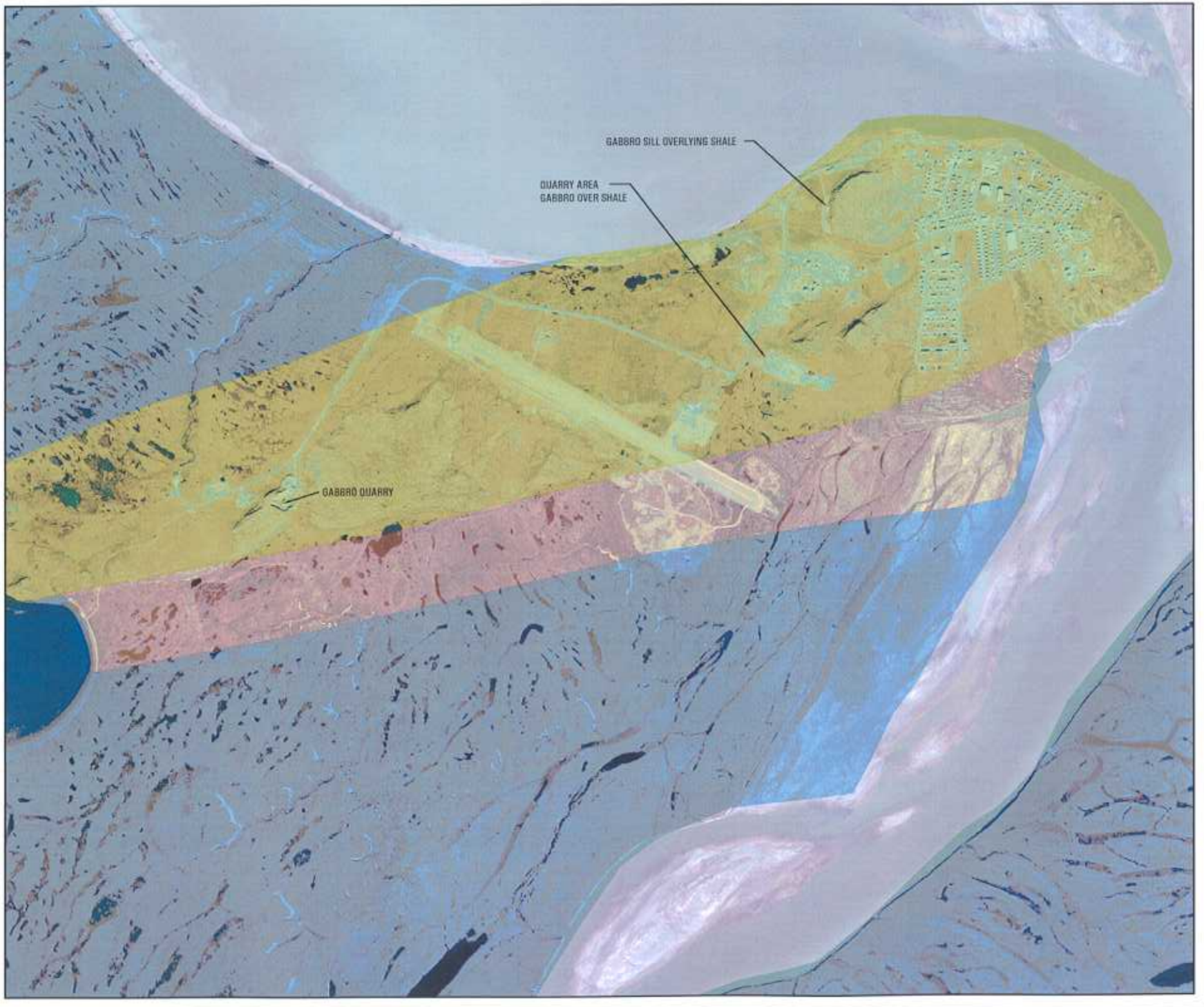


FIGURE 3

HAMLET OF KUGLUKTUK
SCHEMATIC DESIGN

BEDROCK GEOLOGY

Legend

- CORONATION SILLS (and associated dykes): gabbro
- PROTEROZOIC HADRYNIAN RAE GROUP Shaly Sandstone, Siltstone, Shale
- GLACIAL DRIFT

Geology Source: Geological Survey of Canada, "Geology, Coppermine, District of Mackenzie", Map 1337A, Paper 71-39, 1973

Image Platform: Quick Bird (Satellite)
Image Acquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 200 400 600 800 1000 1200 1400 1600
Meters

1:20,000
October 2005
Project Number: N 0 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

NUNA BURNSIDE

FE009754 SD BEDROCK GEOLOGY.DWG

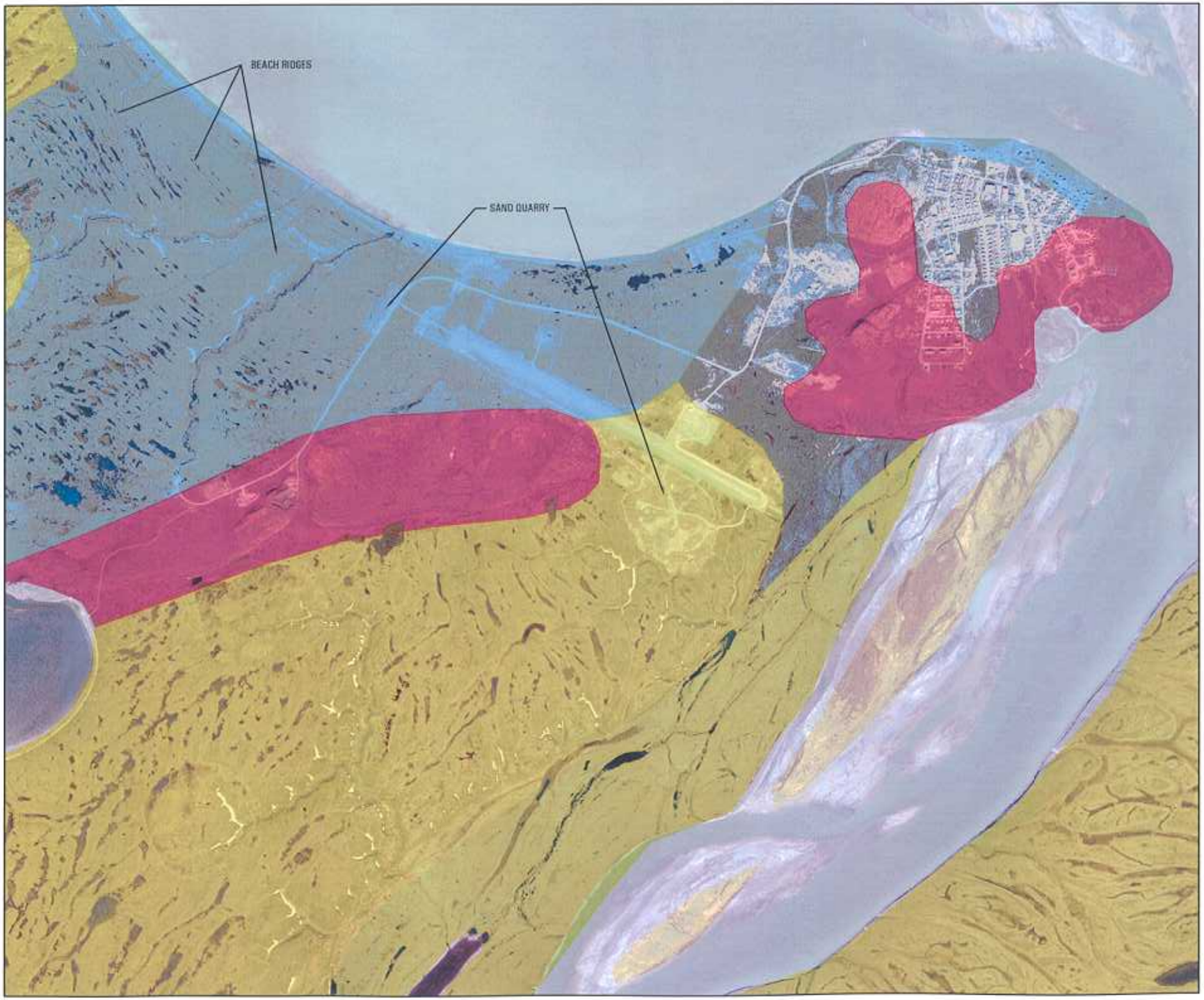


FIGURE 4

HAMLET OF KUGLUKTUK
SCHEMATIC DESIGN

SURFICIAL GEOLOGY

Legend

POST-LAST GLACIATION

- Floodplain Sediments: coarse sand and gravel; 3 to 10 m thick; veneer of pebble and boulder lag common on surface
- Terraced Sediments: fine to coarse sand with minor gravel lenses; wood and peaty material common; 3 to 10 m thick; terrace surfaces commonly gullied or channelled
- Deltaic sediments: boulders, gravel, and sand; 5 to 20 m thick; deeply channelled surfaces with boulder pavements at the bottom of channels
- Littoral Sediments: medium to coarse grained sand with minor gravel; 1 to 5 m thick; blanket deposit with flat to gently undulating surface and with occasional beach ridges

LAST GLACIATION

- Till, washed: boulders and gravel on bedrock surface; 1 to 3 m thick; concentration resulting from washing out of fines by meltwater flow

PRE-QUATERNARY

- Rocks of Middle to Late Proterozoic Coppermine Homocline: sedimentary and volcanic successions, gabbro and diabase sills

Geology Source: 1988: Surficial Geology, Coppermine River, District of Mackenzie, Northwest Territories, Geological Survey of Canada, Map 1645A.

Image Platform: Quick Bird (Satellite)
Image Acquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 200 400 600 800 1000 1200 1400 1600
Meters

1:20,000
October 2005
Project Number: N 0 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

Nunn BURNSIDE

FE009754 SD SURFICIAL GEOLOGY.DWG

FIGURE 5

HAMLET OF KUGLUKTUK

SEWAGE LAGOON AND MUNICIPAL SOLID WASTE AREA

Legend

- TEST PIT LOCATION
- SURFACE WATER SAMPLE LOCATION

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 20 40 60 80 100 120 140 160

Meters

1:2,000
October 2005
Project Number: N-0 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 SD LANDFILL AREA.DWG

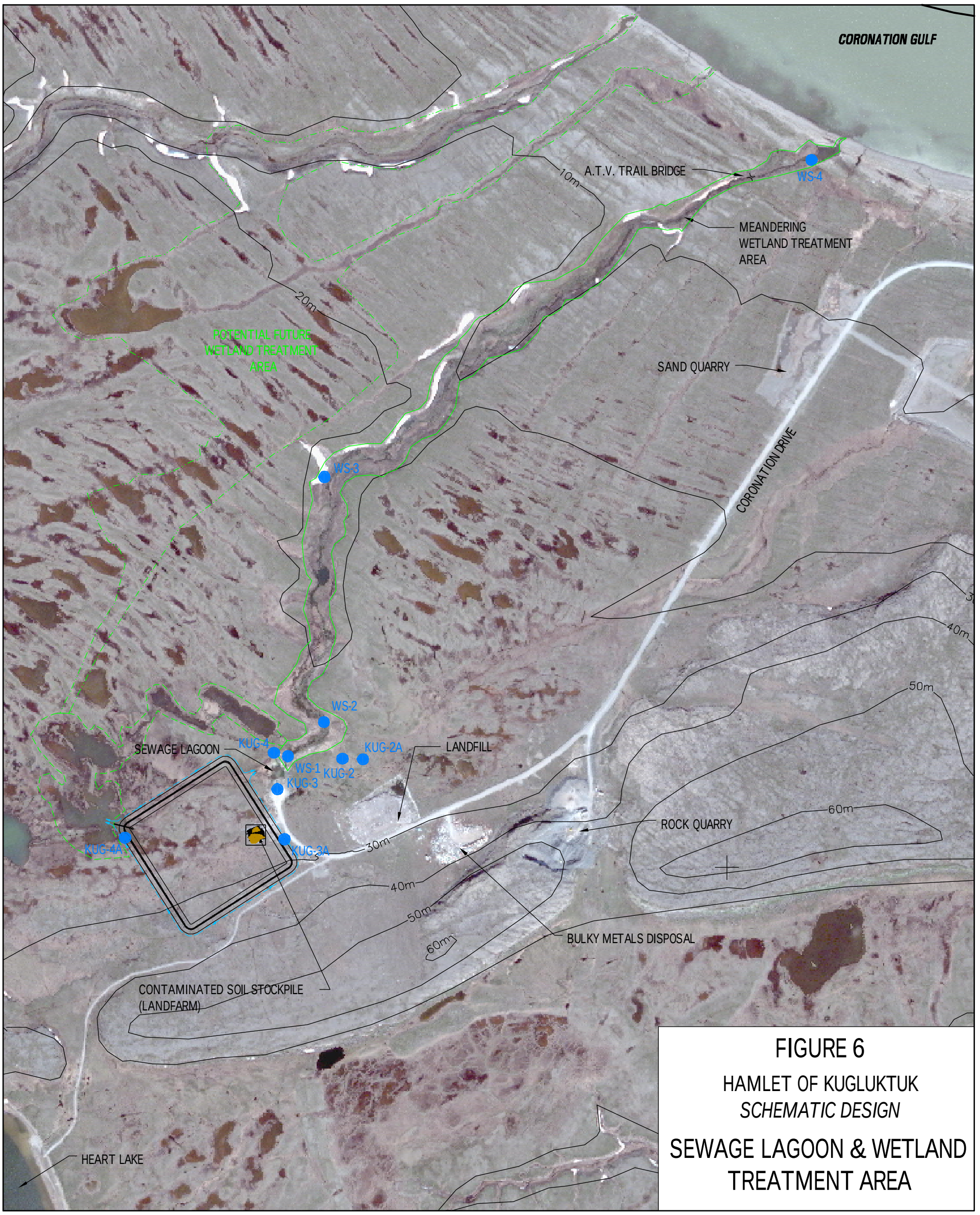


FIGURE 6

HAMLET OF KUGLUKTUK

SCHEMATIC DESIGN

SEWAGE LAGOON & WETLAND TREATMENT AREA

Legend

- **SURFACE WATER SAMPLE LOCATION**
- 50m — **EXISTING CONTOURS (m amsl) obtained from National Topographic Survey Digital Data Contour interval 10m**
- **OUTLINE OF WETLAND TREATMENT AREA (10 ha)**
- **OUTLINE OF EXPANDED WETLAND TREATMENT AREA (5.1 ha)**
- **OUTLINE OF POTENTIAL FUTURE WETLAND TREATMENT AREA *(If required)* (29.9 ha)**

N

Image Platform: Quick Bird (Satellite)
Image Acquisition: 01 July, 2002
Spatial Resolution: 0.6m

0 100 200 300 400 500 600
Meters

1:7,500
November 2005
Project Number: N-0-09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

FEO09754 SD SEWAGE SP.DWG

FIGURE 7

HAMLET OF KUGLUKTUK

CONTAMINATED SOIL AND WASTE OIL STORAGE AREA

Legend

- TEST PIT LOCATION
- GROUNDWATER SAMPLE LOCATION
- SOIL SAMPLE LOCATION
- EXISTING GEOTEXTILE LINER
- 23.50 — EXISTING CONTOURS (m amsl) by Ollerhead & Associates Ltd. Contour interval 0.25m

Image Source: © Copyright 2002 DigitalGlobe Inc., All Rights Reserved.

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July 2002
Spatial Resolution: 0.6m

N

0 5 10 15 20 25 30 35 40

Meters

1:500
November 2005
Project Number: N-O 09755.0

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 SD CONTAMINATED SOIL.DWG

FIGURE 8

HAMLET OF KUGLUKTUK

BULKY METALS DISPOSAL AREA

Legend

- APPROXIMATE OUTLINE OF BULKY METALS DISPOSAL AREA
  6340m²
- PROPOSED CONTAINMENT BERM
  Length of berm around Bulky Metals Cell 1 = 184 m
  Length of additional berm around Proposed Future Bulky Metals Disposal Cell 2 = 179 m
- PROPOSED DIVERSION DITCHING

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July 2002
Spatial Resolution: 0.6m

N

0 10 20 30 40 50 60 70 80
Meters

1:750
October 2005
Project Number: N-O 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 SD BULKY METALS SP.DWG

FIGURE 9

HAMLET OF KUGLUKTUK

MUNICIPAL SOLID WASTE DISPOSAL AREA

Legend

- OUTLINE OF FILL AREA 8220m^2
- TEST PIT LOCATION
- GROUND WATER SAMPLE LOCATION
- FENCED AREA SET ASIDE FOR LANDFILLING - 12400m^2

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July 2002
Spatial Resolution: 0.6m

N

0 10 20 30 40 50 60
Meters

1:750
October 2005
Project Number: N-O 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

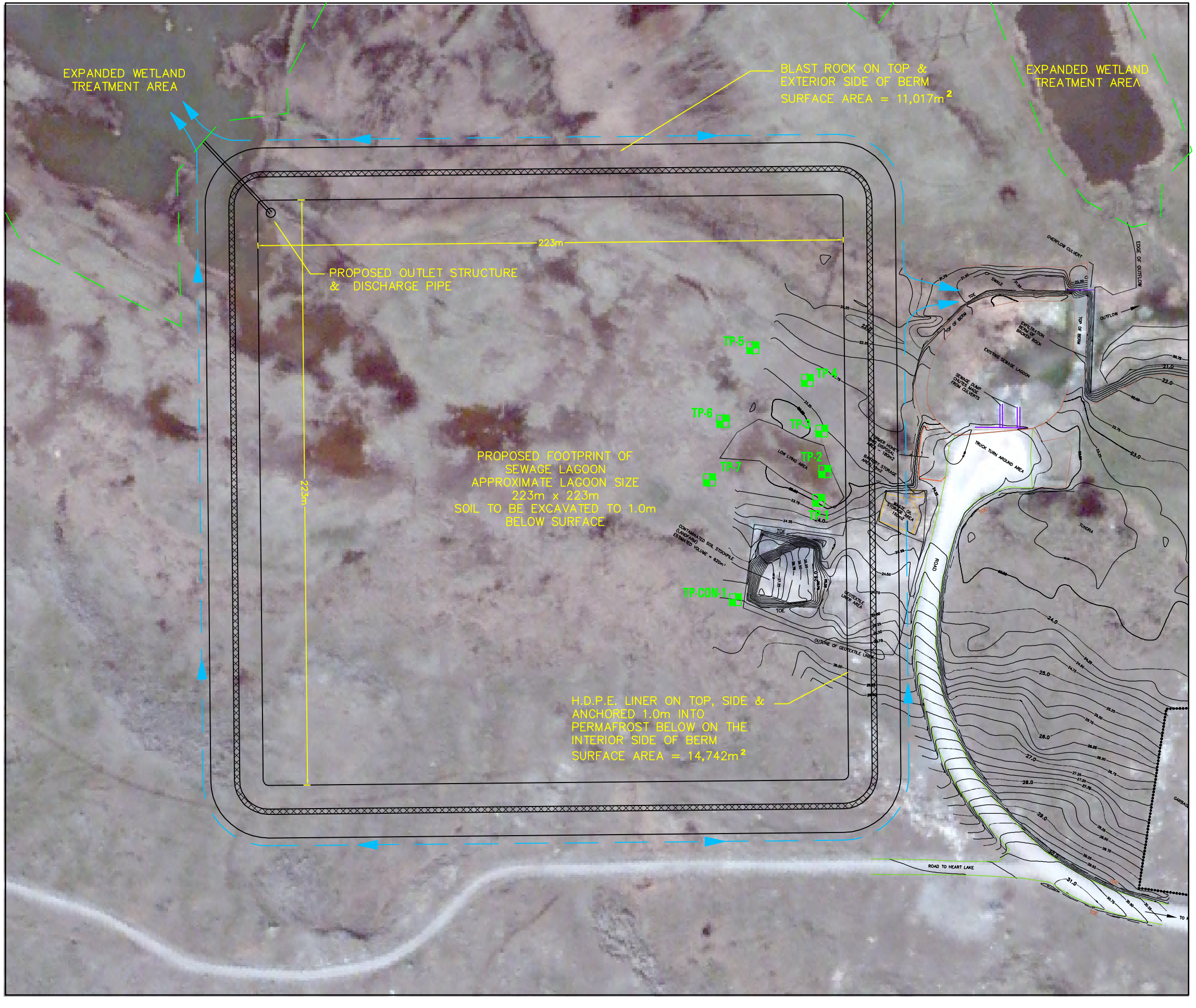
BURNSIDE

FEO09755 SD LANDFILL SP.DWG

FIGURE 10

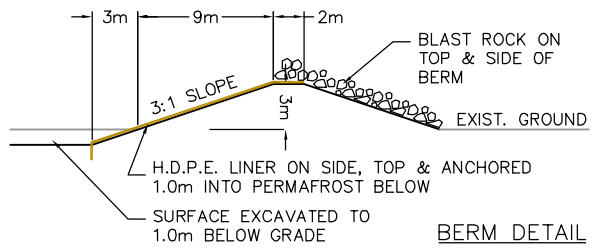
HAMLET OF KUGLUKTUK

RECOMMENDED OPTION FOR UPGRADING AND EXPANDING THE SEWAGE LAGOON



Legend

- TEST PIT LOCATION
- 23.25 — EXISTING CONTOURS (m amsl) by Ollerhead & Assoc. Ltd. Contour interval 0.25m
- PROPOSED CONTAINMENT BERM
  Length of berm around additional Landfill area = 446m
  Length of berm around proposed Bulky Metals Disposal area = 95m
- PROPOSED DIVERSION DITCHING
- OUTLINE OF EXPANDED WETLAND TREATMENT AREA



BERM DETAIL

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July, 2002
Spatial Resolution: 0.6m

Wastewater lagoon site details provided by Ollerhead & Associates Ltd., Canada Lands Surveyors and Engineers, Topographic survey dated September 2004.

N

0 10 20 30 40 50 60 70 80 90 100 110 120

Meters

1:1,500
October 2005
Project Number: N-O 09755.0

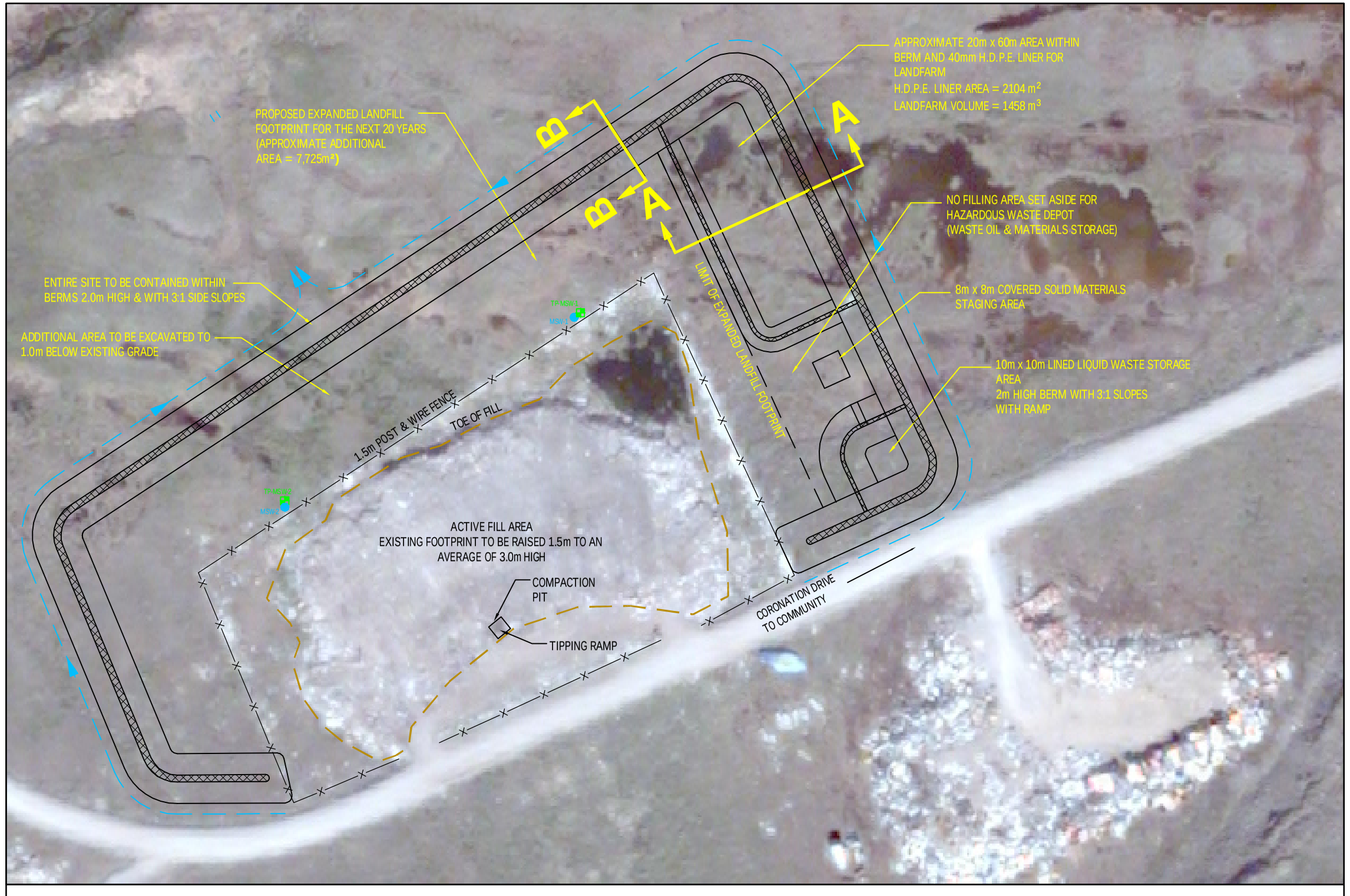
Projection: UTM Zone 16
Datum: NAD83

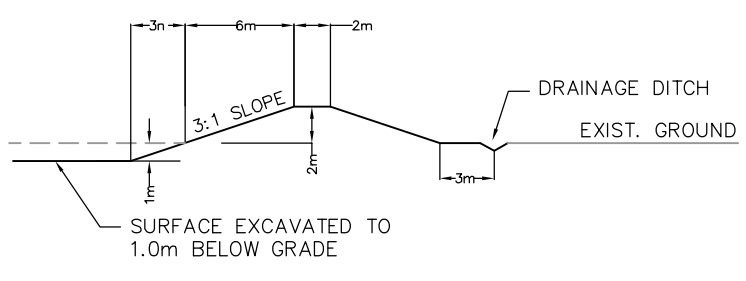
Prepared by: C. Sheppard

Verified by: J. Walls

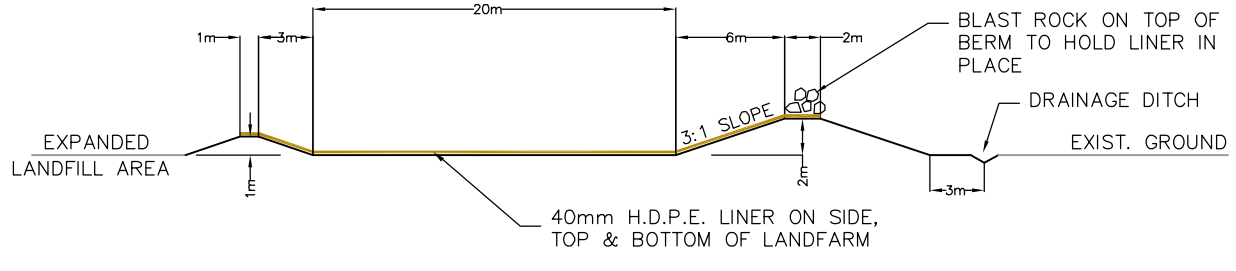
NUNA BURNSIDE

FEO09754 SD UPGRADED LAGOON.DWG





CROSS SECTION B–B
BERM DETAIL



CROSS SECTION A–A
PROPOSED LANDFARM
DISPOSAL AREA DETAIL

FIGURE 11

HAMLET OF KUGLUKTUK

RECOMMENDED OPTION FOR UPGRADING THE SOLID WASTE DISPOSAL FACILITY

Legend

- OUTLINE OF CURRENT FILL AREA 8220m²
- TEST PIT LOCATION
- GROUND WATER SAMPLE LOCATION
- FENCED AREA SET ASIDE FOR CURRENT LANDFILLING - 12400m²
- PROPOSED EXTERIOR CONTAINMENT BERM
  Length of berm around additional Landfill area = 515 m
- PROPOSED DIVERSION DITCHING

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July 2002
Spatial Resolution: 0.6m

N

0 10 20 30 40 50 60 70 80 90 100
Meters

1:1,250
December 2005
Project Number: N-O 09755.0

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

NUNA BURNSIDE

FEO09755 SD UPGRADED LANDFILL SP.DWG

Appendix A
Climatological Information for Kugluktuk

Appendix A
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Temperature: Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	-27.8	-27.4	-25.3	-17	-5.3	5.2	10.7	8.8	2.8	-7.2	-19.6	-25.5		C
Standard Deviation	3.8	4.2	3.2	3	3.2	2	2	1.9	1.5	2.5	4.3	3.4		C
Daily Maximum (°C)	-23.7	-23	-20.6	-12.1	-1.4	9.5	15.4	13.1	6	-4	-15.7	-21.4		C
Daily Minimum (°C)	-31.9	-31.7	-29.8	-21.8	-9.2	0.8	6	4.5	-0.4	-10.3	-23.4	-29.6		C
Extreme Maximum (°C)	0.8	-1.2	-0.1	14	19.8	31.1	34.9	29.2	22.6	13.4	2.8	27.4		
Date (yyyy/dd)	1981/16	1980/07	1999/22	2000/06	1994/24	1996/25	1989/15	2000/01	1994/01	1988/06	1983/03	1999/19		
Extreme Minimum (°C)	-46.9	-47.2	-47	-39.7	-30.2	-12.1	0.3	-4.4	-18.9	-35.4	-41	-44.5		
Date (yyyy/dd)	2002/21	1998/20	1979/05	1979/04	1983/03	2000/01	1978/04+	1995/29	2000/26	1996/29	1985/24	1977/12		
Precipitation: Precipitation:														
Rainfall (mm)	0	0	0	0.6	5.8	12.8	36.3	40.8	32.1	5.1	0	0	133.5	C
Snowfall (cm)	15.4	16.5	16	17.8	16.6	2.7	0	0.3	8.1	34.1	19.7	18.6	165.8	C
Precipitation (mm)	11	9.9	10.6	13.3	19.5	15.1	36.3	41.1	39	29.5	12.6	11.5	249.4	C
Average Snow Depth (cm)	35	43	47	48	28	3	0	0	0	9	20	28		C
Median Snow Depth (cm)	36	42	47	49	28	1	0	0	0	9	19	28		C
Snow Depth at Month-end (cm)	38	45	48	42	15	0	0	0	2	17	24	32		C
Extreme Daily Rainfall (mm)	0	0	0	7.4	20.6	27.4	30.5	53.7	28.8	19.3	3.4	0		
Date (yyyy/dd)	1978/01+	1978/06+	1978/01+	1980/27	1992/27	1987/13	1983/10	1982/12	1983/07	1980/08	2001/17	1977/01+		
Extreme Daily Snowfall (cm)	26.2	24.6	8.6	16	21	13	0.4	5	13.5	23	12.4	26		
Date (yyyy/dd)	1988/01	1981/21	2000/27	1980/30	1993/07	1991/05	1985/07	1986/23	1981/22	1981/29	1981/06	1994/25		
Extreme Daily Precipitation (mm)	25.8	9.1	6	16	21.8	27.4	30.5	53.7	28.8	23	12.4	14.8		
Date (yyyy/dd)	1988/01	1981/21	1990/07+	1980/30	1978/25	1987/13	1983/10	1982/12	1983/07	1981/29	1981/06	1994/25		
Extreme Snow Depth (cm)	80	92	104	107	128	64	3	0	23	43	49	73		
Date (yyyy/dd)	1993/30+	1993/22+	1991/31	1991/03+	1993/08	1993/01	1986/01+	1978/01+	1981/24	1995/29	1992/30	1994/26+		

Appendix A
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Days with Maximum Temperature: Days with Maximum Temperature:														
<= 0 °C	31	28.3	31	28.4	18.7	1.1	0	0	2.5	23.1	29.6	30.9		C
> 0 °C	0.05	0	0	1.6	12.3	28.9	31	31	27.5	7.9	0.45	0.08		C
> 10 °C	0	0	0	0.04	0.91	12	25.6	20.8	5.4	0.1	0	0.08		C
> 20 °C	0	0	0	0	0	2.5	6	3.9	0.22	0	0	0.08		C
> 30 °C	0	0	0	0	0	0.09	0.26	0	0	0	0	0		C
> 35 °C	0	0	0	0	0	0	0	0	0	0	0	0		C
Days with Minimum Temperature: Days with Minimum Temperature:														
> 0 °C	0	0	0	0	0.95	17.9	31	27.7	14	0.71	0	0		C
<= 2 °C	31	28.3	31	30	30.8	20.7	2.7	7.6	22.7	30.9	30	31		C
<= 0 °C	31	28.3	31	30	30.1	12.1	0	3.3	16	30.3	30	31		C
< -2 °C	31	28.3	31	29.8	27.1	5.1	0	0.59	8.6	27.7	30	31		C
< -10 °C	30.9	28.2	30.9	28	12.8	0.09	0	0	0.39	14.6	28.6	30.9		C
< -20 °C	28.7	26.7	28.5	18.4	2	0	0	0	0	3.1	20	27.9		C
< - 30 °C	20.1	18	16.5	4.7	0.05	0	0	0	0	0.29	6.6	16.2		C
Days with Rainfall: Days with Rainfall:														
>= 0.2 mm	0	0	0	0.35	2.1	6.4	10.2	12.5	10.4	1.9	0.05	0		C
>= 5 mm	0	0	0	0.04	0.27	0.65	2.6	2.4	1.9	0.27	0	0		C
>= 10 mm	0	0	0	0	0.18	0.13	0.78	0.73	0.65	0.09	0	0		C
>= 25 mm	0	0	0	0	0	0.04	0.04	0.23	0.04	0	0	0		C
Days With Snowfall: Days With Snowfall:														
>= 0.2 cm	9.4	9.8	10.7	9.4	6.5	1.6	0.09	0.27	3.9	13.9	11.7	10.1		C
>= 5 cm	0.52	0.65	0.35	0.87	0.86	0.17	0	0.05	0.52	2.1	0.91	0.63		C
>= 10 cm	0.13	0.04	0	0.17	0.27	0.04	0	0	0.09	0.55	0.18	0.25		C
>= 25 cm	0.04	0	0	0	0	0	0	0	0	0	0	0.04		C

Appendix A
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Days with Precipitation: Days with Precipitation:														
>= 0.2 mm	8.6	9.1	10	8.9	7.3	7.4	10.2	12.6	12.9	14.5	10.7	9.4		C
>= 5 mm	0.3	0.22	0.17	0.52	1	0.83	2.6	2.4	2.3	1.7	0.18	0.33		C
>= 10 mm	0.04	0	0	0.13	0.45	0.17	0.78	0.73	0.74	0.32	0.05	0.08		C
>= 25 mm	0.04	0	0	0	0	0.04	0.04	0.23	0.04	0	0			
Days with Snow Depth: Days with Snow Depth:														
>= 1 cm	31	28.3	31	30	29.5	9.8	0.7	0	2.4	25.5	29.9	31		C
>= 5 cm	31	28.3	31	29.9	26.1	6.4	0	0	0.7	17.8	29.1	31		C
>= 10	31	28.3	31	29.8	22.8	3.1	0	0	0.39	11.4	25.7	31		C
>= 20	22.9	24.6	26.6	25.7	16.8	1.4	0	0	0.13	4.8	12	20.5		C
Wind: Wind:														
Speed (km/h)	19	18.5	15.6	13.4	13.9	14	14.4	15.5	16.8	17.4	16.8	18.2		C
Most Frequent Direction	SW	SW	SW	SW	E	E	E	E	E	SW	SW	SW		C
Maximum Hourly Speed	93	76	83	72	74	61	67	74	74	80	83	93		
Date (yyyy/dd)	1988/01	1978/08+	1980/03	1984/16	1986/28	1995/26	1991/25	1986/22+	2002/24	1982/27	1994/19	1983/25		
Direction of Maximum Hourly Speed	NW	S	NW	E	NW	NW	N	NW	NW	NW	NW	NW		
Maximum Gust Speed	106	106	106	83	89	74	81	83	85	89	100	104		
Date (yyyy/dd)	1988/01	1978/06	1980/03	1984/16	1986/28	1992/11+	1988/23	1984/10+	1983/28	1982/27	1994/05	1983/26		
Direction of Maximum Gust	NW	SW	NW	E	NW	W	NW	NW	NW	NW	NW	NW		
Days with Winds >= 52 km/hr	1.8	2.7	1.7	0.9	0.6	0.1	0.2	0.8	1.2	1.3	0.9	2.2		C
Days with Winds >= 63 km/hr	0.5	0.8	0.4	0.2	0.3	0	0	0.2	0.4	0.5	0.2	0.7		C

Appendix A
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Degree Days: Degree Days:														
Above 24 °C	0	0	0	0	0	0	0	0	0	0	0	0		C
Above 18 °C	0	0	0	0	0	0.6	3.1	0.8	0	0	0	0		C
Above 15 °C	0	0	0	0	0	1.8	12.3	5.7	0	0	0	0		C
Above 10 °C	0	0	0	0	0.1	13.8	60.3	37.7	2.3	0	0	0		C
Above 5 °C	0	0	0	0	1.9	56.7	178.7	129.1	20.6	0.3	0	0		C
Above 0 °C	0	0	0	0.3	14	160.6	332.2	274.9	100.3	5.2	0	0		C
Below 0 °C	855.2	783.1	782.7	510.1	177.8	6	0	0	15.8	225.4	581.5	790.4		C
Below 5 °C	1010.2	924.5	937.7	659.7	320.7	52.2	1.5	9.2	86.1	375.5	731.5	945.4		C
Below 10 °C	1165.2	1065.8	1092.7	809.7	474	159.2	38.1	72.8	217.9	530.2	881.5	1100.4		C
Below 15 °C	1320.2	1207.2	1247.7	959.7	628.9	297.3	145.1	195.8	365.6	685.2	1031.5	1255.4		C
Below 18 °C	1413.2	1292	1340.7	1049.7	721.9	386	228.9	283.9	455.6	778.2	1121.5	1348.4		C
Bright Sunshine: Bright Sunshine:														
Total Hours		75.8	161.8	221.7	242.5	376.2	342.9	213.2	88.2	52.4	19.7			C
Days with measurable		18	25.8	25.8	25.9	28.6	29.4	27.4	21.1	15.9	9.1			C
% of possible daylight hours		34.8	44.8	47.2	38	52.3	48.7	39.5	22.1	18.1	12.8			C
Extreme Daily	5.2	8.4	12.9	17.2	22.9	24	24	19.1	14.1	10.5	6.4	1		C
Date (yyyy/dd)	1998/30	1980/27	1997/28	1994/28	1985/31	1981/09+	1982/05+	1987/01	2000/01	1988/02	2000/05	1981/01		
Humidex: Humidex:														
Extreme Humidex	0.3	-1.7	-0.3	7.9	19.8	30.3	36.8	36.8	22.7	12.3	2.2	-1.5		
Date (yyyy/dd)	1981/16	1980/07	1999/22	1995/28	1994/24	1996/25	1989/15	1992/02	1994/01	1988/06	1983/03	1999/24		
Days with Humidex >= 30			0	0	0	0	0.5	0.2	0	0	0	0		C
Days with Humidex >= 35			0	0	0	0	0.1	0	0	0	0	0		C
Days with Humidex >= 40			0	0	0	0	0	0	0	0	0	0		C

Appendix A
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Wind Chill: Wind Chill:														
Extreme Wind Chill	-64.3	-64.4	-65	-54.4	-39.7	-15.6	-6.2	-11.8	-22.9	-46.5	-54.1	-61.5		
Date (yyyy/dd)	1990/26	1985/21	1979/05	1979/04	1983/04	1978/09	1985/21	1995/29	1992/25	1996/27	1985/25	1984/09		
Days with Wind Chill < -20	30.7	28.1	30.4	25.5	7.8	0	0	0	0.2	10.5	27.1	30.7		C
Days with Wind Chill < -30	28.4	25.3	27.2	14.7	1.2	0	0	0	0	2.4	18.8	27.1		C
Days with Wind Chill < -40	22.3	18.9	17.2	4.6	0	0	0	0	0	0.2	8.1	18		C
Humidity: Humidity:														
Average Vapour Pressure (kPa)			0.1	0.2	0.4	0.7	1	0.9	0.6	0.4	0.1	0.1		C
Average Relative Humidity - 0600LST (%)			78.4	82.8	87.4	84.1	81.9	87.7	88.8	87	81.5	78		C
Average Relative Humidity - 1500LST (%)			78.4	83	84.1	71.2	64.2	68.4	75.9	84.9	81.1	78.3		C
Pressure: Pressure:														
Average Station Pressure (kPa)	101.6	101.7	101.8	101.8	101.7	101.2	101.1	101	101	101.2	101.4	101.5		C
Average Sea Level Pressure (kPa)	101.9	102	102.1	102.1	102	101.5	101.4	101.3	101.3	101.5	101.7	101.8		C
Visibility (hours with): Visibility (hours with):														
< 1 km	21.2	29.8	18.6	23.6	27.9	9	11.1	5.9	4.8	9.1	11.8			D
1 to 9 km	138.3	129.8	122.9	101.1	74.9	23.2	26	27.7	45	106	97.9			D
> 9 km	584.6	518.1	602.5	595.3	641.2	687.8	706.9	710.4	670.2	628.9	610.3			D
Cloud Amount (hours with): Cloud Amount (hours with):														
0 to 2 tenths	298.4	261.5	290	240.6	171	188.4	146.1	111.1	80.2	105.5	200.2			D
3 to 7 tenths	136	130.8	132.5	120.3	106.3	151.6	181	155.6	105.7	89.9	140.8			D
8 to 10 tenths	309.6	285.4	321.5	359.1	466.7	380.1	416.9	477.4	534.1	548.6	379.1			D

Appendix A
Climatological Information
For Kugluktuk Nunavut

Summary of 2005 Monthly Climatological Information

KUGLUGTUK A
NUNAVUT

Latitude: 67° 49' N **Longitude:** 115° 8' W **Elevation:** 22.60 m

Climate ID: 2300902 **WMO ID:** 71938 **TC ID:** YCO

Monthly Data Report for 2005

Month	Mean Max Temp °C	Mean Temp °C	Mean Min Temp °C	Extr Max Temp °C	Extr Min Temp °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow Grnd Last Day cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
Jan	-22.5	-26.7	-30.9	-5.1	-41.8	0.0	36.0	8.0	21		
Feb	-27.1	-30.8	-34.5	-20.2	-39.6	0.0	9.7	1.5	22		
Mar	-20.7	-25.4	-30.0	-8.2	-39.4	0.0	23.2	3.7	24		
Apr	-8.2	-12.8	-17.4	3.5	-31.2	0.2	33.0	13.5	17		
May	-0.6	-5.3	-10.0	12.1	-19.4	2.4	1.8	3.2	T		
Jun	9.7	5.2	0.6	23.9	-3.1	38.7	T	38.7	0		
Jul	12.6	8.5	4.3	26.2	0.2	69.2	T	69.2	0		
Aug	12.9	8.7	4.4	23.0	-2.2	49.4	0.0	49.4	0		
Sep											
Oct											
Nov											
Sum						159.9	103.7	187.2			
Avg	-3.7	-6.6	-9.5								
Xtrm				26.2	-41.8						

Appendix B
Site Photographs

Photo 1 Looking north across Sewage Lagoon.

Photo 2 Hamlet sewage haul tuck dumping into the Sewage Lagoon.

Photo 3 Culverts used as a spillway for truck discharge into the Sewage Lagoon.

Photo 4 Sewage discharge into wetland draining towards Coronation Gulf.

Photo 5 Meandering stream in wetland treatment area.

Photo 6 Rock quarry east of the Solid Waste Disposal facility.

Photo 7 Blasted Gabbro stockpiled at rock quarry.

Photo 8 Bulky Metals Disposal Area.

Photo 9 Segregated tires and white goods at the Bulky Metals Disposal Area.

Photo 10 Boats and tanks in the Bulky Metals Disposal Area.

Photo 11 Mixed metals in Bulky Metals Disposal Area.

Photo 12 Crushed drums in the Bulky Metals Disposal Area.

Photo 13 Pipe and drums from the old fuel line stored along the edge of the road to the Hamlet.

Photo 14 Municipal Solid Waste Disposal Area (landfill) in foreground and Bulky Metals Disposal Area in background.

Photo 15 Looking northwest across front of fill face at landfill site.

Photo 16 Tipping ramp and burn pit at landfill.

Photo 17 Front face of tipping ramp and burn pit at landfill.

Photo 18 Looking north across landfill site from road.

Photo 19 Burned partially crushed waste pushed out of the burn pit and spread across the landfill footprint.

Photo 20 Test pit MSW-1 and MSW-2 excavated north of landfill fence.

Photo 21 Test pit MSW-2 north of landfill.

Photo 22 Looking north from the landfill towards the contaminated soil stockpile and waste oil storage area.

Photo 23 Contaminated soil stockpile.

Photo 24 Excavation for sampling in south side of contaminated soil stockpile.

Photo 25 Looking north across Waste Oil and Hazardous Waste Storage Area.

Photo 26 Waste Oil and Hazardous Materials Storage Area.

Photo 27 Batteries and waste materials stored in truck box and stacked on ground.

Photo 28 Wind generators west of Hamlet.

Appendix C
Laboratory Certificates of Analysis

Appendix C-1

Sewage Water

ETL Enviro-Test LABORATORIES

ANALYTICAL REPORT

NUNA BURNSIDE ENGINEERING & ENVIRONMENTA

ATTN: MATT PAZNAR

15 TOWNLINE

ORANGEVILLE ON L9W 3R4

DATE: 09-NOV-05 02:56 PM

Lab Work Order #: L326712

Date Received: 05-OCT-05

Project P.O. #:

Job Reference: NUNA BURNSIDE

Other Information:

Comments:

DOUG JOHNSON
Director of Operations, Edmonton

RACHEL JONES
Account Manager

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L326712-1 WS-1 SEWAGE LAGOON								
Sampled By: NS on 04-OCT-05 @ 10:15								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Silver (Ag)	<0.0004	RAMB	0.0004	mg/L		07-OCT-05	MX	R333221
Aluminum (Al)	1.78		0.01	mg/L		07-OCT-05	MX	R333221
Arsenic (As)	0.0015		0.0004	mg/L		07-OCT-05	MX	R333221
Boron (B)	0.14		0.05	mg/L		07-OCT-05	MX	R333221
Barium (Ba)	0.016		0.003	mg/L		07-OCT-05	MX	R333221
Beryllium (Be)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Cadmium (Cd)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Cobalt (Co)	<0.002		0.002	mg/L		07-OCT-05	MX	R333221
Chromium (Cr)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Copper (Cu)	0.075		0.001	mg/L		07-OCT-05	MX	R333221
Mercury (Hg)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Lithium (Li)	<0.01		0.01	mg/L		07-OCT-05	MX	R333221
Molybdenum (Mo)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Nickel (Ni)	0.005		0.002	mg/L		07-OCT-05	MX	R333221
Lead (Pb)	0.0026		0.0001	mg/L		07-OCT-05	MX	R333221
Antimony (Sb)	0.0023		0.0004	mg/L		07-OCT-05	MX	R333221
Selenium (Se)	0.0009		0.0004	mg/L		07-OCT-05	MX	R333221
Tin (Sn)	<0.05		0.05	mg/L		07-OCT-05	MX	R333221
Titanium (Ti)	0.010		0.001	mg/L		07-OCT-05	MX	R333221
Thallium (Tl)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Uranium (U)	0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Vanadium (V)	0.002		0.001	mg/L		07-OCT-05	MX	R333221
Zinc (Zn)	0.140		0.004	mg/L		07-OCT-05	MX	R333221
Total Major Metals								
Calcium (Ca)	19.9		0.5	mg/L		07-OCT-05	HAS	R332984
Potassium (K)	23.0		0.1	mg/L		07-OCT-05	HAS	R332984
Magnesium (Mg)	10.6		0.1	mg/L		07-OCT-05	HAS	R332984
Sodium (Na)	95		1	mg/L		07-OCT-05	HAS	R332984
Iron (Fe)	1.16		0.005	mg/L		07-OCT-05	HAS	R332984
Manganese (Mn)	0.143		0.001	mg/L		07-OCT-05	HAS	R332984
Ammonia-N	94.0		0.05	mg/L		05-OCT-05	KMY	R331840
Biochemical Oxygen Demand	276		2	mg/L		05-OCT-05	FY/TL	R333612
Note: DO drop of SEED blank for is greater than the acceptable limit, however LCS is acceptable. EOC								
MF - Fecal Coliforms	13000000		1	CFU/100mL		07-OCT-05	PB	R334085
Oil and Grease	22		1	mg/L		12-OCT-05	HPOD	R334242
Phenols (4AAP)	0.465		0.001	mg/L		07-OCT-05	HSC	R332989
Total Suspended Solids	95		3	mg/L		06-OCT-05	SVG	R332372
pH	7.4		0.1	pH		05-OCT-05	PTT	R332174
L326712-2 WS-2 WETLAND								
Sampled By: JW on 04-OCT-05 @ 09:45								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Silver (Ag)	<0.0004	RAMB	0.0004	mg/L		07-OCT-05	MX	R333221
Aluminum (Al)	0.20		0.01	mg/L		07-OCT-05	MX	R333221
Arsenic (As)	0.0008		0.0004	mg/L		07-OCT-05	MX	R333221

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L326712-2 WS-2 WETLAND								
Sampled By: JW on 04-OCT-05 @ 09:45								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Boron (B)	0.05		0.05	mg/L		07-OCT-05	MX	R333221
Barium (Ba)	0.019		0.003	mg/L		07-OCT-05	MX	R333221
Beryllium (Be)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Cadmium (Cd)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Cobalt (Co)	<0.002		0.002	mg/L		07-OCT-05	MX	R333221
Chromium (Cr)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Copper (Cu)	0.016		0.001	mg/L		07-OCT-05	MX	R333221
Mercury (Hg)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Lithium (Li)	<0.01		0.01	mg/L		07-OCT-05	MX	R333221
Molybdenum (Mo)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Nickel (Ni)	0.002		0.002	mg/L		07-OCT-05	MX	R333221
Lead (Pb)	0.0006		0.0001	mg/L		07-OCT-05	MX	R333221
Antimony (Sb)	0.0012		0.0004	mg/L		07-OCT-05	MX	R333221
Selenium (Se)	<0.0004		0.0004	mg/L		07-OCT-05	MX	R333221
Tin (Sn)	<0.05		0.05	mg/L		07-OCT-05	MX	R333221
Titanium (Ti)	0.011		0.001	mg/L		07-OCT-05	MX	R333221
Thallium (Tl)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Uranium (U)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Vanadium (V)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Zinc (Zn)	0.018		0.004	mg/L		07-OCT-05	MX	R333221
Total Major Metals								
Calcium (Ca)	17.0		0.5	mg/L		07-OCT-05	HAS	R332984
Potassium (K)	6.9		0.1	mg/L		07-OCT-05	HAS	R332984
Magnesium (Mg)	11.8		0.1	mg/L		07-OCT-05	HAS	R332984
Sodium (Na)	46		1	mg/L		07-OCT-05	HAS	R332984
Iron (Fe)	1.42		0.005	mg/L		07-OCT-05	HAS	R332984
Manganese (Mn)	0.153		0.001	mg/L		07-OCT-05	HAS	R332984
Ammonia-N	22.5		0.05	mg/L		05-OCT-05	KMY	R331840
Biochemical Oxygen Demand	68		2	mg/L		05-OCT-05	FY/TL	R333612
Note: DO drop of SEED blank for is greater than the acceptable limit, however LCS is acceptable. EOC								
MF - Fecal Coliforms	1900000		1	CFU/100mL		07-OCT-05	PB	R334085
Phenols (4AAP)	0.098		0.001	mg/L		07-OCT-05	HSC	R332989
Total Suspended Solids	14		3	mg/L		06-OCT-05	SVG	R332372
pH	7.4		0.1	pH		05-OCT-05	PTT	R332174
L326712-3 WS-3 WETLAND								
Sampled By: JW on 04-OCT-05 @ 09:45								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Silver (Ag)	<0.0004	RAMB	0.0004	mg/L		07-OCT-05	MX	R333221
Aluminum (Al)	0.21		0.01	mg/L		07-OCT-05	MX	R333221
Arsenic (As)	0.0012		0.0004	mg/L		07-OCT-05	MX	R333221
Boron (B)	0.06		0.05	mg/L		07-OCT-05	MX	R333221
Barium (Ba)	0.023		0.003	mg/L		07-OCT-05	MX	R333221
Beryllium (Be)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Cadmium (Cd)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Cobalt (Co)	<0.002		0.002	mg/L		07-OCT-05	MX	R333221

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L326712-3 WS-3 WETLAND								
Sampled By: JW on 04-OCT-05 @ 09:45								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Chromium (Cr)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Copper (Cu)	0.021		0.001	mg/L		07-OCT-05	MX	R333221
Mercury (Hg)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Lithium (Li)	<0.01		0.01	mg/L		07-OCT-05	MX	R333221
Molybdenum (Mo)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Nickel (Ni)	0.003		0.002	mg/L		07-OCT-05	MX	R333221
Lead (Pb)	0.0007		0.0001	mg/L		07-OCT-05	MX	R333221
Antimony (Sb)	0.0007		0.0004	mg/L		07-OCT-05	MX	R333221
Selenium (Se)	<0.0004		0.0004	mg/L		07-OCT-05	MX	R333221
Tin (Sn)	<0.05		0.05	mg/L		07-OCT-05	MX	R333221
Titanium (Ti)	0.015		0.001	mg/L		07-OCT-05	MX	R333221
Thallium (Tl)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Uranium (U)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Vanadium (V)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Zinc (Zn)	0.022		0.004	mg/L		07-OCT-05	MX	R333221
Total Major Metals								
Calcium (Ca)	18.1		0.5	mg/L		07-OCT-05	HAS	R332984
Potassium (K)	13.2		0.1	mg/L		07-OCT-05	HAS	R332984
Magnesium (Mg)	12.3		0.1	mg/L		07-OCT-05	HAS	R332984
Sodium (Na)	57		1	mg/L		07-OCT-05	HAS	R332984
Iron (Fe)	4.82		0.005	mg/L		07-OCT-05	HAS	R332984
Manganese (Mn)	0.225		0.001	mg/L		07-OCT-05	HAS	R332984
Ammonia-N	34.3		0.05	mg/L		05-OCT-05	KMY	R331840
Biochemical Oxygen Demand	81		2	mg/L		05-OCT-05	FY/TL	R333612
Note: DO drop of SEED blank for is greater than the acceptable limit, however LCS is acceptable. EOC								
MF - Fecal Coliforms	1500000		1	CFU/100mL		07-OCT-05	PB	R334085
Oil and Grease	7		1	mg/L		12-OCT-05	HPOD	R334242
Phenols (4AAP)	0.119		0.001	mg/L		07-OCT-05	HSC	R332989
Total Suspended Solids	34		3	mg/L		06-OCT-05	SVG	R332372
pH	7.5		0.1	pH		05-OCT-05	PTT	R332174
L326712-4 WS-4 WETLAND								
Sampled By: SD on 04-OCT-05 @ 10:30								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Silver (Ag)	<0.0004	RAMB	0.0004	mg/L		07-OCT-05	MX	R333221
Aluminum (Al)	0.10		0.01	mg/L		07-OCT-05	MX	R333221
Arsenic (As)	0.0012		0.0004	mg/L		07-OCT-05	MX	R333221
Boron (B)	<0.05		0.05	mg/L		07-OCT-05	MX	R333221
Barium (Ba)	0.013		0.003	mg/L		07-OCT-05	MX	R333221
Beryllium (Be)	<0.001		0.001	mg/L		07-OCT-05	MX	R333221
Cadmium (Cd)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221
Cobalt (Co)	<0.002		0.002	mg/L		07-OCT-05	MX	R333221
Chromium (Cr)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Copper (Cu)	0.003		0.001	mg/L		07-OCT-05	MX	R333221
Mercury (Hg)	<0.0002		0.0002	mg/L		07-OCT-05	MX	R333221

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L326712-4 WS-4 WETLAND								
Sampled By: SD on 04-OCT-05 @ 10:30								
Matrix: WATER								
Total Metals - CCME								
Total Trace Metals								
Lithium (Li)	<0.01		0.01	mg/L		07-OCT-05	MX	R333221
Molybdenum (Mo)	<0.005		0.005	mg/L		07-OCT-05	MX	R333221
Nickel (Ni)	0.003		0.002	mg/L		07-OCT-05	MX	R333221
Lead (Pb)	0.0002		0.0001	mg/L		07-OCT-05	MX	R333221
Antimony (Sb)	<0.0004		0.0004	mg/L		07-OCT-05	MX	R333221
Selenium (Se)	<0.0004		0.0004	mg/L		07-OCT-05	MX	R333221
Tin (Sn)	<0.05		0.05	mg/L		07-OCT-05	MX	R333221
Titanium (Ti)	0.003		0.001	mg/L		07-OCT-05	MX	R333221
Thallium (Tl)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Uranium (U)	<0.0001		0.0001	mg/L		07-OCT-05	MX	R333221
Vanadium (V)	0.001		0.001	mg/L		07-OCT-05	MX	R333221
Zinc (Zn)	<0.004		0.004	mg/L		07-OCT-05	MX	R333221
Total Major Metals								
Calcium (Ca)	19.0		0.5	mg/L		07-OCT-05	HAS	R332984
Potassium (K)	4.8		0.1	mg/L		07-OCT-05	HAS	R332984
Magnesium (Mg)	13.9		0.1	mg/L		07-OCT-05	HAS	R332984
Sodium (Na)	40		1	mg/L		07-OCT-05	HAS	R332984
Iron (Fe)	6.14		0.005	mg/L		07-OCT-05	HAS	R332984
Manganese (Mn)	0.551		0.001	mg/L		07-OCT-05	HAS	R332984
Chlorine, Total	<0.1		0.1	mg/L		05-OCT-05	SVG	R332182
Ammonia-N	12.4		0.05	mg/L		05-OCT-05	KMY	R331840
Biochemical Oxygen Demand	8		2	mg/L		05-OCT-05	FY/TL	R333612
Note: DO drop of SEED blank for is greater than the acceptable limit, however LCS is acceptable. EOC								
MF - Fecal Coliforms	4000		1	CFU/100mL		07-OCT-05	PB	R334085
Oil and Grease	<1		1	mg/L		12-OCT-05	HPOD	R334242
Phenols (4AAP)	0.029		0.001	mg/L		07-OCT-05	HSC	R332989
Total Suspended Solids	7		3	mg/L		06-OCT-05	SVG	R332372
pH	7.5		0.1	pH		05-OCT-05	PTT	R332174

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
RAMB	Result Adjusted For Method Blank

Methods Listed (if applicable):

ETL Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
BOD-ED	Water	Biochemical Oxygen Demand (BOD)		APHA 5210 B-5 day Incub.-O2 electrode
CL2-TOT-ED	Water	Chlorine, Total		APHA 4500 Cl G-Colorimetry
FCC-MF-PB	Water	Fecal Coliform Count-MF		APHA 9222D MF
MET1-TOT-CCME-ED	Water	Total Trace Metals	EPA3015	EPA 6020
MET2-TOT-LOW-ED	Water	Total Major Metals	EPA3015	EPA 200.7
NH4-ED	Water	Ammonia-N		APHA4500NH3F Colorimetry
OGG-ED	Water	Oil and Grease-Gravimetric		APHA 5520 B Hexane MTBE ext. Gravime
PH-ED	Water	pH		APHA 4500 H-Electrode
PHENOLS-CL	Water	Phenols (4AAP)		EPA 9066-Colorimetric
SOLIDS-TOTSUS-ED	Water	Total Suspended Solids		APHA 2540 D-Gravimetric

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.

Chain of Custody numbers:

231052

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
CL	Enviro-Test Laboratories - Calgary, Alberta, Canada	ED	Enviro-Test Laboratories - Edmonton, Alberta, Canada
PB	PBR LABARATORIES		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency. The Laboratory warning units are determined under column heading D.L.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
< - Less than
D.L. - Detection Limit
N/A - Result not available. Refer to qualifier code and definition for explanation

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
UNLESS OTHERWISE STATED, SAMPLES ARE NOT CORRECTED FOR CLIENT FIELD BLANKS.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

Enviro-Test Laboratories has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, Enviro-Test Laboratories assumes no liability for the use or interpretation of the results.

BURNSIDE

Sewage C-2

Soil and Groundwater

FEO 09754. 425
soil + Groundwater

ETL Enviro-Test LABORATORIES

ANALYTICAL REPORT

NUNA BURNSIDE ENGINEERING & ENVIRONMENTA
ATTN: JIM WALLS
15 TOWNLINE
ORANGEVILLE ON L9W 3R4

DATE: 19-OCT-05

Lab Work Order #: L329172 **Sampled By:** CLIENT **Date Received:** 11-OCT-05
Project P.O. #:
Job Reference: FOR09755
Other Information:

Comments:

APPROVED BY: Wayne Smith

WAYNE SMITH, C.CHEM., C.E.T.
Project Manager

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-1 MSW-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
VOC EXCLUDING BTX							
1,1,1,2-Tetrachloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,1,2,2-Tetrachloroethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
1,1,1-Trichloroethane	<0.5		0.5	ug/L	200	15-OCT-05	R335327
1,1,2-Trichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dibromoethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
1,1-Dichloroethane	<0.5		0.5	ug/L	70	15-OCT-05	R335327
1,1-Dichloroethylene	<0.5		0.5	ug/L	(4.1) 0.66	15-OCT-05	R335327
1,2-Dichlorobenzene	<0.5		0.5	ug/L	3.0	15-OCT-05	R335327
1,2-Dichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dichloropropane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,3-Dichlorobenzene	<0.5		0.5	ug/L	630	15-OCT-05	R335327
1,4-Dichlorobenzene	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
2-Chloroethylvinyl Ether	<20		20	ug/L		15-OCT-05	R335327
2-Hexanone	<20		20	ug/L		15-OCT-05	R335327
Acetone	<20		20	ug/L	3000	15-OCT-05	R335327
Bromodichloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromoform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromomethane	<1		1	ug/L	(10) 3.7	15-OCT-05	R335327
Carbon Disulfide	<0.5		0.5	ug/L		15-OCT-05	R335327
Carbon tetrachloride	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chlorobenzene	<0.5		0.5	ug/L	30	15-OCT-05	R335327
Chloroethane	<1		1	ug/L		15-OCT-05	R335327
Chloroform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chloromethane	<1		1	ug/L		15-OCT-05	R335327
cis-1,2-Dichloroethylene	<0.5		0.5	ug/L	70	15-OCT-05	R335327
cis-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Dibromochloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Dichlorodifluoromethane	<1		1	ug/L		15-OCT-05	R335327
Dichloromethane	<0.5		0.5	ug/L	50	15-OCT-05	R335327
Methyl Ethyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
Methyl Isobutyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
MTBE	<0.5		0.5	ug/L	700	15-OCT-05	R335327
Styrene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
Tetrachloroethylene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
trans-1,2-Dichloroethylene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
trans-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Trichloroethylene	<0.5		0.5	ug/L	50	15-OCT-05	R335327
Trichlorofluoromethane	<1		1	ug/L		15-OCT-05	R335327
Trihalomethanes (total)	<2.0		2	ug/L		15-OCT-05	R335327
Vinyl chloride	<0.5		0.5	ug/L	(1.3) 0.5	15-OCT-05	R335327
Surr: 1,2-Dichloroethane d4	111		67-133	%		15-OCT-05	R335327
Surr: Toluene-d8	98		67-133	%		15-OCT-05	R335327
Surr: 4-Bromofluorobenzene	97		67-133	%		15-OCT-05	R335327
F2-F4 (O.Reg.153/04)							
Prep/Analysis Dates						18-OCT-05	R336150
Surr: Octacosane	70		50-150	%		18-OCT-05	R336150
CCME Total Hydrocarbons							

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-1 MSW-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
CCME Total Hydrocarbons							
F1 (C6-C10)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F1-BTEX	<100		100	ug/L		18-OCT-05	
F2 (C10-C16)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F3 (C16-C34)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
F4 (C34-C50)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
Total Hydrocarbons (C6-C50)	<500		500	ug/L		18-OCT-05	
Chromatogram to baseline at nC50	yes					18-OCT-05	
BTEX (O.Reg.153/04)							
Benzene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335457
Ethyl Benzene	<0.5		0.5	ug/L	2.4	15-OCT-05	R335457
m+p-Xylenes	<1		1	ug/L		15-OCT-05	R335457
o-Xylene	<0.5		0.5	ug/L		15-OCT-05	R335457
Toluene	<0.5		0.5	ug/L	24	15-OCT-05	R335457
Xylene, (total)	<1.5		1.5	ug/L	300	15-OCT-05	R335457
Individual Analytes							
Mercury (Hg)	<0.0001		0.0001	mg/L	0.00012	14-OCT-05	R335069
Metal Scan-Total							
Aluminum (Al)-Total	1.85		0.01	mg/L		15-OCT-05	R334486
Antimony (Sb)-Total	0.005		0.005	mg/L	0.006	15-OCT-05	R334486
Arsenic (As)-Total	0.003		0.001	mg/L	0.025	15-OCT-05	R334486
Barium (Ba)-Total	0.07		0.01	mg/L	1	15-OCT-05	R334486
Beryllium (Be)-Total	<0.001		0.001	mg/L	0.004	15-OCT-05	R334486
Bismuth (Bi)-Total	0.007		0.001	mg/L		15-OCT-05	R334486
Boron (B)-Total	2.42		0.05	mg/L	5.0	15-OCT-05	R334486
Cadmium (Cd)-Total	<0.0001		0.0001	mg/L	0.005	15-OCT-05	R334486
Calcium (Ca)-Total	394		0.5	mg/L		15-OCT-05	R334486
Chromium (Cr)-Total	0.008		0.001	mg/L	0.05	15-OCT-05	R334486
Cobalt (Co)-Total	0.0044		0.0005	mg/L	0.1	15-OCT-05	R334486
Copper (Cu)-Total	0.039		0.001	mg/L	** 0.023	15-OCT-05	R334486
Iron (Fe)-Total	3.20		0.05	mg/L		15-OCT-05	R334486
Lead (Pb)-Total	0.002		0.001	mg/L	0.01	15-OCT-05	R334486
Magnesium (Mg)-Total	131		0.5	mg/L		15-OCT-05	R334486
Manganese (Mn)-Total	2.88		0.001	mg/L		15-OCT-05	R334486
Molybdenum (Mo)-Total	0.005		0.001	mg/L	7.3	15-OCT-05	R334486
Nickel (Ni)-Total	0.031		0.002	mg/L	0.1	15-OCT-05	R334486
Phosphorus (P)-Total	0.25		0.05	mg/L		15-OCT-05	R334486
Potassium (K)-Total	107		0.5	mg/L		15-OCT-05	R334486
Selenium (Se)-Total	<0.005		0.005	mg/L	0.01	15-OCT-05	R334486
Silicon (Si)-Total	5.5		0.1	mg/L		15-OCT-05	R334486
Silver (Ag)-Total	0.0002		0.0001	mg/L	0.0012	15-OCT-05	R334486
Sodium (Na)-Total	323		0.5	mg/L	** 200	15-OCT-05	R334486
Strontium (Sr)-Total	1.46		0.001	mg/L		15-OCT-05	R334486
Thallium (Tl)-Total	<0.0003		0.0003	mg/L	0.002	15-OCT-05	R334486
Tin (Sn)-Total	<0.001		0.001	mg/L		15-OCT-05	R334486
Titanium (Ti)-Total	0.089		0.002	mg/L		15-OCT-05	R334486
Tungsten (W)-Total	<0.01		0.01	mg/L		15-OCT-05	R334486

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-1 MSW-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
Individual Analytes							
Metal Scan-Total							
Uranium (U)-Total	0.019		0.005	mg/L		15-OCT-05	R334486
Vanadium (V)-Total	0.008		0.001	mg/L	0.2	15-OCT-05	R334486
Zinc (Zn)-Total	0.019		0.003	mg/L	1.1	15-OCT-05	R334486
Zirconium (Zr)-Total	<0.004		0.004	mg/L		15-OCT-05	R334486
Ammonia as N	3.40		0.05	mg/L		17-OCT-05	R335645
Phenols (4AAP)	<0.001		0.001	mg/L		13-OCT-05	R334935
Total Kjeldahl Nitrogen	7.0		0.2	mg/L		18-OCT-05	R336256
Anion Scan (IC)							
Chloride	338		2	mg/L	** 250	14-OCT-05	R335756
Bromide	3.0		0.1	mg/L		14-OCT-05	R335756
Fluoride	<0.1		0.1	mg/L		13-OCT-05	R334849
Nitrite-N	<1		1	mg/L	1	14-OCT-05	R335756
Nitrate-N	29.5		0.1	mg/L	** 10	14-OCT-05	R335756
Phosphate-P (ortho)	<0.3		0.3	mg/L		13-OCT-05	R334849
Sulphate	1440		2	mg/L		14-OCT-05	R335756
L329172-5 MSW-2							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
VOC EXCLUDING BTX							
1,1,1,2-Tetrachloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,1,2,2-Tetrachloroethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
1,1,1-Trichloroethane	<0.5		0.5	ug/L	200	15-OCT-05	R335327
1,1,2-Trichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dibromoethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
1,1-Dichloroethane	<0.5		0.5	ug/L	70	15-OCT-05	R335327
1,1-Dichloroethylene	<0.5		0.5	ug/L	(4.1) 0.66	15-OCT-05	R335327
1,2-Dichlorobenzene	<0.5		0.5	ug/L	3.0	15-OCT-05	R335327
1,2-Dichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dichloropropane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,3-Dichlorobenzene	<0.5		0.5	ug/L	630	15-OCT-05	R335327
1,4-Dichlorobenzene	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
2-Chloroethylvinyl Ether	<20		20	ug/L		15-OCT-05	R335327
2-Hexanone	<20		20	ug/L		15-OCT-05	R335327
Acetone	<20		20	ug/L	3000	15-OCT-05	R335327
Bromodichloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromoform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromomethane	<1		1	ug/L	(10) 3.7	15-OCT-05	R335327
Carbon Disulfide	<0.5		0.5	ug/L		15-OCT-05	R335327
Carbon tetrachloride	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chlorobenzene	<0.5		0.5	ug/L	30	15-OCT-05	R335327
Chloroethane	<1		1	ug/L		15-OCT-05	R335327
Chloroform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chloromethane	<1		1	ug/L		15-OCT-05	R335327

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-5 MSW-2							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
VOC EXCLUDING BTX							
cis-1,2-Dichloroethylene	<0.5		0.5	ug/L	70	15-OCT-05	R335327
cis-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Dibromochloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Dichlorodifluoromethane	<1		1	ug/L		15-OCT-05	R335327
Dichloromethane	<0.5		0.5	ug/L	50	15-OCT-05	R335327
Methyl Ethyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
Methyl Isobutyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
MTBE	<0.5		0.5	ug/L	700	15-OCT-05	R335327
Styrene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
Tetrachloroethylene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
trans-1,2-Dichloroethylene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
trans-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Trichloroethylene	<0.5		0.5	ug/L	50	15-OCT-05	R335327
Trichlorofluoromethane	<1		1	ug/L		15-OCT-05	R335327
Trihalomethanes (total)	<2.0		2	ug/L		15-OCT-05	R335327
Vinyl chloride	<0.5		0.5	ug/L	(1.3) 0.5	15-OCT-05	R335327
Surr: 1,2-Dichloroethane d4	110		67-133	%		15-OCT-05	R335327
Surr: Toluene-d8	98		67-133	%		15-OCT-05	R335327
Surr: 4-Bromofluorobenzene	96		67-133	%		15-OCT-05	R335327
F2-F4 (O.Reg.153/04)							
Prep/Analysis Dates						18-OCT-05	R336150
Surr: Octacosane	71		50-150	%		18-OCT-05	R336150
CCME Total Hydrocarbons							
F1 (C6-C10)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F1-BTEX	<100		100	ug/L		18-OCT-05	
F2 (C10-C16)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F3 (C16-C34)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
F4 (C34-C50)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
Total Hydrocarbons (C6-C50)	<500		500	ug/L		18-OCT-05	
Chromatogram to baseline at nC50	yes					18-OCT-05	
BTEX (O.Reg.153/04)							
Benzene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335457
Ethyl Benzene	<0.5		0.5	ug/L	2.4	15-OCT-05	R335457
m+p-Xylenes	<1		1	ug/L		15-OCT-05	R335457
o-Xylene	<0.5		0.5	ug/L		15-OCT-05	R335457
Toluene	<0.5		0.5	ug/L	24	15-OCT-05	R335457
Xylene, (total)	<1.5		1.5	ug/L	300	15-OCT-05	R335457
Individual Analytes							
Mercury (Hg)	<0.0001		0.0001	mg/L	0.00012	14-OCT-05	R335069
Metal Scan-Total							
Aluminum (Al)-Total	7.04		0.01	mg/L		15-OCT-05	R334486
Antimony (Sb)-Total	<0.005		0.005	mg/L	0.006	15-OCT-05	R334486
Arsenic (As)-Total	0.003		0.001	mg/L	0.025	15-OCT-05	R334486
Barium (Ba)-Total	0.16		0.01	mg/L	1	15-OCT-05	R334486
Beryllium (Be)-Total	<0.001		0.001	mg/L	0.004	15-OCT-05	R334486
Bismuth (Bi)-Total	0.001		0.001	mg/L		15-OCT-05	R334486

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-5 MSW-2							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
Individual Analytes							
Metal Scan-Total							
Boron (B)-Total	0.42		0.05	mg/L	5.0	15-OCT-05	R334486
Cadmium (Cd)-Total	0.0002		0.0001	mg/L	0.005	15-OCT-05	R334486
Calcium (Ca)-Total	170		0.5	mg/L		15-OCT-05	R334486
Chromium (Cr)-Total	0.022		0.001	mg/L	0.05	15-OCT-05	R334486
Cobalt (Co)-Total	0.0067		0.0005	mg/L	0.1	15-OCT-05	R334486
Copper (Cu)-Total	0.092		0.001	mg/L	** 0.023	15-OCT-05	R334486
Iron (Fe)-Total	12.6		0.05	mg/L		15-OCT-05	R334486
Lead (Pb)-Total	0.005		0.001	mg/L	0.01	15-OCT-05	R334486
Magnesium (Mg)-Total	40.6		0.5	mg/L		15-OCT-05	R334486
Manganese (Mn)-Total	0.168		0.001	mg/L		15-OCT-05	R334486
Molybdenum (Mo)-Total	0.002		0.001	mg/L	7.3	15-OCT-05	R334486
Nickel (Ni)-Total	0.020		0.002	mg/L	0.1	15-OCT-05	R334486
Phosphorus (P)-Total	0.30		0.05	mg/L		15-OCT-05	R334486
Potassium (K)-Total	15.7		0.5	mg/L		15-OCT-05	R334486
Selenium (Se)-Total	<0.005		0.005	mg/L	0.01	15-OCT-05	R334486
Silicon (Si)-Total	13.1		0.1	mg/L		15-OCT-05	R334486
Silver (Ag)-Total	<0.0001		0.0001	mg/L	0.0012	15-OCT-05	R334486
Sodium (Na)-Total	69.5		0.5	mg/L	200	15-OCT-05	R334486
Strontium (Sr)-Total	0.300		0.001	mg/L		15-OCT-05	R334486
Thallium (Tl)-Total	<0.0003		0.0003	mg/L	0.002	15-OCT-05	R334486
Tin (Sn)-Total	<0.001		0.001	mg/L		15-OCT-05	R334486
Titanium (Ti)-Total	0.368		0.002	mg/L		15-OCT-05	R334486
Tungsten (W)-Total	<0.01		0.01	mg/L		15-OCT-05	R334486
Uranium (U)-Total	0.006		0.005	mg/L		15-OCT-05	R334486
Vanadium (V)-Total	0.017		0.001	mg/L	0.2	15-OCT-05	R334486
Zinc (Zn)-Total	0.041		0.003	mg/L	1.1	15-OCT-05	R334486
Zirconium (Zr)-Total	<0.004		0.004	mg/L		15-OCT-05	R334486
Ammonia as N	0.22		0.05	mg/L		17-OCT-05	R335645
Phenols (4AAP)	<0.001		0.001	mg/L		13-OCT-05	R334935
Total Kjeldahl Nitrogen	4.8		0.2	mg/L		18-OCT-05	R336256
Anion Scan (IC)							
Chloride	110		2	mg/L	250	14-OCT-05	R335756
Bromide	0.7		0.1	mg/L		13-OCT-05	R334849
Fluoride	<0.1		0.1	mg/L		13-OCT-05	R334849
Nitrite-N	<0.1		0.1	mg/L	1	13-OCT-05	R334849
Nitrate-N	13		0.1	mg/L	** 10	14-OCT-05	R335756
Phosphate-P (ortho)	<0.3		0.3	mg/L		13-OCT-05	R334849
Sulphate	330		2	mg/L		14-OCT-05	R335756
L329172-6 CON-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
VOC EXCLUDING BTX							
1,1,1,2-Tetrachloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,1,2,2-Tetrachloroethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-6 CON-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
VOC EXCLUDING BTX							
1,1,1-Trichloroethane	<0.5		0.5	ug/L	200	15-OCT-05	R335327
1,1,2-Trichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dibromoethane	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
1,1-Dichloroethane	<0.5		0.5	ug/L	70	15-OCT-05	R335327
1,1-Dichloroethylene	<0.5		0.5	ug/L	(4.1) 0.66	15-OCT-05	R335327
1,2-Dichlorobenzene	<0.5		0.5	ug/L	3.0	15-OCT-05	R335327
1,2-Dichloroethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,2-Dichloropropane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
1,3-Dichlorobenzene	<0.5		0.5	ug/L	630	15-OCT-05	R335327
1,4-Dichlorobenzene	<0.5		0.5	ug/L	1.0	15-OCT-05	R335327
2-Chloroethylvinyl Ether	<20		20	ug/L		15-OCT-05	R335327
2-Hexanone	<20		20	ug/L		15-OCT-05	R335327
Acetone	<20		20	ug/L	3000	15-OCT-05	R335327
Bromodichloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromoform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Bromomethane	<1		1	ug/L	(10) 3.7	15-OCT-05	R335327
Carbon Disulfide	<0.5		0.5	ug/L		15-OCT-05	R335327
Carbon tetrachloride	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chlorobenzene	<0.5		0.5	ug/L	30	15-OCT-05	R335327
Chloroethane	<1		1	ug/L		15-OCT-05	R335327
Chloroform	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Chloromethane	<1		1	ug/L		15-OCT-05	R335327
cis-1,2-Dichloroethylene	<0.5		0.5	ug/L	70	15-OCT-05	R335327
cis-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Dibromochloromethane	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
Dichlorodifluoromethane	<1		1	ug/L		15-OCT-05	R335327
Dichloromethane	0.7		0.5	ug/L	50	15-OCT-05	R335327
Methyl Ethyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
Methyl Isobutyl Ketone	<20		20	ug/L	350	15-OCT-05	R335327
MTBE	<0.5		0.5	ug/L	700	15-OCT-05	R335327
Styrene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
Tetrachloroethylene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335327
trans-1,2-Dichloroethylene	<0.5		0.5	ug/L	100	15-OCT-05	R335327
trans-1,3-Dichloropropene	<0.5		0.5	ug/L		15-OCT-05	R335327
Trichloroethylene	<0.5		0.5	ug/L	50	15-OCT-05	R335327
Trichlorofluoromethane	<1		1	ug/L		15-OCT-05	R335327
Trihalomethanes (total)	<2.0		2	ug/L		15-OCT-05	R335327
Vinyl chloride	<0.5		0.5	ug/L	(1.3) 0.5	15-OCT-05	R335327
Surr: 1,2-Dichloroethane d4	116		67-133	%		15-OCT-05	R335327
Surr: Toluene-d8	99		67-133	%		15-OCT-05	R335327
Surr: 4-Bromofluorobenzene	96		67-133	%		15-OCT-05	R335327
F2-F4 (O.Reg.153/04)							
Prep/Analysis Dates						18-OCT-05	R336150
Surr: Octacosane	77		50-150	%		18-OCT-05	R336150
CCME Total Hydrocarbons							
F1 (C6-C10)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F1-BTEX	<100		100	ug/L		18-OCT-05	

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits	Analyzed	Batch
L329172-6 CON-1							
Sample Date: 06-OCT-05							
Matrix: WATER					ON-153/04-TABLE 2		
VOC, F1-F4 (O.Reg.153/04)							
CCME Total Hydrocarbons							
F2 (C10-C16)	<100		100	ug/L	F1+F2=1000	18-OCT-05	
F3 (C16-C34)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
F4 (C34-C50)	<500		500	ug/L	F3+F4=1000	18-OCT-05	
Total Hydrocarbons (C6-C50)	<500		500	ug/L		18-OCT-05	
Chromatogram to baseline at nC50	yes					18-OCT-05	
BTEX (O.Reg.153/04)							
Benzene	<0.5		0.5	ug/L	5.0	15-OCT-05	R335457
Ethyl Benzene	<0.5		0.5	ug/L	2.4	15-OCT-05	R335457
m+p-Xylenes	<1		1	ug/L		15-OCT-05	R335457
o-Xylene	<0.5		0.5	ug/L		15-OCT-05	R335457
Toluene	<0.5		0.5	ug/L	24	15-OCT-05	R335457
Xylene, (total)	<1.5		1.5	ug/L	300	15-OCT-05	R335457
Individual Analytes							
Mercury (Hg)	<0.0001		0.0001	mg/L	0.00012	14-OCT-05	R335069
Metal Scan-Total							
Aluminum (Al)-Total	16.2		0.01	mg/L		15-OCT-05	R334486
Antimony (Sb)-Total	<0.005		0.005	mg/L	0.006	15-OCT-05	R334486
Arsenic (As)-Total	0.005		0.001	mg/L	0.025	15-OCT-05	R334486
Barium (Ba)-Total	0.39		0.01	mg/L	1	15-OCT-05	R334486
Beryllium (Be)-Total	<0.001		0.001	mg/L	0.004	15-OCT-05	R334486
Bismuth (Bi)-Total	<0.001		0.001	mg/L		15-OCT-05	R334486
Boron (B)-Total	0.06		0.05	mg/L	5.0	15-OCT-05	R334486
Cadmium (Cd)-Total	<0.0001		0.0001	mg/L	0.005	15-OCT-05	R334486
Calcium (Ca)-Total	76.7		0.5	mg/L		15-OCT-05	R334486
Chromium (Cr)-Total	0.027		0.001	mg/L	0.05	15-OCT-05	R334486
Cobalt (Co)-Total	0.0134		0.0005	mg/L	0.1	15-OCT-05	R334486
Copper (Cu)-Total	0.126		0.001	mg/L	** 0.023	15-OCT-05	R334486
Iron (Fe)-Total	23.1		0.05	mg/L		15-OCT-05	R334486
Lead (Pb)-Total	0.014		0.001	mg/L	** 0.01	15-OCT-05	R334486
Magnesium (Mg)-Total	49.8		0.5	mg/L		15-OCT-05	R334486
Manganese (Mn)-Total	0.737		0.001	mg/L		15-OCT-05	R334486
Molybdenum (Mo)-Total	<0.001		0.001	mg/L	7.3	15-OCT-05	R334486
Nickel (Ni)-Total	0.027		0.002	mg/L	0.1	15-OCT-05	R334486
Phosphorus (P)-Total	0.67		0.05	mg/L		15-OCT-05	R334486
Potassium (K)-Total	3.2		0.5	mg/L		15-OCT-05	R334486
Selenium (Se)-Total	<0.005		0.005	mg/L	0.01	15-OCT-05	R334486
Silicon (Si)-Total	19.3		0.1	mg/L		15-OCT-05	R334486
Silver (Ag)-Total	<0.0001		0.0001	mg/L	0.0012	15-OCT-05	R334486
Sodium (Na)-Total	25.4		0.5	mg/L	200	15-OCT-05	R334486
Strontium (Sr)-Total	0.078		0.001	mg/L		15-OCT-05	R334486
Thallium (Tl)-Total	<0.0003		0.0003	mg/L	0.002	15-OCT-05	R334486
Tin (Sn)-Total	<0.001		0.001	mg/L		15-OCT-05	R334486
Titanium (Ti)-Total	0.393		0.002	mg/L		15-OCT-05	R334486
Tungsten (W)-Total	<0.01		0.01	mg/L		15-OCT-05	R334486
Uranium (U)-Total	0.005		0.005	mg/L		15-OCT-05	R334486
Vanadium (V)-Total	0.025		0.001	mg/L	0.2	15-OCT-05	R334486

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-6 CON-1								
Sample Date: 06-OCT-05								
Matrix: WATER					ON-153/04-TABLE 2			
Individual Analytes								
Metal Scan-Total								
Zinc (Zn)-Total	0.050		0.003	mg/L	1.1		15-OCT-05	R334486
Zirconium (Zr)-Total	<0.004		0.004	mg/L			15-OCT-05	R334486
Ammonia as N	<0.05		0.05	mg/L			17-OCT-05	R335645
Phenols (4AAP)	<0.001		0.001	mg/L			13-OCT-05	R334935
Total Kjeldahl Nitrogen	2.3		0.2	mg/L			18-OCT-05	R336256
Anion Scan (IC)								
Chloride	31		2	mg/L	250		13-OCT-05	R334849
Bromide	<0.1		0.1	mg/L			13-OCT-05	R334849
Fluoride	<0.1		0.1	mg/L			13-OCT-05	R334849
Nitrite-N	<0.1		0.1	mg/L	1		13-OCT-05	R334849
Nitrate-N	0.1		0.1	mg/L	10		13-OCT-05	R334849
Phosphate-P (ortho)	<0.3		0.3	mg/L			13-OCT-05	R334849
Sulphate	16		2	mg/L			13-OCT-05	R334849
L329172-7 LF-1								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
Prep/Analysis Dates							12-OCT-05	R335024
VOC EXCLUDING BTEX								
1,1,1,2-Tetrachloroethane	<0.008		0.008	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,1,2,2-Tetrachloroethane	<0.008		0.008	mg/kg	0.01	0.01	14-OCT-05	R335401
1,1,1-Trichloroethane	<0.003		0.003	mg/kg	(34) 26	(34) 26	14-OCT-05	R335401
1,1,2-Trichloroethane	<0.01		0.01	mg/kg	0.28	0.28	14-OCT-05	R335401
1,1-Dichloroethane	<0.01		0.01	mg/kg	3.0	3.0	14-OCT-05	R335401
1,1-Dichloroethylene	<0.002		0.002	mg/kg	(0.015) 0.0024	(0.015) 0.002	14-OCT-05	R335401
1,2-Dibromoethane	<0.005		0.005	mg/kg	(0.01) 0.0056	(0.012) 0.0056	14-OCT-05	R335401
1,2-Dichlorobenzene	<0.02		0.02	mg/kg	0.88	0.88	14-OCT-05	R335401
1,2-Dichloroethane	<0.002		0.002	mg/kg	(0.05) 0.022	(0.05) 0.022	14-OCT-05	R335401
1,2-Dichloropropane	<0.001		0.001	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,3-Dichlorobenzene	<0.02		0.02	mg/kg	30	30	14-OCT-05	R335401
1,4-Dichlorobenzene	<0.02		0.02	mg/kg	0.32	0.32	14-OCT-05	R335401
2-Chloroethylvinyl Ether	<0.03		0.03	mg/kg			14-OCT-05	R335401
2-Hexanone	<0.2		0.2	mg/kg			14-OCT-05	R335401
Acetone	<0.5		0.5	mg/kg	3.5	3.5	14-OCT-05	R335401
Bromodichloromethane	<0.01		0.01	mg/kg	0.12	0.12	14-OCT-05	R335401
Bromoform	<0.02		0.02	mg/kg	0.11	0.11	14-OCT-05	R335401
Bromomethane	<0.01		0.01	mg/kg	(0.38) 0.061	(0.38) 0.061	14-OCT-05	R335401
Carbon Disulfide	<0.02		0.02	mg/kg			14-OCT-05	R335401
Carbon tetrachloride	<0.01		0.01	mg/kg	(0.64) 0.10	(0.64) 0.10	14-OCT-05	R335401
Chlorobenzene	<0.02		0.02	mg/kg	2.4	2.4	14-OCT-05	R335401
Chloroethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Chloroform	<0.01		0.01	mg/kg	0.13	0.13	14-OCT-05	R335401
Chloromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
cis-1,2-Dichloroethylene	<0.02		0.02	mg/kg	2.3	2.3	14-OCT-05	R335401
cis-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-7 LF-1								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
VOC EXCLUDING BTEX								
Dibromochloromethane	<0.001		0.001	mg/kg	0.09	0.09	14-OCT-05	R335401
Dichlorodifluoromethane	<0.03		0.03	mg/kg			14-OCT-05	R335401
Dichloromethane	<0.1		0.1	mg/kg	1.1	1.1	14-OCT-05	R335401
MTBE	<0.3		0.25	mg/kg	5.7	5.7	14-OCT-05	R335401
Methyl Ethyl Ketone	<0.2		0.2	mg/kg	0.27	0.27	14-OCT-05	R335401
Methyl Isobutyl Ketone	<0.2		0.2	mg/kg	0.48	0.48	14-OCT-05	R335401
Styrene	<0.02		0.02	mg/kg	(1.7) 1.2	(1.7) 1.2	14-OCT-05	R335401
Tetrachloroethylene	<0.02		0.02	mg/kg	0.45	0.45	14-OCT-05	R335401
trans-1,2-Dichloroethylene	<0.06		0.06	mg/kg	4.1	4.1	14-OCT-05	R335401
trans-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Trichloroethylene	<0.05		0.05	mg/kg	(3.9) 1.1	(3.9) 1.1	14-OCT-05	R335401
Trichlorofluoromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Trihalomethanes (total)	<0.041		0.041	mg/kg			14-OCT-05	R335401
Vinyl chloride	<0.003		0.003	mg/kg	(0.0075) 0.003	(0.0075) 0.003	14-OCT-05	R335401
Surr: 1,2-Dichloroethane d4	114		80-120	%			14-OCT-05	R335401
Surr: Toluene-d8	101		80-120	%			14-OCT-05	R335401
Surr: 4-Bromofluorobenzene	97		80-120	%			14-OCT-05	R335401
F2-F4 (O.Reg.153/04)								
Prep/Analysis Dates							15-OCT-05	R336038
Surr: Octacosane	87		50-150	%			15-OCT-05	R336038
CCME Total Hydrocarbons								
F1 (C6-C10)	11		5	mg/kg	(180) 30	(180) 230	18-OCT-05	
F1-BTEX	11		5	mg/kg			18-OCT-05	
F2 (C10-C16)	63		5	mg/kg	(250) 150	(250) 150	18-OCT-05	
F3 (C16-C34)	49		5	mg/kg	(800) 400	(2500) 1700	18-OCT-05	
F4 (C34-C50)	36		5	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
F4G-SG (GHH-Silica)	100		100	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
Total Hydrocarbons (C6-C50)	159		5	mg/kg			18-OCT-05	
Chromatogram to baseline at nC50	no						18-OCT-05	
BTEX (O.Reg.153/04)								
Benzene	<0.05		0.05	mg/kg	0.24	0.24	14-OCT-05	R335025
Ethyl Benzene	<0.05		0.05	mg/kg	0.28	0.28	14-OCT-05	R335025
m+p-Xylenes	<0.1		0.1	mg/kg			14-OCT-05	R335025
o-Xylene	<0.05		0.05	mg/kg			14-OCT-05	R335025
Toluene	<0.05		0.05	mg/kg	2.1	2.1	14-OCT-05	R335025
Xylene, (total)	<0.15		0.15	mg/kg	25	25	14-OCT-05	R335025
Individual Analytes								
% Moisture	7.6		0.5	%			13-OCT-05	R334360
Prep/Analysis Dates							18-OCT-05	R336364
L329172-8 LF-2								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
Prep/Analysis Dates							12-OCT-05	R335024

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-8 LF-2								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
VOC EXCLUDING BTEX								
1,1,1,2-Tetrachloroethane	<0.008		0.008	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,1,2,2-Tetrachloroethane	<0.008		0.008	mg/kg	0.01	0.01	14-OCT-05	R335401
1,1,1-Trichloroethane	<0.003		0.003	mg/kg	(34) 26	(34) 26	14-OCT-05	R335401
1,1,2-Trichloroethane	<0.01		0.01	mg/kg	0.28	0.28	14-OCT-05	R335401
1,1-Dichloroethane	<0.01		0.01	mg/kg	3.0	3.0	14-OCT-05	R335401
1,1-Dichloroethylene	<0.002		0.002	mg/kg	(0.015) 0.0024	(0.015) 0.002	14-OCT-05	R335401
1,2-Dibromoethane	<0.005		0.005	mg/kg	(0.01) 0.0056	(0.012) 0.0056	14-OCT-05	R335401
1,2-Dichlorobenzene	<0.02		0.02	mg/kg	0.88	0.88	14-OCT-05	R335401
1,2-Dichloroethane	<0.002		0.002	mg/kg	(0.05) 0.022	(0.05) 0.022	14-OCT-05	R335401
1,2-Dichloropropane	<0.001		0.001	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,3-Dichlorobenzene	<0.02		0.02	mg/kg	30	30	14-OCT-05	R335401
1,4-Dichlorobenzene	<0.02		0.02	mg/kg	0.32	0.32	14-OCT-05	R335401
2-Chloroethylvinyl Ether	<0.03		0.03	mg/kg			14-OCT-05	R335401
2-Hexanone	<0.2		0.2	mg/kg			14-OCT-05	R335401
Acetone	<0.5		0.5	mg/kg	3.5	3.5	14-OCT-05	R335401
Bromodichloromethane	<0.01		0.01	mg/kg	0.12	0.12	14-OCT-05	R335401
Bromoform	<0.02		0.02	mg/kg	0.11	0.11	14-OCT-05	R335401
Bromomethane	<0.01		0.01	mg/kg	(0.38) 0.061	(0.38) 0.061	14-OCT-05	R335401
Carbon Disulfide	<0.02		0.02	mg/kg			14-OCT-05	R335401
Carbon tetrachloride	<0.01		0.01	mg/kg	(0.64) 0.10	(0.64) 0.10	14-OCT-05	R335401
Chlorobenzene	<0.02		0.02	mg/kg	2.4	2.4	14-OCT-05	R335401
Chloroethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Chloroform	<0.01		0.01	mg/kg	0.13	0.13	14-OCT-05	R335401
Chloromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
cis-1,2-Dichloroethylene	<0.02		0.02	mg/kg	2.3	2.3	14-OCT-05	R335401
cis-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Dibromochloromethane	<0.001		0.001	mg/kg	0.09	0.09	14-OCT-05	R335401
Dichlorodifluoromethane	<0.03		0.03	mg/kg			14-OCT-05	R335401
Dichloromethane	<0.1		0.1	mg/kg	1.1	1.1	14-OCT-05	R335401
MTBE	<0.3		0.25	mg/kg	5.7	5.7	14-OCT-05	R335401
Methyl Ethyl Ketone	<0.2		0.2	mg/kg	0.27	0.27	14-OCT-05	R335401
Methyl Isobutyl Ketone	<0.2		0.2	mg/kg	0.48	0.48	14-OCT-05	R335401
Styrene	<0.02		0.02	mg/kg	(1.7) 1.2	(1.7) 1.2	14-OCT-05	R335401
Tetrachloroethylene	<0.02		0.02	mg/kg	0.45	0.45	14-OCT-05	R335401
trans-1,2-Dichloroethylene	<0.06		0.06	mg/kg	4.1	4.1	14-OCT-05	R335401
trans-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Trichloroethylene	<0.05		0.05	mg/kg	(3.9) 1.1	(3.9) 1.1	14-OCT-05	R335401
Trichlorofluoromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Trihalomethanes (total)	<0.041		0.041	mg/kg			14-OCT-05	R335401
Vinyl chloride	<0.003		0.003	mg/kg	(0.0075) 0.003	(0.0075) 0.003	14-OCT-05	R335401
Surr: 1,2-Dichloroethane d4	105		80-120	%			14-OCT-05	R335401
Surr: Toluene-d8	101		80-120	%			14-OCT-05	R335401
Surr: 4-Bromofluorobenzene	95		80-120	%			14-OCT-05	R335401
F2-F4 (O.Reg.153/04)								
Prep/Analysis Dates							15-OCT-05	R336038
Surr: Octacosane	78		50-150	%			15-OCT-05	R336038
CCME Total Hydrocarbons								
F1 (C6-C10)	7		5	mg/kg	(180) 30	(180) 230	18-OCT-05	

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-8 LF-2								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
CCME Total Hydrocarbons								
F1-BTEX	7		5	mg/kg			18-OCT-05	
F2 (C10-C16)	39		5	mg/kg	(250) 150	(250) 150	18-OCT-05	
F3 (C16-C34)	62		5	mg/kg	(800) 400	(2500) 1700	18-OCT-05	
F4 (C34-C50)	42		5	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
F4G-SG (GHH-Silica)	100		100	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
Total Hydrocarbons (C6-C50)	150		5	mg/kg			18-OCT-05	
Chromatogram to baseline at nC50	no						18-OCT-05	
BTEX (O.Reg.153/04)								
Benzene	<0.05		0.05	mg/kg	0.24	0.24	14-OCT-05	R335025
Ethyl Benzene	<0.05		0.05	mg/kg	0.28	0.28	14-OCT-05	R335025
m+p-Xylenes	<0.1		0.1	mg/kg			14-OCT-05	R335025
o-Xylene	<0.05		0.05	mg/kg			14-OCT-05	R335025
Toluene	<0.05		0.05	mg/kg	2.1	2.1	14-OCT-05	R335025
Xylene, (total)	<0.15		0.15	mg/kg	25	25	14-OCT-05	R335025
Individual Analytes								
% Moisture	7.9		0.5	%			13-OCT-05	R334360
Prep/Analysis Dates							18-OCT-05	R336364
L329172-9 LF-3								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
Prep/Analysis Dates							12-OCT-05	R335024
VOC EXCLUDING BTEX								
1,1,1,2-Tetrachloroethane	<0.008		0.008	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,1,2,2-Tetrachloroethane	<0.008		0.008	mg/kg	0.01	0.01	14-OCT-05	R335401
1,1,1-Trichloroethane	<0.003		0.003	mg/kg	(34) 26	(34) 26	14-OCT-05	R335401
1,1,2-Trichloroethane	<0.01		0.01	mg/kg	0.28	0.28	14-OCT-05	R335401
1,1-Dichloroethane	<0.01		0.01	mg/kg	3.0	3.0	14-OCT-05	R335401
1,1-Dichloroethylene	<0.002		0.002	mg/kg	(0.015) 0.0024	(0.015) 0.002	14-OCT-05	R335401
1,2-Dibromoethane	<0.005		0.005	mg/kg	(0.01) 0.0056	(0.012) 0.0056	14-OCT-05	R335401
1,2-Dichlorobenzene	<0.02		0.02	mg/kg	0.88	0.88	14-OCT-05	R335401
1,2-Dichloroethane	<0.002		0.002	mg/kg	(0.05) 0.022	(0.05) 0.022	14-OCT-05	R335401
1,2-Dichloropropane	<0.001		0.001	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,3-Dichlorobenzene	<0.02		0.02	mg/kg	30	30	14-OCT-05	R335401
1,4-Dichlorobenzene	<0.02		0.02	mg/kg	0.32	0.32	14-OCT-05	R335401
2-Chloroethylvinyl Ether	<0.03		0.03	mg/kg			14-OCT-05	R335401
2-Hexanone	<0.2		0.2	mg/kg			14-OCT-05	R335401
Acetone	<0.5		0.5	mg/kg	3.5	3.5	14-OCT-05	R335401
Bromodichloromethane	<0.01		0.01	mg/kg	0.12	0.12	14-OCT-05	R335401
Bromoform	<0.02		0.02	mg/kg	0.11	0.11	14-OCT-05	R335401
Bromomethane	<0.01		0.01	mg/kg	(0.38) 0.061	(0.38) 0.061	14-OCT-05	R335401
Carbon Disulfide	<0.02		0.02	mg/kg			14-OCT-05	R335401
Carbon tetrachloride	<0.01		0.01	mg/kg	(0.64) 0.10	(0.64) 0.10	14-OCT-05	R335401
Chlorobenzene	<0.02		0.02	mg/kg	2.4	2.4	14-OCT-05	R335401
Chloroethane	<0.02		0.02	mg/kg			14-OCT-05	R335401

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits RES/PARK	Criteria Specific Limits IND/COMM	Analyzed	Batch
L329172-9 LF-3								
Sample Date: 06-OCT-05								
Matrix: SOIL								
VOC, F1-F4 (O.Reg.153/04)								
VOC EXCLUDING BTEX								
Chloroform	<0.01		0.01	mg/kg	0.13	0.13	14-OCT-05	R335401
Chloromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
cis-1,2-Dichloroethylene	<0.02		0.02	mg/kg	2.3	2.3	14-OCT-05	R335401
cis-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Dibromochloromethane	<0.001		0.001	mg/kg	0.09	0.09	14-OCT-05	R335401
Dichlorodifluoromethane	<0.03		0.03	mg/kg			14-OCT-05	R335401
Dichloromethane	<0.1		0.1	mg/kg	1.1	1.1	14-OCT-05	R335401
MTBE	<0.3		0.25	mg/kg	5.7	5.7	14-OCT-05	R335401
Methyl Ethyl Ketone	<0.2		0.2	mg/kg	0.27	0.27	14-OCT-05	R335401
Methyl Isobutyl Ketone	<0.2		0.2	mg/kg	0.48	0.48	14-OCT-05	R335401
Styrene	<0.02		0.02	mg/kg	(1.7) 1.2	(1.7) 1.2	14-OCT-05	R335401
Tetrachloroethylene	<0.02		0.02	mg/kg	0.45	0.45	14-OCT-05	R335401
trans-1,2-Dichloroethylene	<0.06		0.06	mg/kg	4.1	4.1	14-OCT-05	R335401
trans-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Trichloroethylene	<0.05		0.05	mg/kg	(3.9) 1.1	(3.9) 1.1	14-OCT-05	R335401
Trichlorofluoromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Trihalomethanes (total)	<0.041		0.041	mg/kg			14-OCT-05	R335401
Vinyl chloride	<0.003		0.003	mg/kg	(0.0075) 0.003	(0.0075) 0.003	14-OCT-05	R335401
Surr: 1,2-Dichloroethane d4	112		80-120	%			14-OCT-05	R335401
Surr: Toluene-d8	101		80-120	%			14-OCT-05	R335401
Surr: 4-Bromofluorobenzene	95		80-120	%			14-OCT-05	R335401
F2-F4 (O.Reg.153/04)								
Prep/Analysis Dates							15-OCT-05	R336038
Surr: Octacosane	89		50-150	%			15-OCT-05	R336038
CCME Total Hydrocarbons								
F1 (C6-C10)	10		5	mg/kg	(180) 30	(180) 230	18-OCT-05	
F1-BTEX	10		5	mg/kg			18-OCT-05	
F2 (C10-C16)	83		5	mg/kg	(250) 150	(250) 150	18-OCT-05	
F3 (C16-C34)	54		5	mg/kg	(800) 400	(2500) 1700	18-OCT-05	
F4 (C34-C50)	31		5	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
F4G-SG (GHH-Silica)	<100		100	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
Total Hydrocarbons (C6-C50)	178		5	mg/kg			18-OCT-05	
Chromatogram to baseline at nC50	no						18-OCT-05	
BTEX (O.Reg.153/04)								
Benzene	<0.05		0.05	mg/kg	0.24	0.24	14-OCT-05	R335025
Ethyl Benzene	<0.05		0.05	mg/kg	0.28	0.28	14-OCT-05	R335025
m+p-Xylenes	<0.1		0.1	mg/kg			14-OCT-05	R335025
o-Xylene	<0.05		0.05	mg/kg			14-OCT-05	R335025
Toluene	<0.05		0.05	mg/kg	2.1	2.1	14-OCT-05	R335025
Xylene, (total)	<0.15		0.15	mg/kg	25	25	14-OCT-05	R335025
Individual Analytes								
% Moisture	7.7		0.5	%			13-OCT-05	R334360
Prep/Analysis Dates							18-OCT-05	R336364

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-10 LF-4								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
Prep/Analysis Dates							12-OCT-05	R335024
VOC EXCLUDING BTEX								
1,1,1,2-Tetrachloroethane	<0.008		0.008	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,1,2,2-Tetrachloroethane	<0.008		0.008	mg/kg	0.01	0.01	14-OCT-05	R335401
1,1,1-Trichloroethane	<0.003		0.003	mg/kg	(34) 26	(34) 26	14-OCT-05	R335401
1,1,2-Trichloroethane	<0.01		0.01	mg/kg	0.28	0.28	14-OCT-05	R335401
1,1-Dichloroethane	<0.01		0.01	mg/kg	3.0	3.0	14-OCT-05	R335401
1,1-Dichloroethylene	<0.002		0.002	mg/kg	(0.015) 0.0024	(0.015) 0.002	14-OCT-05	R335401
1,2-Dibromoethane	<0.005		0.005	mg/kg	(0.01) 0.0056	(0.012) 0.0056	14-OCT-05	R335401
1,2-Dichlorobenzene	<0.02		0.02	mg/kg	0.88	0.88	14-OCT-05	R335401
1,2-Dichloroethane	<0.002		0.002	mg/kg	(0.05) 0.022	(0.05) 0.022	14-OCT-05	R335401
1,2-Dichloropropane	<0.001		0.001	mg/kg	(0.12) 0.019	(0.12) 0.019	14-OCT-05	R335401
1,3-Dichlorobenzene	<0.02		0.02	mg/kg	30	30	14-OCT-05	R335401
1,4-Dichlorobenzene	<0.02		0.02	mg/kg	0.32	0.32	14-OCT-05	R335401
2-Chloroethylvinyl Ether	<0.03		0.03	mg/kg			14-OCT-05	R335401
2-Hexanone	<0.2		0.2	mg/kg			14-OCT-05	R335401
Acetone	<0.5		0.5	mg/kg	3.5	3.5	14-OCT-05	R335401
Bromodichloromethane	<0.01		0.01	mg/kg	0.12	0.12	14-OCT-05	R335401
Bromoform	<0.02		0.02	mg/kg	0.11	0.11	14-OCT-05	R335401
Bromomethane	<0.01		0.01	mg/kg	(0.38) 0.061	(0.38) 0.061	14-OCT-05	R335401
Carbon Disulfide	<0.02		0.02	mg/kg			14-OCT-05	R335401
Carbon tetrachloride	<0.01		0.01	mg/kg	(0.64) 0.10	(0.64) 0.10	14-OCT-05	R335401
Chlorobenzene	<0.02		0.02	mg/kg	2.4	2.4	14-OCT-05	R335401
Chloroethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Chloroform	<0.01		0.01	mg/kg	0.13	0.13	14-OCT-05	R335401
Chloromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
cis-1,2-Dichloroethylene	<0.02		0.02	mg/kg	2.3	2.3	14-OCT-05	R335401
cis-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Dibromochloromethane	<0.001		0.001	mg/kg	0.09	0.09	14-OCT-05	R335401
Dichlorodifluoromethane	<0.03		0.03	mg/kg			14-OCT-05	R335401
Dichloromethane	<0.1		0.1	mg/kg	1.1	1.1	14-OCT-05	R335401
MTBE	<0.3		0.25	mg/kg	5.7	5.7	14-OCT-05	R335401
Methyl Ethyl Ketone	<0.2		0.2	mg/kg	0.27	0.27	14-OCT-05	R335401
Methyl Isobutyl Ketone	<0.2		0.2	mg/kg	0.48	0.48	14-OCT-05	R335401
Styrene	<0.02		0.02	mg/kg	(1.7) 1.2	(1.7) 1.2	14-OCT-05	R335401
Tetrachloroethylene	<0.02		0.02	mg/kg	0.45	0.45	14-OCT-05	R335401
trans-1,2-Dichloroethylene	<0.06		0.06	mg/kg	4.1	4.1	14-OCT-05	R335401
trans-1,3-Dichloropropene	<0.002		0.002	mg/kg	(0.04) 0.0066	(0.04) 0.0066	14-OCT-05	R335401
Trichloroethylene	<0.05		0.05	mg/kg	(3.9) 1.1	(3.9) 1.1	14-OCT-05	R335401
Trichlorofluoromethane	<0.02		0.02	mg/kg			14-OCT-05	R335401
Trihalomethanes (total)	<0.041		0.041	mg/kg			14-OCT-05	R335401
Vinyl chloride	<0.003		0.003	mg/kg	(0.0075) 0.003	(0.0075) 0.003	14-OCT-05	R335401
Surr: 1,2-Dichloroethane d4	95		80-120	%			14-OCT-05	R335401
Surr: Toluene-d8	100		80-120	%			14-OCT-05	R335401
Surr: 4-Bromofluorobenzene	94		80-120	%			14-OCT-05	R335401
F2-F4 (O.Reg.153/04)								
Prep/Analysis Dates							15-OCT-05	R336038
Surr: Octacosane	86		50-150	%			15-OCT-05	R336038
CCME Total Hydrocarbons								

** analytical results for this parameter exceed criteria limits listed on this report

ENVIRO-TEST CRITERIA REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L329172-10 LF-4								
Sample Date: 06-OCT-05								
Matrix: SOIL					RES/PARK	IND/COMM		
VOC, F1-F4 (O.Reg.153/04)								
CCME Total Hydrocarbons								
F1 (C6-C10)	<5		5	mg/kg	(180) 30	(180) 230	18-OCT-05	
F1-BTEX	<5		5	mg/kg			18-OCT-05	
F2 (C10-C16)	<5		5	mg/kg	(250) 150	(250) 150	18-OCT-05	
F3 (C16-C34)	18		5	mg/kg	(800) 400	(2500) 1700	18-OCT-05	
F4 (C34-C50)	16		5	mg/kg	(5600) 2800	(6600) 3300	18-OCT-05	
Total Hydrocarbons (C6-C50)	34		5	mg/kg			18-OCT-05	
Chromatogram to baseline at nC50	yes						18-OCT-05	
BTEX (O.Reg.153/04)								
Benzene	<0.05		0.05	mg/kg	0.24	0.24	14-OCT-05	R335025
Ethyl Benzene	<0.05		0.05	mg/kg	0.28	0.28	14-OCT-05	R335025
m+p-Xylenes	<0.1		0.1	mg/kg			14-OCT-05	R335025
o-Xylene	<0.05		0.05	mg/kg			14-OCT-05	R335025
Toluene	<0.05		0.05	mg/kg	2.1	2.1	14-OCT-05	R335025
Xylene, (total)	<0.15		0.15	mg/kg	25	25	14-OCT-05	R335025
Individual Analytes								
% Moisture	8.7		0.5	%			13-OCT-05	R334360

** analytical results for this parameter exceed criteria limits listed on this report

Reference Information

Methods Listed (if applicable):

ETL Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
ANIONS-WT	Water	Anion Scan (IC)		EPA 300.0 (IC)
BTX-R153-WT	Water	BTEX (O.Reg.153/04)		MOE DECPH-E3421/CCME Tier 1
BTX-R153-WT	Soil	BTEX (O.Reg.153/04)		MOE DECPH-E3398/CCME Tier 1
ETL-TVH,TEH-CCME-WT	Water	CCME Total Hydrocarbons		CCME CWS-PHC Dec-2000 - Pub# 1310

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

ETL-TVH,TEH-CCME-WT	Soil	CCME Total Hydrocarbons		CCME CWS-PHC Dec-2000 - Pub# 1310

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-WT	Water	F1 (O.Reg.153/04)		MOE DECPH-E3421/CCME Tier 1
F1-WT	Soil	F1 (O.Reg.153/04)		MOE DECPH-E3398/CCME Tier 1
F2-F4-WT	Water	F2-F4 (O.Reg.153/04)		MOE DECPH-E3421/CCME Tier 1
F2-F4-WT	Soil	F2-F4 (O.Reg.153/04)		MOE DECPH-E3398/CCME Tier 1
F4G-ADD-WT	Soil	F4G-SG (O.Reg.153/04)		MOE DECPH-E3398/CCME Tier 1
HG-TOT-WT	Water	Mercury (Hg)-Total		SW846 7470A
MET-TOT-WT	Water	Metal Scan-Total		EPA 200.8
MOISTURE-WT	Soil	% Moisture		Gravimetric: Oven Dried
NH3-WT	Water	Ammonia as N		APHA 4500-NH3
PHENOLS-4AAP-WT	Water	Phenols (4AAP)		APHA 5530

Reference Information

VOC-ROU-NO-BTX-WT	Water	VOC EXCLUDING BTX	SW846 8260
VOC-ROU-NO-BTX-WT	Soil	VOC EXCLUDING BTEX	EPA 8260

Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	Enviro-Test Laboratories - Waterloo (Sentinel), Ontario, Can		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds. The reported surrogate recovery value provides a measure of method efficiency. The Laboratory warning units are determined under column heading D.L.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
< - Less than
D.L. - Detection Limit
N/A - Result not available. Refer to qualifier code and definition for explanation

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
UNLESS OTHERWISE STATED, SAMPLES ARE NOT CORRECTED FOR CLIENT FIELD BLANKS.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

Enviro-Test Laboratories has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, Enviro-Test Laboratories assumes no liability for the use or interpretation of the results.

Enviro-Test Quality Control Report

Workorder: L329172

Client: NUNA BURNSIDE ENGINEERING & ENVIRONMENTA
15 TOWNLINE
ORANGEVILLE ON L9W 3R4

Contact: JIM WALLS

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-WT	**Water**							
Batch R334849								
WG363828-5 DUP		**L328949-1**						
Bromide		<0.1	<0.1	RPD-NA	mg/L	N/A	20	13-OCT-05
Chloride		8	8	J	mg/L	0	6.1	13-OCT-05
Fluoride		0.2	0.2	J	mg/L	0.0	0.31	13-OCT-05
Nitrate-N		<0.1	<0.1	RPD-NA	mg/L	N/A	20	13-OCT-05
Nitrite-N		<0.1	<0.1	RPD-NA	mg/L	N/A	20	13-OCT-05
Phosphate-P (ortho)		<0.3	<0.3	RPD-NA	mg/L	N/A	20	13-OCT-05
Sulphate		7	7	J	mg/L	0	6.1	13-OCT-05
WG363828-7 DUP		**WG363828-4**						
Bromide		1.0	1.0	J	mg/L	0.1	0.31	13-OCT-05
Chloride		19	19	J	mg/L	0	6.1	13-OCT-05
Fluoride		1.0	1.0		mg/L	0.0	20	13-OCT-05
Nitrate-N		0.9	0.9	J	mg/L	0.0	0.31	13-OCT-05
Nitrite-N		0.9	0.9	J	mg/L	0.0	0.31	13-OCT-05
Phosphate-P (ortho)		0.9	1.0	J	mg/L	0.1	0.92	13-OCT-05
Sulphate		20	20	J	mg/L	0	6.1	13-OCT-05
WG363828-2 LCS								
Bromide			101		%		80-120	13-OCT-05
Chloride			97		%		80-120	13-OCT-05
Fluoride			98		%		80-120	13-OCT-05
Nitrate-N			100		%		80-120	13-OCT-05
Nitrite-N			100		%		80-120	13-OCT-05
Phosphate-P (ortho)			97		%		75-125	13-OCT-05
Sulphate			96		%		80-120	13-OCT-05
WG363828-1 MB								
Bromide			<0.1		mg/L		0.1	13-OCT-05
Chloride			<2		mg/L		2	13-OCT-05
Fluoride			<0.1		mg/L		0.1	13-OCT-05
Nitrate-N			<0.1		mg/L		0.1	13-OCT-05
Nitrite-N			<0.1		mg/L		0.1	13-OCT-05
Phosphate-P (ortho)			<0.3		mg/L		0.3	13-OCT-05
Sulphate			<2		mg/L		2	13-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-WT	**Water**							
Batch R335756								
WG364974-7 DUP		**WG364974-4**						
Bromide		1.0	1.0	J	mg/L	0.0	0.31	14-OCT-05
Chloride		20	20		mg/L	0.099	20	14-OCT-05
Fluoride		1.0	1.0	J	mg/L	0.0	0.31	14-OCT-05
Nitrate-N		0.9	0.9	J	mg/L	0.0	0.31	14-OCT-05
Nitrite-N		0.9	0.9	J	mg/L	0.0	0.31	14-OCT-05
Phosphate-P (ortho)		0.9	0.9	J	mg/L	0.0	0.92	14-OCT-05
Sulphate		21	21		mg/L	0.049	15	14-OCT-05
WG364974-2 LCS								
Bromide			98		%		80-120	14-OCT-05
Chloride			101		%		80-120	14-OCT-05
Fluoride			101		%		80-120	14-OCT-05
Nitrate-N			99		%		80-120	14-OCT-05
Nitrite-N			100		%		80-120	14-OCT-05
Phosphate-P (ortho)			96		%		75-125	14-OCT-05
Sulphate			101		%		80-120	14-OCT-05
WG364974-1 MB								
Bromide			<0.1		mg/L		0.1	14-OCT-05
Chloride			<2		mg/L		2	14-OCT-05
Fluoride			<0.1		mg/L		0.1	14-OCT-05
Nitrate-N			<0.1		mg/L		0.1	14-OCT-05
Nitrite-N			<0.1		mg/L		0.1	14-OCT-05
Phosphate-P (ortho)			<0.3		mg/L		0.3	14-OCT-05
Sulphate			<2		mg/L		2	14-OCT-05
BTX-R153-WT	**Water**							
Batch R335457								
WG364406-1 CVS								
Benzene			102		%		88-114	15-OCT-05
Ethyl Benzene			104		%		85-112	15-OCT-05
m+p-Xylenes			106		%		84-113	15-OCT-05
o-Xylene			106		%		85-112	15-OCT-05
Toluene			104		%		87-112	15-OCT-05
WG364406-3 DUP		**L329172-6**						
Benzene		<0.5	<0.5	RPD-NA	ug/L	N/A	30	15-OCT-05
Ethyl Benzene		<0.5	<0.5	RPD-NA	ug/L	N/A	30	15-OCT-05
m+p-Xylenes		<1	<1	RPD-NA	ug/L	N/A	30	15-OCT-05
o-Xylene		<0.5	<0.5	RPD-NA	ug/L	N/A	30	15-OCT-05
Toluene		<0.5	<0.5	RPD-NA	ug/L	N/A	30	15-OCT-05
WG364406-2 MB								

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX-R153-WT	Water							
Batch R335457								
WG364406-2 MB								
Benzene			<0.5		ug/L		0.5	15-OCT-05
Ethyl Benzene			<0.5		ug/L		0.5	15-OCT-05
m+p-Xylenes			<1		ug/L		1	15-OCT-05
o-Xylene			<0.5		ug/L		0.5	15-OCT-05
Toluene			<0.5		ug/L		0.5	15-OCT-05
F1-WT	Water							
Batch R335461								
WG364407-1 CVS								
TVH: (C6-C10 / No BTEX Correction)			90		%		70-120	12-JUL-05
WG364407-3 DUP		L329172-6						
TVH: (C6-C10 / No BTEX Correction)		<100	<100	RPD-NA	ug/L	N/A	15	12-JUL-05
WG364407-2 MB								
TVH: (C6-C10 / No BTEX Correction)			<100		ug/L		100	12-JUL-05
F2-F4-WT	Water							
Batch R336150								
WG365407-1 CVS								
F2 (C10-C16)			118		%		80-120	18-OCT-05
F3 (C16-C34)			120		%		80-120	18-OCT-05
F4 (C34-C50)			121	H	%		80-120	18-OCT-05
WG364982-2 LCS								
F2 (C10-C16)			67	H	%		72-118	18-OCT-05
F3 (C16-C34)			75		%		72-118	18-OCT-05
F4 (C34-C50)			79		%		72-118	18-OCT-05
WG364982-1 MB								
F2 (C10-C16)			<100		ug/L		100	18-OCT-05
F3 (C16-C34)			<500		ug/L		500	18-OCT-05
F4 (C34-C50)			<500		ug/L		500	18-OCT-05
HG-TOT-WT	Water							
Batch R335069								
WG363765-2 CVS								
Mercury (Hg)			85		%		75-125	14-OCT-05
WG363765-4 DUP		WG363765-3						
Mercury (Hg)		<0.0001	<0.0001	RPD-NA	mg/L	N/A	20	14-OCT-05
WG363765-1 MB								
Mercury (Hg)			<0.0001		mg/L		0.0001	14-OCT-05
MET-TOT-WT	Water							

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-WT	**Water**							
Batch R334486								
WG363205-1 CVS								
Aluminum (Al)-Total			100		%		85-120	13-OCT-05
Antimony (Sb)-Total			104		%		81-120	13-OCT-05
Arsenic (As)-Total			108		%		92-117	13-OCT-05
Barium (Ba)-Total			101		%		90-112	13-OCT-05
Beryllium (Be)-Total			103		%		87-116	13-OCT-05
Bismuth (Bi)-Total			99		%		80-120	13-OCT-05
Boron (B)-Total			96		%		78-120	13-OCT-05
Cadmium (Cd)-Total			100		%		90-115	13-OCT-05
Calcium (Ca)-Total			104		%		80-120	13-OCT-05
Chromium (Cr)-Total			101		%		89-113	13-OCT-05
Cobalt (Co)-Total			90		%		86-112	13-OCT-05
Copper (Cu)-Total			107		%		89-117	13-OCT-05
Iron (Fe)-Total			110		%		90-130	13-OCT-05
Lead (Pb)-Total			106		%		88-120	13-OCT-05
Magnesium (Mg)-Total			96		%		86-116	13-OCT-05
Manganese (Mn)-Total			85		%		84-116	13-OCT-05
Molybdenum (Mo)-Total			102		%		87-115	13-OCT-05
Nickel (Ni)-Total			107		%		87-117	13-OCT-05
Phosphorus (P)-Total			104		%		81-122	13-OCT-05
Potassium (K)-Total			122		%		89-128	13-OCT-05
Selenium (Se)-Total			116		%		89-121	13-OCT-05
Silver (Ag)-Total			99		%		85-115	13-OCT-05
Sodium (Na)-Total			105		%		86-116	13-OCT-05
Strontium (Sr)-Total			102		%		88-112	13-OCT-05
Thallium (Tl)-Total			101		%		83-123	13-OCT-05
Uranium (U)-Total			106		%		86-116	13-OCT-05
Vanadium (V)-Total			91		%		83-115	13-OCT-05
Zinc (Zn)-Total			118		%		85-121	13-OCT-05
WG363205-2 CVS								
Silicon (Si)-Total			111		%		75-131	13-OCT-05
Tin (Sn)-Total			110		%		91-123	13-OCT-05
Titanium (Ti)-Total			112		%		89-117	13-OCT-05
Tungsten (W)-Total			118		%		81-121	13-OCT-05
Zirconium (Zr)-Total			95		%		84-120	13-OCT-05
WG363205-5 DUP		**WG363205-4**						
Aluminum (Al)-Total		<0.01	<0.01	RPD-NA	mg/L	N/A	15	13-OCT-05
Antimony (Sb)-Total		<0.005	<0.005	RPD-NA	mg/L	N/A	15	13-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-WT	Water							
Batch R334486								
WG363205-5 DUP		WG363205-4						
Arsenic (As)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Barium (Ba)-Total		<0.01	<0.01	RPD-NA	mg/L	N/A	15	13-OCT-05
Beryllium (Be)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Bismuth (Bi)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	20	13-OCT-05
Boron (B)-Total		<0.05	<0.05	RPD-NA	mg/L	N/A	15	13-OCT-05
Cadmium (Cd)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	13-OCT-05
Calcium (Ca)-Total		<0.5	<0.5	RPD-NA	mg/L	N/A	15	13-OCT-05
Chromium (Cr)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Cobalt (Co)-Total		<0.0005	<0.0005	RPD-NA	mg/L	N/A	20	13-OCT-05
Copper (Cu)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Iron (Fe)-Total		<0.05	<0.05	RPD-NA	mg/L	N/A	15	13-OCT-05
Lead (Pb)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Magnesium (Mg)-Total		<0.5	<0.5	RPD-NA	mg/L	N/A	15	13-OCT-05
Manganese (Mn)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Molybdenum (Mo)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Nickel (Ni)-Total		<0.002	<0.002	RPD-NA	mg/L	N/A	15	13-OCT-05
Phosphorus (P)-Total		<0.05	<0.05	RPD-NA	mg/L	N/A	15	13-OCT-05
Selenium (Se)-Total		<0.005	<0.005	RPD-NA	mg/L	N/A	15	13-OCT-05
Silicon (Si)-Total		2.7	2.9		mg/L	5.7	17	13-OCT-05
Silver (Ag)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	13-OCT-05
Sodium (Na)-Total		3.0	3.4	J	mg/L	0.4	1.5	13-OCT-05
Strontium (Sr)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Thallium (Tl)-Total		<0.0003	<0.0003	RPD-NA	mg/L	N/A	15	13-OCT-05
Tin (Sn)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	20	13-OCT-05
Titanium (Ti)-Total		<0.002	<0.002	RPD-NA	mg/L	N/A	15	13-OCT-05
Tungsten (W)-Total		<0.01	<0.01	RPD-NA	mg/L	N/A	15	13-OCT-05
Uranium (U)-Total		<0.005	<0.005	RPD-NA	mg/L	N/A	15	13-OCT-05
Vanadium (V)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	13-OCT-05
Zinc (Zn)-Total		0.011	0.011	J	mg/L	0.000	0.0092	13-OCT-05
Zirconium (Zr)-Total		<0.004	<0.004	RPD-NA	mg/L	N/A	15	13-OCT-05
Potassium (K)-Total		18.8	19.9		mg/L	5.3	15	13-OCT-05
WG363205-3 MB								
Aluminum (Al)-Total			<0.01		mg/L		0.01	13-OCT-05
Antimony (Sb)-Total			<0.005		mg/L		0.005	13-OCT-05
Arsenic (As)-Total			<0.001		mg/L		0.001	13-OCT-05
Barium (Ba)-Total			<0.01		mg/L		0.01	13-OCT-05
Beryllium (Be)-Total			<0.001		mg/L		0.001	13-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-WT	**Water**							
Batch R334486								
WG363205-3 MB								
Bismuth (Bi)-Total			<0.001		mg/L		0.001	13-OCT-05
Boron (B)-Total			<0.05		mg/L		0.05	13-OCT-05
Cadmium (Cd)-Total			<0.0001		mg/L		0.0001	13-OCT-05
Calcium (Ca)-Total			<0.5		mg/L		0.5	13-OCT-05
Chromium (Cr)-Total			<0.001		mg/L		0.001	13-OCT-05
Cobalt (Co)-Total			<0.0005		mg/L		0.0005	13-OCT-05
Copper (Cu)-Total			<0.001		mg/L		0.001	13-OCT-05
Iron (Fe)-Total			<0.05		mg/L		0.05	13-OCT-05
Lead (Pb)-Total			<0.001		mg/L		0.001	13-OCT-05
Magnesium (Mg)-Total			<0.5		mg/L		0.5	13-OCT-05
Manganese (Mn)-Total			<0.001		mg/L		0.001	13-OCT-05
Molybdenum (Mo)-Total			<0.001		mg/L		0.001	13-OCT-05
Nickel (Ni)-Total			<0.002		mg/L		0.002	13-OCT-05
Phosphorus (P)-Total			<0.05		mg/L		0.05	13-OCT-05
Potassium (K)-Total			<0.5		mg/L		0.5	13-OCT-05
Selenium (Se)-Total			<0.005		mg/L		0.005	13-OCT-05
Silicon (Si)-Total			<0.1		mg/L		0.1	13-OCT-05
Silver (Ag)-Total			<0.0001		mg/L		0.0001	13-OCT-05
Sodium (Na)-Total			<0.5		mg/L		0.5	13-OCT-05
Strontium (Sr)-Total			<0.001		mg/L		0.001	13-OCT-05
Thallium (Tl)-Total			<0.0003		mg/L		0.0003	13-OCT-05
Tin (Sn)-Total			<0.001		mg/L		0.001	13-OCT-05
Titanium (Ti)-Total			<0.002		mg/L		0.002	13-OCT-05
Tungsten (W)-Total			<0.01		mg/L		0.01	13-OCT-05
Uranium (U)-Total			<0.005		mg/L		0.005	13-OCT-05
Vanadium (V)-Total			<0.001		mg/L		0.001	13-OCT-05
Zinc (Zn)-Total			<0.003		mg/L		0.003	13-OCT-05
Zirconium (Zr)-Total			<0.004		mg/L		0.004	13-OCT-05
NH3-WT	**Water**							
Batch R335645								
WG363882-2 CVS								
Ammonia as N			99		%		80-120	17-OCT-05
WG363882-3 DUP		**L327951-1**						
Ammonia as N		0.37	0.34	J	mg/L	0.03	0.15	17-OCT-05
WG363882-1 MB								
Ammonia as N			<0.05		mg/L		0.05	17-OCT-05
PHENOLS-4AAP-WT	**Water**							

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PHENOLS-4AAP-WT	**Water**							
Batch R334935								
WG363187-3 DUP		**L328006-1**						
Phenols (4AAP)		0.027	0.028		mg/L	3.5	15	13-OCT-05
WG363187-2 LCS								
Phenols (4AAP)			98		%		90-110	13-OCT-05
WG363187-1 MB								
Phenols (4AAP)			<0.001		mg/L		0.001	13-OCT-05
TKN-WT	**Water**							
Batch R336256								
WG365612-2 CVS								
Total Kjeldahl Nitrogen			91		%		90-110	18-OCT-05
WG365612-3 DUP		**L329172-1**						
Total Kjeldahl Nitrogen		7.0	7.0		mg/L	0.0	15	18-OCT-05
WG365612-1 MB								
Total Kjeldahl Nitrogen			<0.2		mg/L		0.2	18-OCT-05
VOC-ROU-NO-BTX-WT	**Water**							
Batch R335327								
WG364439-1 CVS								
1,1,1,2-Tetrachloroethane			105		%		85-114	15-OCT-05
1,1,1-Trichloroethane			108		%		86-120	15-OCT-05
1,1,2,2-Tetrachloroethane			106		%		83-113	15-OCT-05
1,1,2-Trichloroethane			103		%		83-115	15-OCT-05
1,1-Dichloroethane			102		%		89-115	15-OCT-05
1,1-Dichloroethylene			115		%		92-127	15-OCT-05
1,2-Dichlorobenzene			101		%		83-114	15-OCT-05
1,2-Dichloroethane			115		%		80-127	15-OCT-05
1,2-Dichloropropane			106		%		90-117	15-OCT-05
1,3-Dichlorobenzene			100		%		85-110	15-OCT-05
1,4-Dichlorobenzene			103		%		87-112	15-OCT-05
2-Chloroethylvinyl Ether			100		%		63-126	15-OCT-05
2-Hexanone			90		%		63-120	15-OCT-05
Acetone			84		%		59-144	15-OCT-05
Bromodichloromethane			104		%		82-118	15-OCT-05
Bromoform			106		%		78-118	15-OCT-05
Bromomethane			121		%		72-144	15-OCT-05
Carbon Disulfide			108		%		80-128	15-OCT-05
Carbon tetrachloride			115		%		82-123	15-OCT-05
Chlorobenzene			104		%		83-118	15-OCT-05
Dibromochloromethane			103		%		85-111	15-OCT-05
Chloroethane			105		%		76-130	15-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Water							
Batch R335327								
WG364439-1 CVS								
Chloroform			106		%		89-119	15-OCT-05
Chloromethane			90		%		71-124	15-OCT-05
cis-1,2-Dichloroethylene			97		%		87-112	15-OCT-05
cis-1,3-Dichloropropene			114		%		98-128	15-OCT-05
Dichlorodifluoromethane			73		%		46-148	15-OCT-05
1,2-Dibromoethane			102		%		84-112	15-OCT-05
Methyl Ethyl Ketone			89		%		66-126	15-OCT-05
Methyl Isobutyl Ketone			99		%		71-112	15-OCT-05
MTBE			91		%		80-113	15-OCT-05
Dichloromethane			107		%		84-120	15-OCT-05
Styrene			105		%		86-118	15-OCT-05
Tetrachloroethylene			74	H	%		77-108	15-OCT-05
trans-1,2-Dichloroethylene			113		%		92-123	15-OCT-05
trans-1,3-Dichloropropene			102		%		88-120	15-OCT-05
Trichloroethylene			105		%		86-120	15-OCT-05
Trichlorofluoromethane			104		%		72-120	15-OCT-05
Vinyl chloride			93		%		76-126	15-OCT-05
COMMENTS: Due to the number of analyes 10% can exceed QC limits, analytes detected positive were reanalyzed.								
WG364439-4 DUP		WG364439-3						
1,1,1,2-Tetrachloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,1,1-Trichloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,1,2,2-Tetrachloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,1,2-Trichloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,1-Dichloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,1-Dichloroethylene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,2-Dichlorobenzene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,2-Dichloroethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,2-Dichloropropane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,3-Dichlorobenzene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
1,4-Dichlorobenzene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
2-Chloroethylvinyl Ether		<20	<20	RPD-NA	ug/L	N/A	15	15-OCT-05
2-Hexanone		<20	<20	RPD-NA	ug/L	N/A	15	15-OCT-05
Acetone		<20	<20	RPD-NA	ug/L	N/A	15	15-OCT-05
Bromodichloromethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Bromoform		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Bromomethane		<1	<1	RPD-NA	ug/L	N/A	15	15-OCT-05
Carbon Disulfide		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Water							
Batch R335327								
WG364439-4 DUP		WG364439-3						
Carbon tetrachloride		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Chlorobenzene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Dibromochloromethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Chloroethane		<1	<1	RPD-NA	ug/L	N/A	15	15-OCT-05
Chloroform		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Chloromethane		<1	<1	RPD-NA	ug/L	N/A	15	15-OCT-05
cis-1,2-Dichloroethylene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
cis-1,3-Dichloropropene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Dichlorodifluoromethane		<1	<1	RPD-NA	ug/L	N/A	15	15-OCT-05
1,2-Dibromoethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Methyl Ethyl Ketone		<20	<20	RPD-NA	ug/L	N/A	15	15-OCT-05
Methyl Isobutyl Ketone		<20	<20	RPD-NA	ug/L	N/A	15	15-OCT-05
MTBE		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Dichloromethane		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Styrene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Tetrachloroethylene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
trans-1,2-Dichloroethylene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
trans-1,3-Dichloropropene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Trichloroethylene		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
Trichlorofluoromethane		<1	<1	RPD-NA	ug/L	N/A	15	15-OCT-05
Vinyl chloride		<0.5	<0.5	RPD-NA	ug/L	N/A	15	15-OCT-05
WG364439-2 MB								
1,1,1,2-Tetrachloroethane			<0.5		ug/L		0.5	15-OCT-05
1,1,1-Trichloroethane			<0.5		ug/L		0.5	15-OCT-05
1,1,2,2-Tetrachloroethane			<0.5		ug/L		0.5	15-OCT-05
1,1,2-Trichloroethane			<0.5		ug/L		0.5	15-OCT-05
1,1-Dichloroethane			<0.5		ug/L		0.5	15-OCT-05
1,1-Dichloroethylene			<0.5		ug/L		0.5	15-OCT-05
1,2-Dichlorobenzene			<0.5		ug/L		0.5	15-OCT-05
1,2-Dichloroethane			<0.5		ug/L		0.5	15-OCT-05
1,2-Dichloropropane			<0.5		ug/L		0.5	15-OCT-05
1,3-Dichlorobenzene			<0.5		ug/L		0.5	15-OCT-05
1,4-Dichlorobenzene			<0.5		ug/L		0.5	15-OCT-05
2-Chloroethylvinyl Ether			<20		ug/L		20	15-OCT-05
2-Hexanone			<20		ug/L		20	15-OCT-05
Acetone			<20		ug/L		20	15-OCT-05
Bromodichloromethane			<0.5		ug/L		0.5	15-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Water							
Batch R335327								
WG364439-2 MB								
Bromoform			<0.5		ug/L		0.5	15-OCT-05
Bromomethane			<1		ug/L		1	15-OCT-05
Carbon Disulfide			<0.5		ug/L		0.5	15-OCT-05
Carbon tetrachloride			<0.5		ug/L		0.5	15-OCT-05
Chlorobenzene			<0.5		ug/L		0.5	15-OCT-05
Dibromochloromethane			<0.5		ug/L		0.5	15-OCT-05
Chloroethane			<1		ug/L		1	15-OCT-05
Chloroform			<0.5		ug/L		0.5	15-OCT-05
Chloromethane			<1		ug/L		1	15-OCT-05
cis-1,2-Dichloroethylene			<0.5		ug/L		0.5	15-OCT-05
cis-1,3-Dichloropropene			<0.5		ug/L		0.5	15-OCT-05
Dichlorodifluoromethane			<1		ug/L		1	15-OCT-05
1,2-Dibromoethane			<0.5		ug/L		0.5	15-OCT-05
Methyl Ethyl Ketone			<20		ug/L		20	15-OCT-05
Methyl Isobutyl Ketone			<20		ug/L		20	15-OCT-05
MTBE			<0.5		ug/L		0.5	15-OCT-05
Dichloromethane			<0.5		ug/L		0.5	15-OCT-05
Styrene			<0.5		ug/L		0.5	15-OCT-05
Tetrachloroethylene			<0.5		ug/L		0.5	15-OCT-05
trans-1,2-Dichloroethylene			<0.5		ug/L		0.5	15-OCT-05
trans-1,3-Dichloropropene			<0.5		ug/L		0.5	15-OCT-05
Trichloroethylene			<0.5		ug/L		0.5	15-OCT-05
Trichlorofluoromethane			<1		ug/L		1	15-OCT-05
Vinyl chloride			<0.5		ug/L		0.5	15-OCT-05
BTX-R153-WT	Soil							
Batch R335025								
WG363442-1 CVS								
Benzene			98		%		87-114	13-OCT-05
Ethyl Benzene			100		%		85-111	13-OCT-05
m+p-Xylenes			101		%		84-112	13-OCT-05
o-Xylene			100		%		84-111	13-OCT-05
Toluene			100		%		86-111	13-OCT-05
WG363067-2 DUP		L329172-10						
Benzene		<0.05	<0.05	RPD-NA	mg/kg	N/A	46	14-OCT-05
Ethyl Benzene		<0.05	<0.05	RPD-NA	mg/kg	N/A	30	14-OCT-05
m+p-Xylenes		<0.1	<0.1	RPD-NA	mg/kg	N/A	46	14-OCT-05
o-Xylene		<0.05	<0.05	RPD-NA	mg/kg	N/A	46	14-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX-R153-WT	Soil							
Batch R335025								
WG363067-2 DUP		L329172-10						
Toluene		<0.05	<0.05	RPD-NA	mg/kg	N/A	46	14-OCT-05
WG363067-1 MB								
Benzene			<0.05		mg/kg		0.05	14-OCT-05
Ethyl Benzene			<0.05		mg/kg		0.05	14-OCT-05
m+p-Xylenes			<0.1		mg/kg		0.1	14-OCT-05
o-Xylene			<0.05		mg/kg		0.05	14-OCT-05
Toluene			<0.05		mg/kg		0.05	14-OCT-05
F1-WT	Soil							
Batch R335024								
WG363443-1 CVS								
TVH: (C6-C10 / No BTEX Correction)			99		%		70-120	12-JUL-05
WG363067-2 DUP		L329172-10						
TVH: (C6-C10 / No BTEX Correction)		<5	<5	RPD-NA	mg/kg	N/A	50	12-JUL-05
WG363067-1 MB								
TVH: (C6-C10 / No BTEX Correction)			<5		mg/kg		5	12-JUL-05
F2-F4-WT	Soil							
Batch R336038								
WG365189-1 CVS								
F2 (C10-C16)			119		%		80-120	15-OCT-05
F3 (C16-C34)			121	H	%		80-120	15-OCT-05
F4 (C34-C50)			123	H	%		80-120	15-OCT-05
WG363451-3 DUP		L329172-7						
F2 (C10-C16)		63	53		mg/kg	16	50	15-OCT-05
F3 (C16-C34)		49	47	J,G	mg/kg	2	1.5	15-OCT-05
F4 (C34-C50)		36	34	J,G	mg/kg	2	1.5	15-OCT-05
WG363451-2 LCS								
F2 (C10-C16)			70	H	%		72-118	15-OCT-05
F3 (C16-C34)			81		%		72-118	15-OCT-05
F4 (C34-C50)			67	H	%		72-118	15-OCT-05
WG363451-1 MB								
F2 (C10-C16)			<5		mg/kg		5	15-OCT-05
F3 (C16-C34)			<5		mg/kg		5	15-OCT-05
F4 (C34-C50)			<5		mg/kg		5	15-OCT-05
F4G-ADD-WT	Soil							
Batch R336364								
WG365540-2 LCS								
F4G-SG (GHH-Silica)			83		%		60-118	18-OCT-05
WG365540-1 MB								
F4G-SG (GHH-Silica)			<100		mg/kg		100	18-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R334360								
WG363091-3 DUP		**L329172-9**						
% Moisture		7.7	7.8		%	0.80	20	13-OCT-05
WG363091-2 LCS								
% Moisture			109		%		70-110	13-OCT-05
WG363091-1 MB								
% Moisture			<0.5		%		0.5	13-OCT-05
VOC-ROU-NO-BTX-WT	**Soil**							
Batch R335401								
WG364545-1 CVS								
1,1,1,2-Tetrachloroethane			95		%		80-122	14-OCT-05
1,1,1-Trichloroethane			100		%		80-125	14-OCT-05
1,1,2,2-Tetrachloroethane			98		%		71-123	14-OCT-05
1,1,2-Trichloroethane			100		%		87-113	14-OCT-05
1,1-Dichloroethane			103		%		73-127	14-OCT-05
1,1-Dichloroethylene			112		%		84-131	14-OCT-05
1,2-Dichlorobenzene			97		%		79-120	14-OCT-05
1,2-Dichloroethane			102		%		76-130	14-OCT-05
1,2-Dichloropropane			102		%		83-126	14-OCT-05
1,3-Dichlorobenzene			96		%		77-118	14-OCT-05
1,4-Dichlorobenzene			98		%		80-120	14-OCT-05
2-Chloroethylvinyl Ether			99		%		72-128	14-OCT-05
2-Hexanone			139	G	%		64-122	14-OCT-05
Acetone			211	G	%		62-149	14-OCT-05
Bromodichloromethane			95		%		79-122	14-OCT-05
Bromoform			94		%		79-113	14-OCT-05
Bromomethane			109		%		50-150	14-OCT-05
Carbon Disulfide			107		%		50-150	14-OCT-05
Carbon tetrachloride			98		%		83-123	14-OCT-05
Chlorobenzene			97		%		91-111	14-OCT-05
Dibromochloromethane			92		%		85-111	14-OCT-05
Chloroethane			101		%		76-130	14-OCT-05
Chloroform			102		%		50-150	14-OCT-05
Chloromethane			92		%		71-124	14-OCT-05
cis-1,2-Dichloroethylene			100		%		87-112	14-OCT-05
cis-1,3-Dichloropropene			117		%		98-128	14-OCT-05
Dichlorodifluoromethane			93		%		27-163	14-OCT-05
1,2-Dibromoethane			96		%		72-124	14-OCT-05
Methyl Ethyl Ketone			146	G	%		66-126	14-OCT-05
Methyl Isobutyl Ketone			108				71-112	

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Soil							
Batch R335401								
WG364545-1 CVS								
Methyl Isobutyl Ketone			108		%		71-112	14-OCT-05
MTBE			96		%		80-113	14-OCT-05
Dichloromethane			106		%		94-116	14-OCT-05
Styrene			98		%		70-130	14-OCT-05
Tetrachloroethylene			96		%		70-120	14-OCT-05
trans-1,2-Dichloroethylene			110		%		92-123	14-OCT-05
trans-1,3-Dichloropropene			107		%		88-120	14-OCT-05
Trichloroethylene			102		%		88-113	14-OCT-05
Trichlorofluoromethane			95		%		72-120	14-OCT-05
Vinyl chloride			95		%		73-131	14-OCT-05
COMMENTS: Due to the number of analytes 10% can exceed QC limits analytes not detected in related samples.								
WG362934-2 DUP		L328684-1						
1,1,1,2-Tetrachloroethane		<0.008	<0.008	RPD-NA	mg/kg	N/A	15	14-OCT-05
1,1,1-Trichloroethane		<0.003	<0.003	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,1,2,2-Tetrachloroethane		<0.008	<0.008	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,1,2-Trichloroethane		<0.01	<0.01	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,1-Dichloroethane		<0.01	<0.01	RPD-NA	mg/kg	N/A	30	14-OCT-05
1,1-Dichloroethylene		<0.002	<0.002	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,2-Dichlorobenzene		<0.02	<0.02	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,2-Dichloroethane		<0.002	<0.002	RPD-NA	mg/kg	N/A	50	14-OCT-05
1,2-Dichloropropane		<0.001	<0.001	RPD-NA	mg/kg	N/A	30	14-OCT-05
1,3-Dichlorobenzene		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
1,4-Dichlorobenzene		<0.02	<0.02	RPD-NA	mg/kg	N/A	50	14-OCT-05
2-Chloroethylvinyl Ether		<0.03	<0.03	RPD-NA	mg/kg	N/A	30	14-OCT-05
2-Hexanone		<0.2	<0.2	RPD-NA	mg/kg	N/A	30	14-OCT-05
Acetone		<0.5	<0.5	RPD-NA	mg/kg	N/A	15	14-OCT-05
Bromodichloromethane		<0.01	<0.01	RPD-NA	mg/kg	N/A	50	14-OCT-05
Bromoform		<0.02	<0.02	RPD-NA	mg/kg	N/A	50	14-OCT-05
Bromomethane		<0.01	<0.01	RPD-NA	mg/kg	N/A	30	14-OCT-05
Carbon Disulfide		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
Carbon tetrachloride		<0.01	<0.01	RPD-NA	mg/kg	N/A	50	14-OCT-05
Chlorobenzene		<0.02	<0.02	RPD-NA	mg/kg	N/A	50	14-OCT-05
Dibromochloromethane		<0.001	<0.001	RPD-NA	mg/kg	N/A	30	14-OCT-05
Chloroethane		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
Chloroform		<0.01	<0.01	RPD-NA	mg/kg	N/A	30	14-OCT-05
Chloromethane		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
cis-1,2-Dichloroethylene		<0.02	<0.02	RPD-NA	mg/kg	N/A	23	14-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Soil							
Batch R335401								
WG362934-2 DUP		L328684-1						
cis-1,3-Dichloropropene		<0.002	<0.002	RPD-NA	mg/kg	N/A	30	14-OCT-05
Dichlorodifluoromethane		<0.03	<0.03	RPD-NA	mg/kg	N/A	30	14-OCT-05
1,2-Dibromoethane		<0.005	<0.005	RPD-NA	mg/kg	N/A	50	14-OCT-05
Methyl Ethyl Ketone		<0.2	<0.2	RPD-NA	mg/kg	N/A	30	14-OCT-05
Methyl Isobutyl Ketone		<0.2	<0.2	RPD-NA	mg/kg	N/A	30	14-OCT-05
MTBE		<0.3	<0.3	RPD-NA	mg/kg	N/A	30	14-OCT-05
Dichloromethane		<0.1	<0.1	RPD-NA	mg/kg	N/A	50	14-OCT-05
Styrene		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
Tetrachloroethylene		<0.02	<0.02	RPD-NA	mg/kg	N/A	50	14-OCT-05
trans-1,2-Dichloroethylene		<0.06	<0.06	RPD-NA	mg/kg	N/A	30	14-OCT-05
trans-1,3-Dichloropropene		<0.002	<0.002	RPD-NA	mg/kg	N/A	30	14-OCT-05
Trichloroethylene		<0.05	<0.05	RPD-NA	mg/kg	N/A	50	14-OCT-05
Trichlorofluoromethane		<0.02	<0.02	RPD-NA	mg/kg	N/A	30	14-OCT-05
Vinyl chloride		<0.003	<0.003	RPD-NA	mg/kg	N/A	50	14-OCT-05
WG362934-1 MB								
1,1,1,2-Tetrachloroethane			<0.008		mg/kg		0.008	14-OCT-05
1,1,1-Trichloroethane			<0.003		mg/kg		0.003	14-OCT-05
1,1,2,2-Tetrachloroethane			<0.008		mg/kg		0.008	14-OCT-05
1,1,2-Trichloroethane			<0.01		mg/kg		0.01	14-OCT-05
1,1-Dichloroethane			<0.01		mg/kg		0.01	14-OCT-05
1,1-Dichloroethylene			<0.002		mg/kg		0.002	14-OCT-05
1,2-Dichlorobenzene			<0.02		mg/kg		0.02	14-OCT-05
1,2-Dichloroethane			<0.002		mg/kg		0.002	14-OCT-05
1,2-Dichloropropane			<0.001		mg/kg		0.001	14-OCT-05
1,3-Dichlorobenzene			<0.02		mg/kg		0.02	14-OCT-05
1,4-Dichlorobenzene			<0.02		mg/kg		0.02	14-OCT-05
2-Chloroethylvinyl Ether			<0.03		mg/kg		0.03	14-OCT-05
2-Hexanone			<0.2		mg/kg		0.2	14-OCT-05
Acetone			<0.5		mg/kg		0.5	14-OCT-05
Bromodichloromethane			<0.01		mg/kg		0.01	14-OCT-05
Bromoform			<0.02		mg/kg		0.02	14-OCT-05
Bromomethane			<0.01		mg/kg		0.01	14-OCT-05
Carbon Disulfide			<0.02		mg/kg		0.02	14-OCT-05
Carbon tetrachloride			<0.01		mg/kg		0.01	14-OCT-05
Chlorobenzene			<0.02		mg/kg		0.02	14-OCT-05
Dibromochloromethane			<0.001		mg/kg		0.001	14-OCT-05
Chloroethane			<0.02		mg/kg		0.02	14-OCT-05

Enviro-Test Quality Control Report

Workorder: L329172

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-NO-BTX-WT	Soil							
Batch R335401								
WG362934-1 MB								
Chloroform			<0.01		mg/kg		0.01	14-OCT-05
Chloromethane			<0.02		mg/kg		0.02	14-OCT-05
cis-1,2-Dichloroethylene			<0.02		mg/kg		0.02	14-OCT-05
cis-1,3-Dichloropropene			<0.002		mg/kg		0.002	14-OCT-05
Dichlorodifluoromethane			<0.03		mg/kg		0.03	14-OCT-05
1,2-Dibromoethane			<0.005		mg/kg		0.005	14-OCT-05
Methyl Ethyl Ketone			<0.2		mg/kg		0.2	14-OCT-05
Methyl Isobutyl Ketone			<0.2		mg/kg		0.2	14-OCT-05
MTBE			<0.3		mg/kg		0.25	14-OCT-05
Dichloromethane			<0.1		mg/kg		0.1	14-OCT-05
Styrene			<0.02		mg/kg		0.02	14-OCT-05
Tetrachloroethylene			<0.02		mg/kg		0.02	14-OCT-05
trans-1,2-Dichloroethylene			<0.06		mg/kg		0.06	14-OCT-05
trans-1,3-Dichloropropene			<0.002		mg/kg		0.002	14-OCT-05
Trichloroethylene			<0.05		mg/kg		0.05	14-OCT-05
Trichlorofluoromethane			<0.02		mg/kg		0.02	14-OCT-05
Vinyl chloride			<0.003		mg/kg		0.003	14-OCT-05

ENVIRO-TEST QC REPORT

Workorder # L329172

Legend:

Limit	95% Confidence Interval (Laboratory Warning Limits)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Qualifier:

RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.
A	Method blank exceeds acceptance limit. Blank correction not applied, unless the qualifier "RAMB" (result adjusted for method blank) appears in the Analytical Report.
B	Method blank result exceeds acceptance limit, however, it is less than 5% of sample concentration. Blank correction not applied.
E	Matrix spike recovery may fall outside the acceptance limits due to high sample background.
F	Silver recovery low, likely due to elevated chloride levels in sample.
G	Outlier - No assignable cause for nonconformity has been determined.
H	Result falls within the 99% Confidence Interval (Laboratory Control Limits)
J	Duplicate results and limit(s) are expressed in terms of absolute difference.
K	The sample referenced above is of a non-standard matrix type; standard QC acceptance criteria may not be achievable.

Appendix D

Geotechnical Analysis of Soil Samples

alston associates inc.
consulting engineers

EMAIL

Fax to	:	Jim Walls, R.J. Burnside & Associates Limited	Fax Number	:	(519) 941-8120
From	:	Jonathan Bond	Date	:	3 November 2005
Ref. No.	:	05-090	Page 1 of 9		
Subject	:	Laboratory Results Burnside File No. FEO 09754 Kugluktuk			

We enclose the Grain Size Distribution Test Reports and Standar Proctor Test Reports for the samples received in our office on 17 October 2005. Originals will follow by mail. Please note that hydrometers testing was not performed on the samples from test pits 4 and 7, as requested, as the tested material is too coarse. Hydrometers, therefore, are not necessary. Also, Atterberg limits were not performed on those same samples as the material is "not plastic".

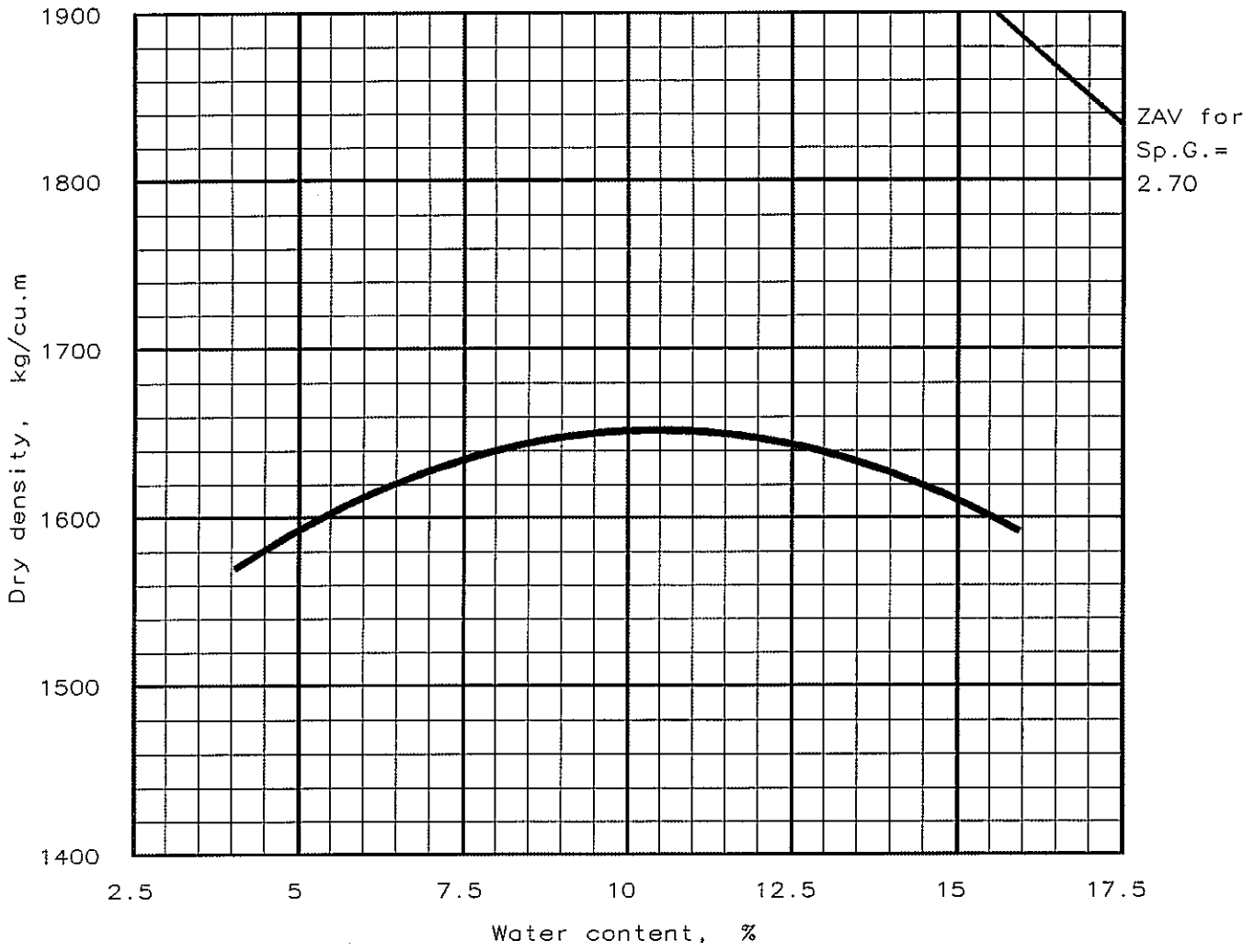
If you have any questions please do not hesitate to contact our office.

Regards

85 citizen court, unit 1
markham, ontario
L6G 1A8

telephone (905) 474-5265
fax (905) 474-2825
e-mail alston@alston.ca

STANDARD PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				2.70			0.00 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 1652 kg/cu.m Optimum moisture = 10.5 %	1652 kg/cu.m 10.5 %	brown SAND

Project No.: 05-090

Project: Burnside Project # FEO 09754 Kugluktuk

Location: Test Pit 4

Date: 3 November 2005

Remarks:

Prepared for:

Burnside Environmental

STANDARD PROCTOR TEST REPORT

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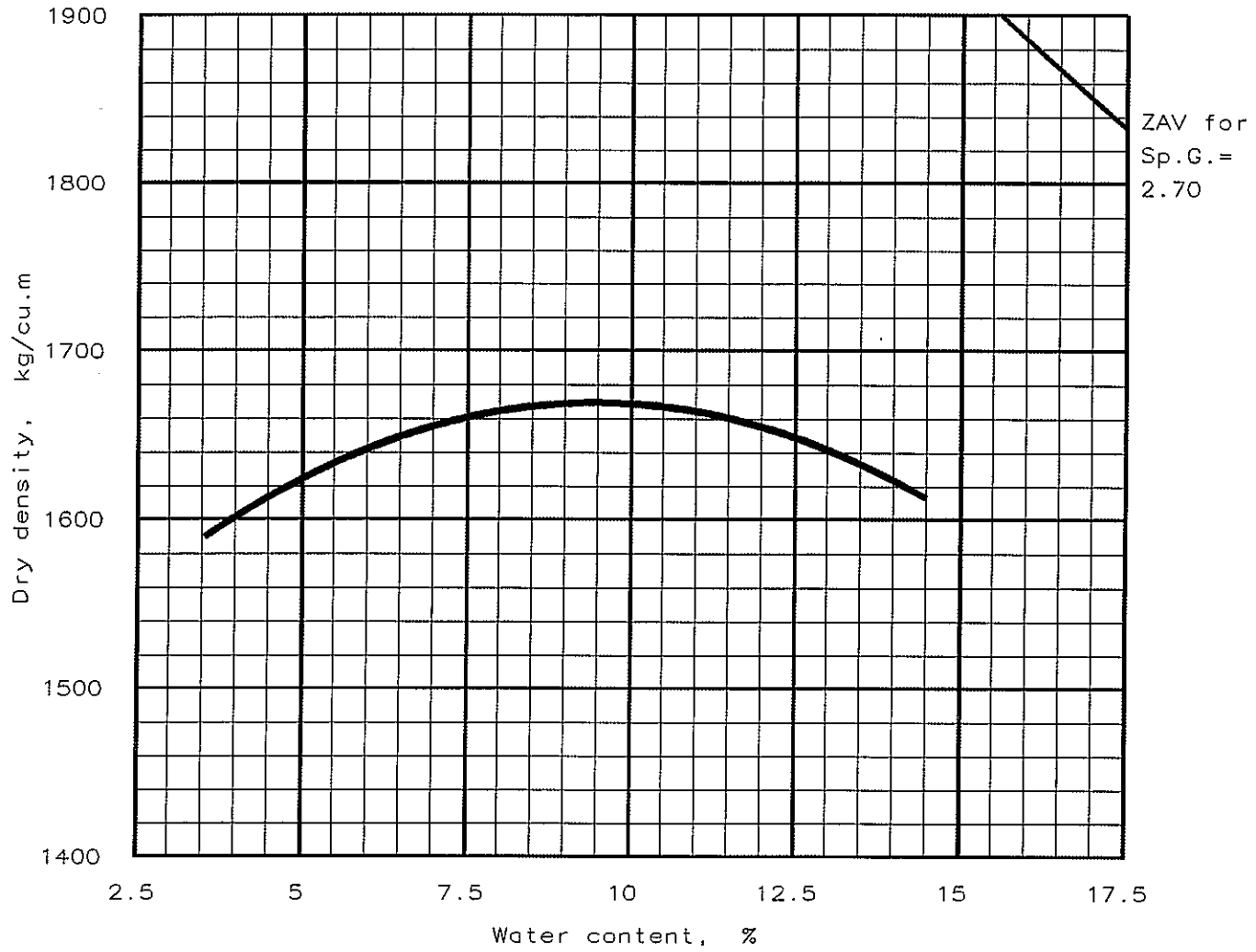
Fig. No. 1

STANDARD PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				2.70			0.00 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 1670 kg/cu.m Optimum moisture = 9.5 %	1670 kg/cu.m 9.5 %	brown SAND

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
Location: Test Pit 7

Date: 3 November 2005

STANDARD PROCTOR TEST REPORT

alston associates inc.

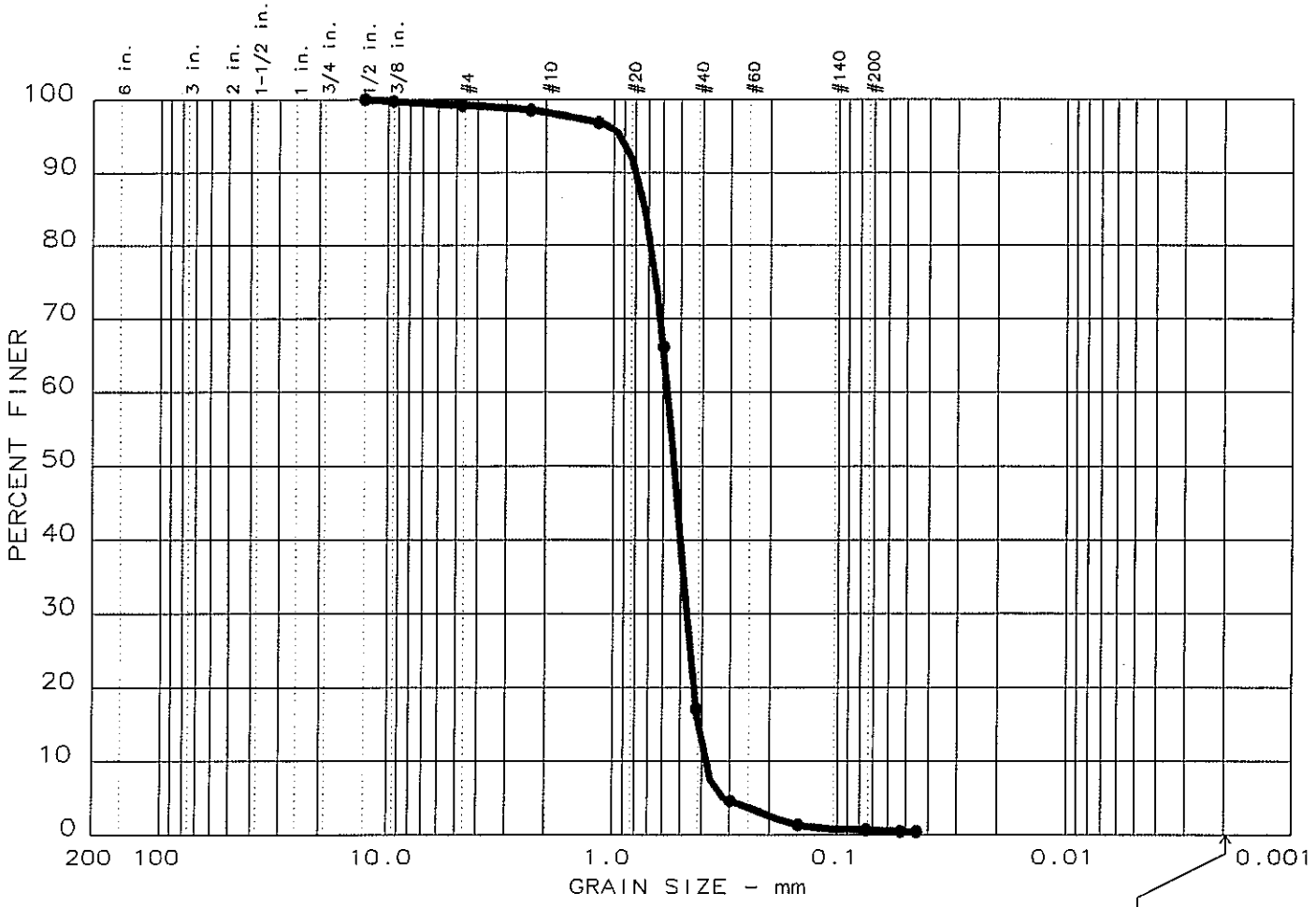
Remarks:

Prepared for:

Burnside Environmental

Fig. No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.8	98.5	0.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.73	0.57	0.54	0.471	0.4150	0.3868	1.00	1.5

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: GOV-1

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

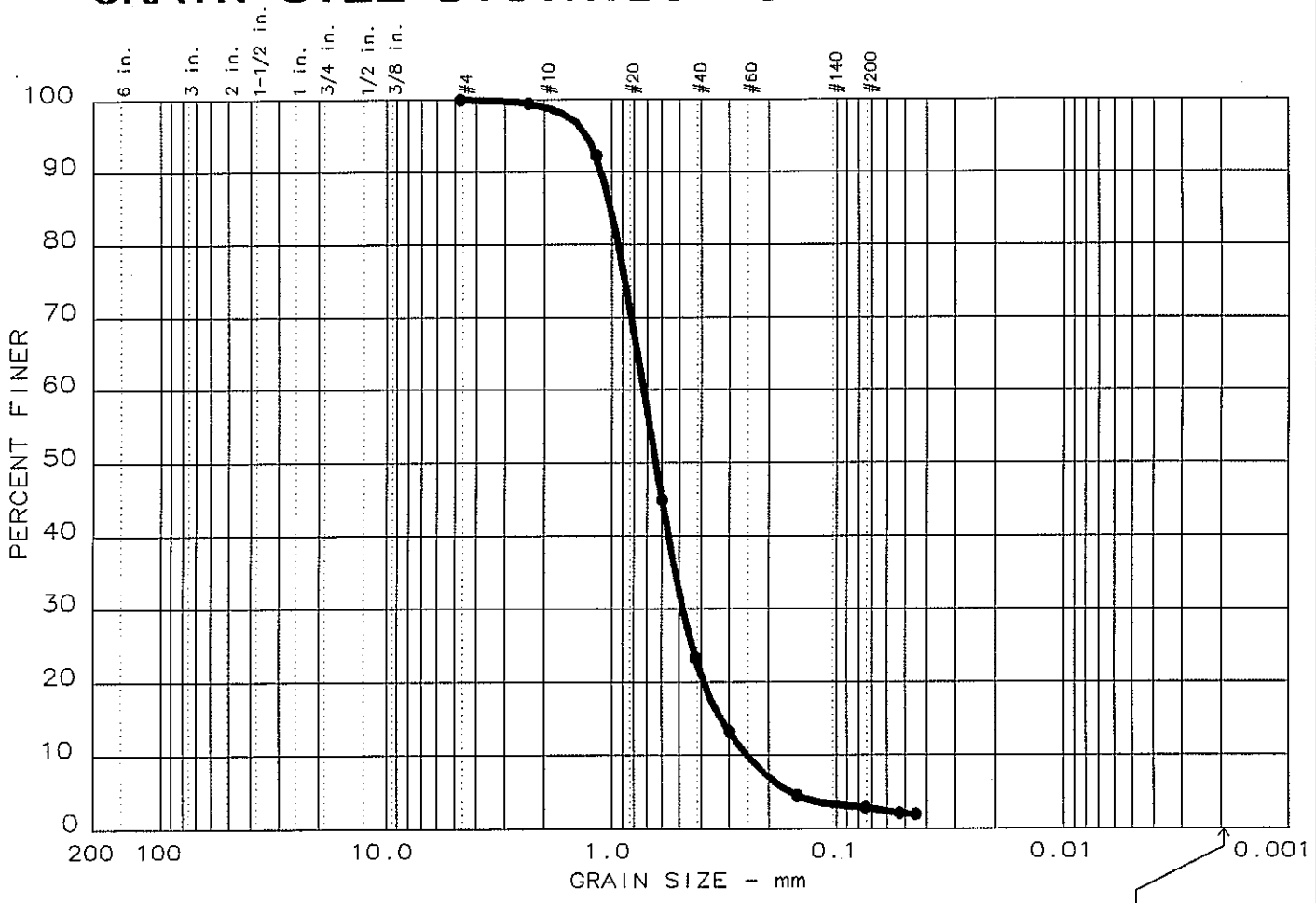
Remarks:

Prepared for:

Burnside Environmental

Figure No. 3

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	97.2	2.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.02	0.72	0.64	0.483	0.3262	0.2475	1.30	2.9

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, trace silt		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: MSW-1

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

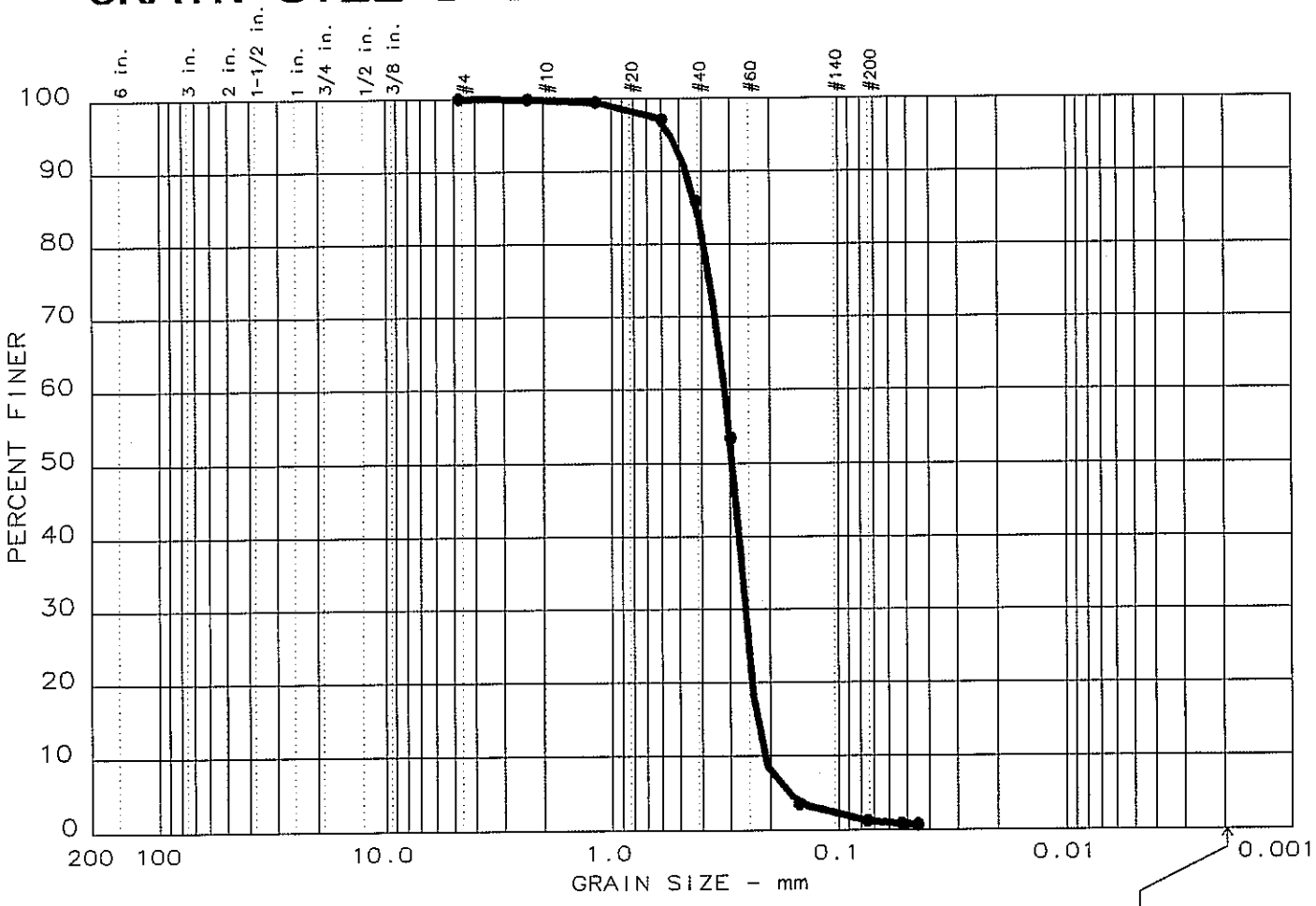
Remarks:

Prepared for:

Burnside Environmental

Figure No. 4

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	98.8	1.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.42	0.32	0.29	0.257	0.2331	0.2226	0.94	1.4

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, trace silt		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: MSW-2

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

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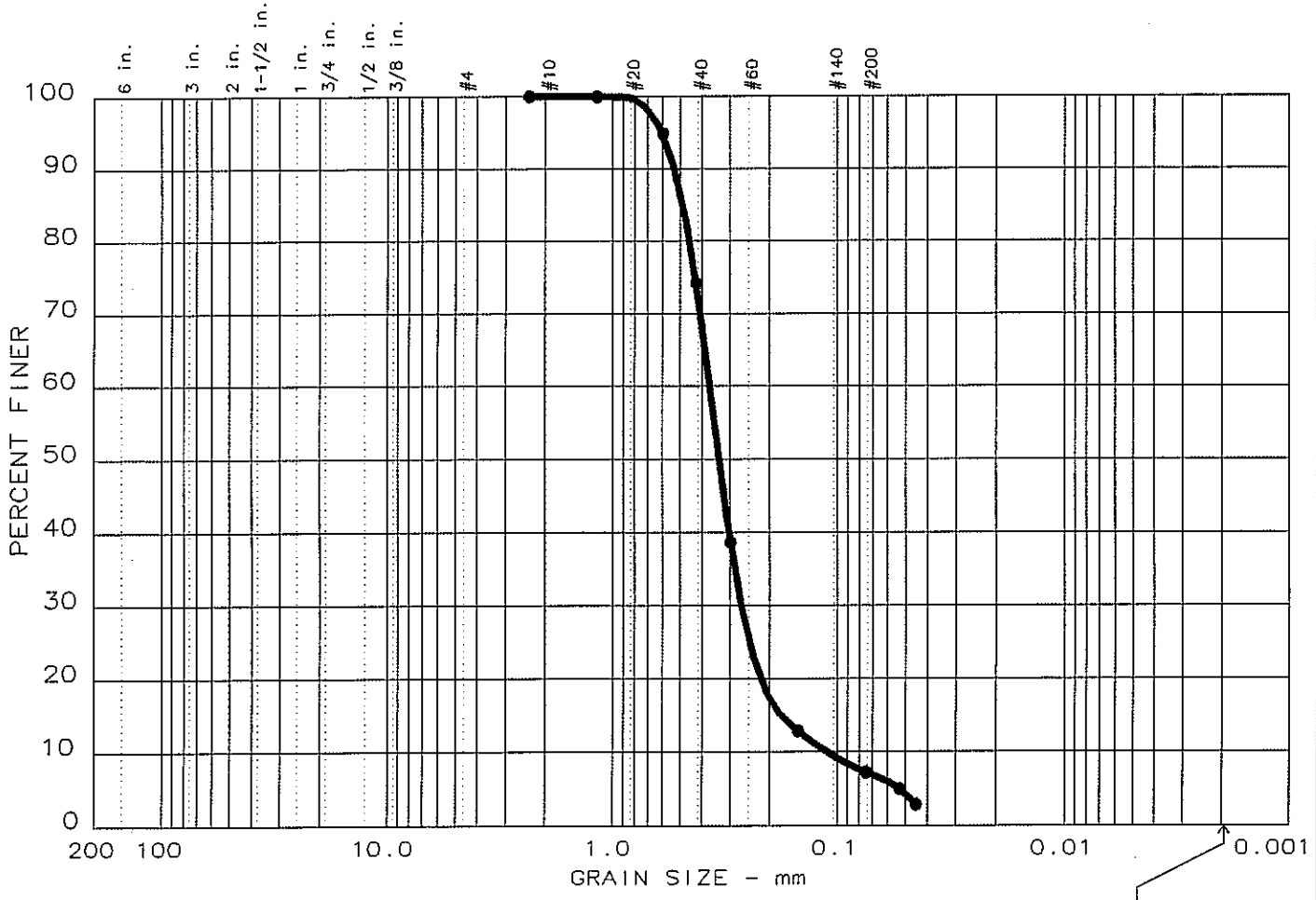
Remarks:

Prepared for:

Burnside Environmental

Figure No. 5

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	92.8	7.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.49	0.37	0.34	0.268	0.1770	0.1104	1.76	3.3

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, trace silt		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: Test Pit 3

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

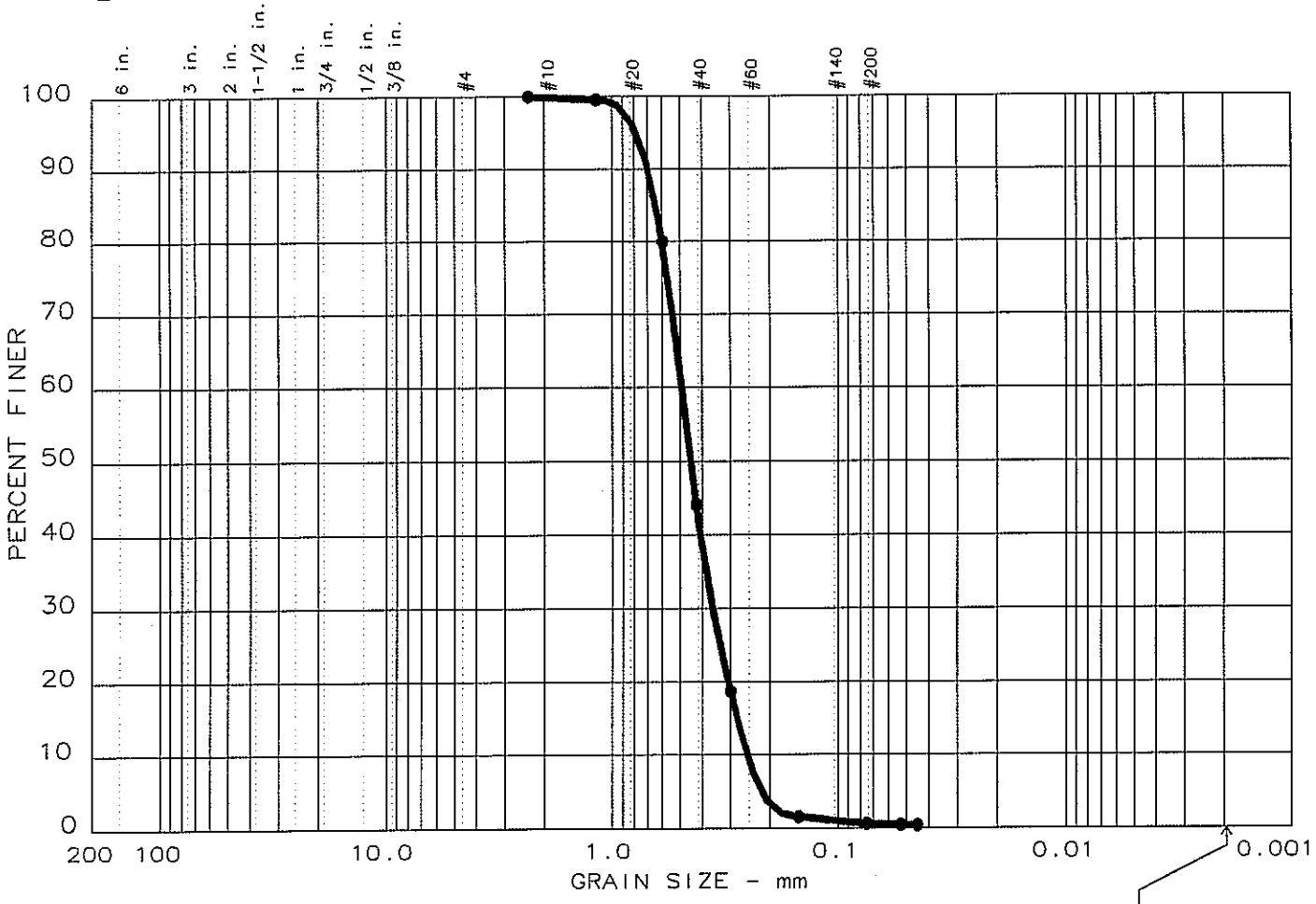
Remarks:

Prepared for:

Burnside Environmental

Figure No. 6

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	99.4	0.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.64	0.49	0.45	0.359	0.2799	0.2523	1.03	2.0

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: Test Pit 4

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

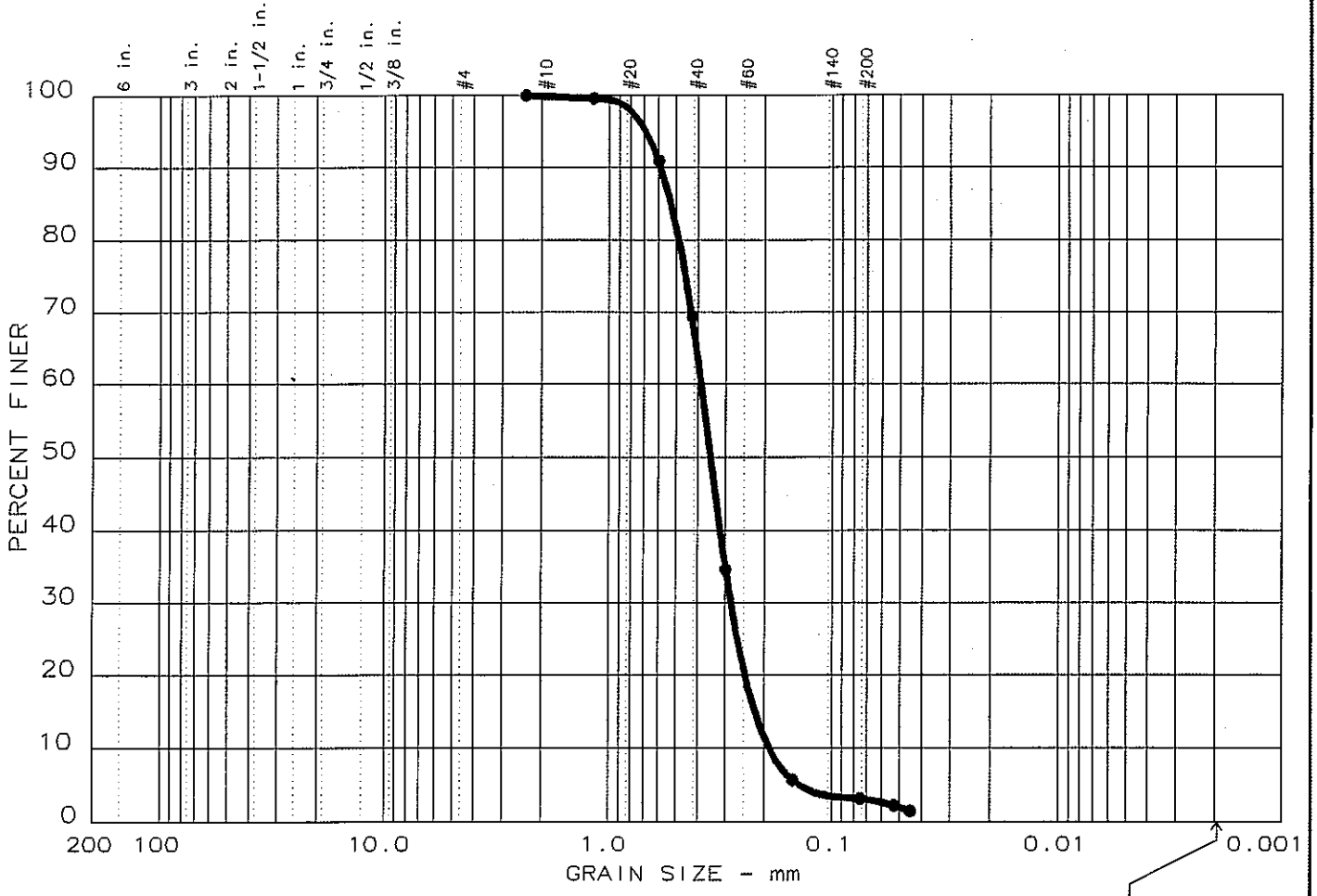
Remarks:

Prepared for:

Burnside Environmental

Figure No. 7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	96.9	3.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.53	0.39	0.35	0.284	0.2203	0.1897	1.10	2.0

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, trace silt		

Project No.: 05-090
Project: Burnside Project # FEO 09754 Kugluktuk
● Location: Test Pit 5

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

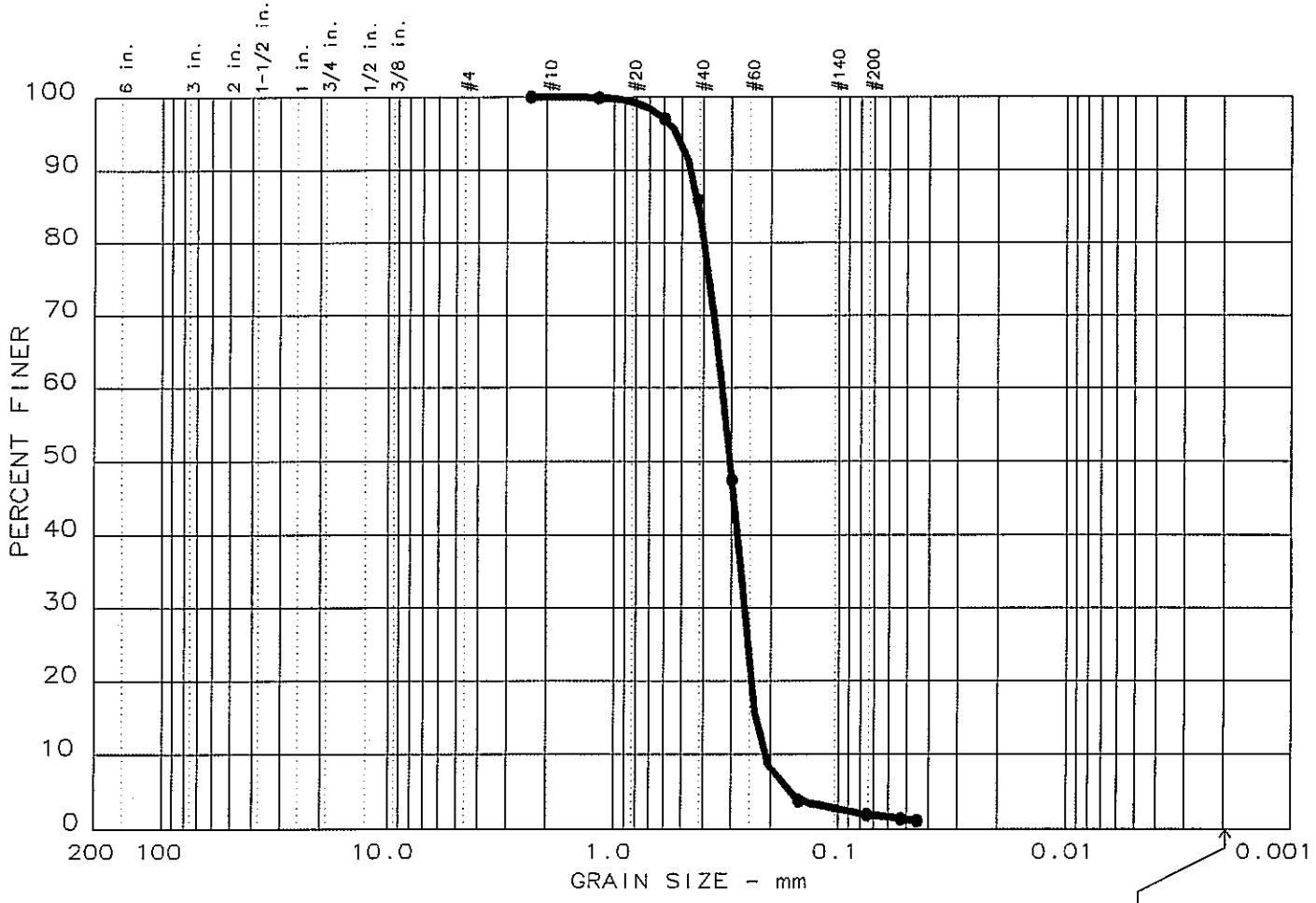
Remarks:

Prepared for:

Burnside Environmental

Figure No. 8

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	0.0	98.1	1.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.42	0.33	0.31	0.262	0.2342	0.2236	0.93	1.5

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, trace silt		

Project No.: 05-090
Project: Burnside Project # FE0 09754 Kugluktuk
● Location: Test Pit 7

Date: 3 November 2005

GRAIN SIZE DISTRIBUTION TEST REPORT

alston associates inc.

Remarks:

Prepared for:

Burnside Environmental

Figure No. 9

BURNSIDE

Appendix E
Alberta Wetland Predictive Model

Appendix E
Alberta Department of the Environment
Wetland Treatment Predictive Model

Assumptions

- Total year 20 discharge (including sewage and precipitation falling into the lagoon) - 128,073 m^3

- Expected sewage lagoon effluent quality prior to wetland treatment in year 2026, assuming 25 percent carbon removal efficiency:

BOD	222 mg/l
TSS	237 mg/l
T-PO_4	11 mg/l
TKN	59 mg/l
Fecal Coliforms	4.7E07 CFU/100ml

- Nunavut guideline requirements for final effluent quality at discharge from the sewage treatment system

	Current Guidelines	**Anticipated Guidelines**
BOD mg/l	120	45
TSS mg/l	180	45
T-PO_4 mg/l	-	1
TKN	-	10
Fecal Coliforms CFU/100 ml	1,000,000	2,000

- Based on Kugluktuk climate data (Appendix A) the average temperature of the period June through September is 6.9ºC. For conservative calculations purposes 5ºC will be used in the predictive model

- Average daily discharge to the wetland during the 120 day biologically active period (June through September) is 1,067 m^3/day

- The wetland predictive model was designed for 20ºC. To account for an average temperature of 5ºC the Area Rate Constant has been charged as follows:

Parameter Area Rate Constant

	@ 20ºC	**@ 10ºC**	**@ 5ºC**
BOD	1,000	500	250
TSS	34	17	8.5
T-PO_4	12	6	3
TKN	22	11	5.5
Fecal Coliforms	77	38.5	19.25

Surface Flow Wetland Treatment - Preliminary Feasibility Calculations

Based upon:
- Predicted effluent volume in year 20
- Predicted effluent chemistry in year 20
- Anticipated future guideline requirements.

Predictive Model

$$\text{Required Area (ha)} = \frac{0.0365Q}{k} * \ln((Ci - C^*) / (Ce - C^*))$$

Design Flow (m^3/day) **Q= 1067**

	TSS	BOD	T-PO_4	TKN	FC
Design Flow (Q)	**1067.00**	**1067.00**			
Wastewater Characterization (Ci)	237.00	222.00	11.00	59.00	4.70E+07
Target Effluent Quality (Ce)	45.00	45.00	1.00	10.00	2.00E+02
Wetland Background Input (C*)	**22.73**	**15.27**	0.05	2.00	100.00
Area Constant at 5°C (k)	250.00	8.50	3.00	5.50	19.25
Required Treatment Area (ha)	**0.35**	**8.88**	**31.74**	**13.90**	**26.42**

for TSS, C* **22.73**
for BOD, C* **15.27**

Predictive model from a "Guidelines for the Approval and Design of Natural and Constructed Treatment Wetlands for Water Quality Improvement", Alberta Department of the Environment, Program Development Branch, Environmental Services Division, March 2000.

Appendix F

Water Board License

P.O. BOX 119
GJOA HAVEN, NU X0B 1J0
TEL: (867) 360-6338
FAX: (867) 360-6369

kNK5 wmoEp5 vtmpq
NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

DECISION

LICENCE NUMBER: NWB3KUG0308

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence dated July 15, 2003, made by:

Hamlet of Kugluktuk

to allow for the use of water and disposal of waste for the Hamlet at Kugluktuk, Nunavut. With respect to this application, the NWB gave notice to the public that the Hamlet had filed an application for a water licence.

DECISION

After having been satisfied that the application was exempt from the requirement for screening by the Nunavut Impact Review Board in accordance with S. 12.3.2 of the *Nunavut Land Claim Agreement* (NLCA), the NWB decided that the application could proceed through the regulatory process. After reviewing the submission of the Applicant and written comments expressed by interested parties, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *Nunavut Land Claims Agreement* and of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), decided to waive the requirement to hold a public hearing and furthermore to delegate its authority to approve the application to the Chief Administrative Officer pursuant to S. 49(a) of the NWNSRTA and determined that:

Licence Number NWB3KUG0308 be issued subject to the terms and conditions contained therein. (Motion #: 2003-35)

SIGNED this 20th day of November 2003 at Gjoa Haven, NU.

Original signed by:

_____

Philippe di Pizzo
Chief Administrative Officer

TABLE OF CONTENTS

I. BACKGROUND

Kugluktuk is located immediately west of the mouth of the Coppermine River on Coronation Gulf at 67°50'N, 115°15'W, 595 air km north of Yellowknife. The Hamlet extends inland to cover a rocky knoll. The town site is underlain by Precambrian sedimentary and volcanic rock. Dolomite and shale, interspersed with volcanic rock, form steep outcrops in the vicinity of the settlement. The buildings along the shore are perched on consolidated beach deposits. Directly behind this ridge is a low, marshy area. There are numerous exposed bedrock surfaces in the community. Surficial deposits in the area include talus and deltaic deposits. The angular talus, derived primarily from the mechanical breakdown of dolerite, ranges in size from silt to boulders but is commonly found as course sand or fine gravel. Kugluktuk is underlain by permafrost. The thickness of the active layer ranges from less than 0.5 m to over 1 m in the sandy waterfront area. Permafrost features such as polygonal ground and thaw-related instability affect the raised delta surfaces and strongly influence their drainage characteristics. Grasses, sedges, heather, mosses, and lichens grow in limited soils. Willow and alder thickets are common in wetland depressions. Kugluktuk receives an average of 10.3 cm of rainfall and 100.7 cm of snowfall per year. Mean annual precipitation totals 20.2 cm. July mean high and low temperatures are 13.8° C and 5.6° C. The January mean high and low temperatures are -26.4° C and -33.8° C. The winds are generally south-west and annually average 16.6 km/h.

II. PROCEDURAL HISTORY

On July 15, 2003, an application for the renewal of water license N3L4-1526, was filed by Ferguson Simek Clark Environmental Consultants (Yellowknife) on behalf of the Hamlet of Kugluktuk. The previous water licence was issued by the Northwest Territories Water Board on 1 July 1998 and valid until June 30, 2003. In consideration of the application for renewal the Nunavut Water Board publicly posted notice of this application, in accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S.55.1 and Article 13 of the *Nunavut Land Claims Agreement,* on July 23, 2003. An assessment of the Hamlet's request for a municipal water licence for water use and waste disposal activities within the Hamlet was then undertaken, so that the Board could make a fully informed decision on the merits of application. This assessment process included the referral of the application to a variety of Federal, Territorial and local organizations for their review and comment. As no public concern was expressed, the NWB waived the requirement to hold a public hearing for the application.

Based upon the results of the detailed assessment, which was completed, including consideration of any potential accidents, malfunctions, or cumulative environmental effects that the overall project might have in the area, the Board delegated to the Chief Administrative Officer authority to approve the application pursuant to S. 13.7.5 of the *Agreemen*t.

III. ISSUES

Term of the Licence

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 45, the NWB may issue a licence for a term not exceeding twenty-five years. In determining an appropriate term of a water licence, the Board considers a number of factors, including the results of the annual Department of Indian Affairs and Northern Development (DIAND) site inspection and the compliance record of the Applicant. Specifically, the August 9, 2001 DIAND Inspection Report indicated that:

1. The Licensee has failed to produce Annual Reports from 1996-2001;
2. Water supply field pH , turbidity, and iron concentration exceeded the levels recommended in the *Guidelines for Canadian Drinking Water Quality*;
3. Sewage treatment system effluent concentrations of ammonia and phenol exceeded the levels recommended in the *Canadian Guidelines for the Protection of Freshwater Aquatic Life*;
4. Sewage treatment effluent contained noteworthy concentrations of faecal coliforms (1,470,000 CFU/100ml);
5. Solid waste disposal site effluent concentrations of iron and zinc exceeded the levels; and
6. The sewage treatment system effluent evidenced a significant toxicity, as determined by a MicroTox EC_{50} assessment.

Additionally, the NWB brings to the attention of the Licensee their failure to provide the Board with the as-built plans and drawings for the modifications to the Sewage Disposal Facilities, as required by Part D, Item 3 of Water License N7L4-1526. The Board requests that these as-built plans and drawings be forwarded by the Licensee within ninety (90) days following issuance of this license.

In review of the application, DIAND, has recommended a licence term of five (5) years. The NWB concurs that a term of five (5) years is appropriate, and will allow enough time for the Hamlet to establish a consistent compliance record with the terms and conditions of its licence. It will also ensure that sufficient time is given to permit the Licensee to develop, submit, and implement the plans required under its licence to the satisfaction of the NWB.

The NWB has imposed the requirement to produce an Annual Report. These Reports are for the purpose of ensuring that the NWB has an accurate annual update of municipal activities during a calendar year. This information is maintained on the public registry and is available to any interested parties upon request. The Licensee's attention is drawn to the attached standard form for completing the Annual Report (see Attachment I).

The NWB has also imposed on the Licensee the requirement to produce an Operations and Maintenance Manual for their sewage and solid waste operations. The purpose of an Operation and Maintenance Manual is to assist Hamlet staff in the proper operation and maintenance of their waste disposal facilities. The manual should demonstrate to the Nunavut Water Board that the Hamlet is

capable of operating and maintaining all waste disposal sites adequately. The Plan should be completed using the *Guidelines for the Preparation of an Operations and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996; see Attachment II).

Water Use

The Municipality currently receives water from Coppermine River. Water is treated using membrane filtration, which is accomplished in a twin train Harmsco filtration system, and stored in a 320 m^3 tank. The water receives a chlorine treatment prior to trucked-service distribution. Water consumption is projected to reach 53,475 m^3 *per annum* in 2003 and 60,533 m^3 *per annum* by 2008.

No serious concerns were raised by the parties in their written submissions as to the amount of water required by the Applicant or the manner in which this water will be used. Issues related to the quality of water produced by the present water treatment system were identified, but are currently being addressed by the Applicant and the Department of Community Government and Transportation, Government of Nunavut. DIAND has provided specific recommendations regarding volume usage limits, as well as recommending that the Applicant to be required to maintain a monitoring station at the water intake area KUG-1 in order to monitor the volume of water used. The Board concurs with these recommendations, and has set the terms and conditions in the water licence, which govern, water usage accordingly. The Board also recommends that the Hamlet and the Department of Community Government and Transportation take whatever steps are necessary to address the water quality issues identified in the August 9, 2001 DIAND Inspection Report.

Deposit of Waste

Sewage

The Hamlet of Kugluktuk utilizes a Sewage Disposal Facility approximately 5.0 km west of the Municipality. A gravel berm provides limited retention of sewage prior to discharge to an undefined wetland where it receives additional treatment prior to discharge to the marine environment. Specific comments relevant to sewage disposal operations in the Hamlet were provided by DIAND, and Environment Canada. Both DIAND and Environment Canada requested that the Applicant provide information to the NWB on how the Municipality plans to address the operational and environmental issues evidenced in the August 9, 2001 DIAND Inspection Report. Additionally, Environment Canada recommended that a minimum of 1 m of freeboard should be maintained at all retention structures, and that All Terrain Vehicle (ATV) traffic be restricted in the wetland area so as to prevent soil erosion and damage to vegetation from compromising the effectiveness of the wetland treatment of the sewage.

DIAND and Environment Canada also recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans. Additionally, DIAND provided recommendations concerning effluent discharge criteria, which are consistent with the *Guidelines for the Discharge of*

Treated Municipal Wastewater in the Northwest Territories (Northwest Territories Water Board; 1992), as well as specific recommendations concerning the Monitoring Program.

The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence. The Monitoring Program is established to collect data on water quality to assess the effectiveness of treatment for protection of public health and to assess potential impacts to the environment associated with the municipal facilities. The Board also draws the attention of the Licensee to their requirements to implement the Quality Assurance/Quality Control (QA/QC) Plan to be provided by the NWB. The purpose of the QA/QC Plan is to ensure that samples taken in the field as part of the Monitoring Program will maintain a high quality, so as to accurately represent the physical and chemical nature of the samples being taken. It should also be noted that while minimum sampling requirements have been imposed, additional sampling may be requested by an Inspector.

Solid Waste

The Hamlet's solid waste management site is located approximately 4.5 km from the community. Waste is segregated, with a generic landfill area, a bulky wastes area, and a sealift container for hazardous wastes. Combustible wastes are burned regularly, and the landfill is compacted and covered on a yearly basis.

Recommendations relevant to solid waste disposal operations in the Hamlet were provided by DIAND and Environment Canada. Both DIAND and Environment Canada recommended that preventative measures be implemented to prevent standing water noted at the toe of the solid waste site from escaping the facility. Environment Canada also recommended that the Municipality undertake a waste composition study, which will assist the Municipality to plan for the long term waste disposal needs of the community. The Board concurs that the Hamlet should give serious consideration to this recommendation, and recommends that discussions be commenced with the Department of Community Government and Transportation to determine potential assistance which may be available to the Hamlet to undertake such a study.

DIAND and Environment Canada recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans for their solid waste operations. DIAND and Environment Canada further recommended that the Hamlet segregate hazardous materials such as waste oils and batteries from municipal solid waste, and that these materials be disposed of off-site in an approved facility. DIAND and Environment Canada recommended the appropriate management of waste oil at the solid waste site, so as to prevent the deposition of hydrocarbons into water in contravention of the *Fisheries Act*. The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence. Additionally, both Environment Canada and DIAND recommended the installation of appropriate fencing at the bulky waste and hazardous waste disposal sites, so as to improve security on the sites. The Board concurs that the Hamlet should give serious consideration to this recommendation, and in the interim take whatever steps are practicable to implement this recommendation.

LICENCE NWB3KUG0308

Pursuant to the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*, the Nunavut Water Board, hereinafter referred to as the Board, hereby grants to

HAMLET OF KUGLUKTUK

(Licensee)

of **KUGLUKTUK, NUNAVUT, X0E 0E0**

(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water for a period subject to restrictions and conditions contained within this licence:

Licence Number **NWB3KUG0308**

Water Management Area **NUNAVUT 05**

Location **KUGLUKTUK, NUNAVUT**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to be Exceeded **64,000 CUBIC METRES ANNUALLY**

Date of Licence **NOVEMBER 20, 2003**

Expiry Date of Licence **NOVEMBER 30, 2008**

Dated this 20th of November 2003 at Gjoa Haven, NU.

Original signed by:

Philippe di Pizzo
Chief Administrative Officer

PART A: SCOPE AND DEFINITIONS

1. Scope

a. This Licence allows for the use of water and the disposal of waste for municipal undertakings at the Hamlet of Kugluktuk, Nunavut (67°50'N, 115°15'W);

b. This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposits of such waste may enter any waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, or other statutes imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be subject to such requirements; and;

c. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

In this Licence: **NWB3KUG0308**

"Act" means the *Nunavut Waters and Nunavut Surface Rights Tribunal Act;*

"Amendment" means a change to original terms and conditions of this licence requiring correction, addition or deletion of specific terms and conditions of the licence; modifications inconsistent with the terms of the set terms and conditions of the Licence;

"Analyst" means an Analyst designated by the Minister under Section 85 (1) of the *Act*;

''Appurtenant undertaking'' means an undertaking in relation to which a use of waters or a deposit of waste is permitted by a licence issued by the Board;

"Average Concentration" means the arithmetic mean of the last four consecutive analytical results for contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

"Average Concentration For Faecal Coliforms" means the geometric mean of the last four consecutive analytical results for faecal coliforms contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

"Board" means the Nunavut Water Board established under the *Nunavut Land Claims Agreement*;

"Chief Administrative Officer" means the Executive Director of the Nunavut Water Board;

"Commercial Waste Water" means water and associated waste generated by the operation of a commercial enterprise, but does not include toilet wastes or greywater;

"Composite Sample" means a water or wastewater sample made up of four (4) samples taken at regular periods over a 24 hour period;

"Effluent" means treated or untreated liquid waste material that is discharged into the environment from a structure such as a settling pond or a treatment plant;

"Final Discharge Point" means an identifiable discharge point of a Waste Disposal Facility beyond which the Licensee no longer exercises care and control over the quality of the Effluent;

"Freeboard" means the vertical distance between water line and crest on a dam or dyke's upstream slope;

"Grab Sample" means a single water or wastewater sample taken at a time and place representative of the total discharge;

"Greywater" means all liquid wastes from showers, baths, sinks, kitchens and domestic washing facilities, but does not include toilet wastes;

"Inspector" means an Inspector designated by the Minister under Section 85 (1) of the *Act*;

"Licensee" means the holder of this Licence;

"Modification" means an alteration to a physical work that introduces new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion, and changes to the operating system that are consistent with the terms of this Licence and do not require amendment;

"Monitoring Program" means a monitoring program established to collect data on surface water and groundwater quality to assess impacts to the freshwater aquatic environment of an appurtenant undertaking;

"Nunavut Land Claims Agreement" (NLCA) means the "*Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*", including its preamble and schedules, and any amendments to that agreement made pursuant to it;

"Sewage" means all toilet wastes and greywater;

"Sewage Disposal Facilities" comprises the area and decant structures designed to contain and treat sewage as described in the Application for Water Licence filed by the Applicant on July 1, 2003 and illustrated in Drawing Nos. 2003-0060-EN1/2;

"Solid Waste Disposal Facilities" comprises the area and associated structures designed to contain solid waste as described in the Application for Water Licence filed by the Applicant on July 1, 2003 and illustrated in Drawing Nos. 2003-0060-EN1/2;

"Toilet Wastes" means all human excreta and associated products, but does not include greywater;

"Waste" means, as defined in S.4 of the *Act*, any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substance is added to an extent that is detrimental to its use by people or by any animal, fish or plant, or any water that would have that effect because of the quantity or concentration of the substances contained in it or because it has been treated or changed, by heat or other means;

"Waste Disposal Facilities" means all facilities designated for the disposal of waste, and includes the Sewage Disposal Facilities and Solid Waste Disposal Facilities, as described in the Application for Water Licence filed by the Applicant on July 1, 2003, and illustrated in Drawing Nos. 2003-0060-EN1/2; and

"Water Supply Facilities" comprises the area and associated intake infrastructure at the Coppermine River, as described in the Application for Water Licence filed by the Applicant on July 1, 2003, and illustrated in Drawing Nos. 2003-0060-EN1/2.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report with the Board not later than March 31st of the year following the calendar year reported which shall contain the following information:

i. tabular summaries of all data generated under the "Monitoring Program";

ii. the monthly and annual quantities in cubic metres of fresh water obtained from all sources;

iii. the monthly and annual quantities in cubic metres of each and all waste discharged;

iv. a summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities;

v. a list of unauthorized discharges and summary of follow-up action taken;

vi. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;

vii. a summary of any studies, reports and plans (e.g., Operation and Maintenance, Abandonment and Restoration, QA/QC) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned;

viii. any other details on water use or waste disposal requested by the Board by November 1st of the year being reported; and

2. The Licensee shall comply with the "Monitoring Program" described in this Licence, and any amendments to the "Monitoring Program" as may be made from time to time, pursuant to the conditions of this Licence.

3. The "Monitoring Program" and compliance dates specified in the Licence may be modified at the discretion of the Board.

4. Meters, devices or other such methods used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee to the satisfaction of an Inspector.

5. The Licensee shall, within ninety (90) days after the first visit of the Inspector, post the necessary signs, where possible, to identify the stations of the "Monitoring Program." All signage postings shall be in the Official Languages of Nunavut, and shall be located and maintained to the satisfaction of an Inspector.

6. The Licensee shall immediately report to the 24-Hour Spill Report Line (867-920-8130) any spills of Waste, which are reported to or observed by the Licensee, within the municipal boundaries or in the areas of the Water Supply or Waste Disposal Facilities.

7. The Licensee shall ensure a copy of this Licence is maintained at the municipal office at all times.

8. Any communication with respect to this Licence shall be made in writing to the attention of:

(i) Chief Administrative Officer:

Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369

(ii) Inspector Contact:

Water Resources Officer
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4298
Fax: (867) 979-6445

(iii) Analyst Contact:

Taiga Laboratories
Department of Indian and Northern Affairs
4601 - 52 Avenue, P.O. Box 1500
Yellowknife, NT X1A 2R3
Telephone: (867) 669-2781
Fax: (867) 669-2718

9. The Licensee shall submit one paper copy and one electronic copy of all reports, studies, and plans to the Board. Reports or studies submitted to the Board by the Licensee shall include a detailed executive summary in Inuktitut.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from Coppermine River using the Water Supply Facilities or as otherwise approved by the Board.

2. The annual quantity of water used for all purposes shall not exceed 64,000 cubic metres.

3. The Licensee shall maintain the Water Supply Facilities to the satisfaction of the Inspector.

4. The water intake hose used on the water pumps shall be equipped with a screen with a mesh size sufficient to ensure no entrainment of fish.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.

2. All Effluent discharged from the Sewage Disposal Facilities at Monitoring Station KUG-4 shall meet the following effluent quality standards:

Parameter	Maximum Average Concentration
Faecal Coliforms	1 x 10^6CFU/dl
BOD_5	120 mg/L
Total Suspended Solids	180 mg/L
Oil and grease	No visible sheen
pH	between 6 and 9

3. A Freeboard limit of 1.0 metre, or as recommended by a qualified geotechnical engineer and as approved by the Board, shall be maintained at all dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

4. The Licensee shall advise an Inspector at least ten (10) days prior to initiating any decant of the sewage lagoon.

5. The Sewage Disposal Facility shall be maintained and operated, to the satisfaction of an Inspector in such a manner as to prevent structural failure.

6. The Licensee shall dispose of and contain all solid wastes at the Solid Waste Disposal Facilities or as otherwise approved by the Board.

7. The Licensee shall implement measures to ensure waste from the Solid Waste Disposal Facility does not enter water.

8. The Licensee shall submit to the Board for review within six (6) months of the issuance of this license a report identifying each Final Discharge Point. The report shall at least include:

    a. Plans, specifications and a general description of each Final Discharge Point together with its specific geo-referenced location;

    b. A description of how each Final Discharge Point is designed and maintained.

9. If, during the term of this Licence, additional Final Discharge Points are identified, the Licensee shall submit the information as required by Part D, Item 8 for each new Final Discharge Point within 30 days after the discharge point is identified and at least 60 days prior to depositing Effluent from the new Final Discharge Point and/or proposed changes are made to a Final Discharge Point.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval design drawings stamped by a qualified engineer registered in Nunavut prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

2. The Licensee may, without written approval from the Board, carry out modifications to the Water Supply and Waste Disposal Facilities provided that such modifications are consistent with the terms of this Licence and the following requirements are met:

    i. the Licensee has notified the Board in writing of such proposed modifications at least sixty (60) days prior to beginning the modifications;

    ii. said modifications do not place the Licensee in contravention of the Licence or the *Act*;

    iii. the Board has not, during the sixty (60) days following notification of the proposed modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and

    iv. the Board has not rejected the proposed modifications.

3. Modifications for which all of the conditions referred to in Part E, Item 1, have not been met may be carried out only with written approval from the Board.

4. The Licensee shall provide as built plans/drawings of the modifications referred to in this Licence within ninety (90) days of completion of the modifications.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall, before March 31, 2004 submit to the Board for approval, a Plan for the Operation and Maintenance of the Sewage and Solid Waste Disposal Facilities in accordance with *"Guidelines for Preparing an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities"* (October 1996). This Plan shall specifically address the waste disposal and operational issues related to the Sewage Disposal Facility and the Solid Disposal Facility, which were identified in the August 9, 2001 DIAND Inspection Report.

2. The Licensee shall implement the Plan specified in Part F, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part F, Item 1, if not acceptable to the Board. The revised Plan shall be submitted to the Board for approval within thirty (30) days of notification of the Board decision

4. If, during the period of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:

    i. employ the appropriate contingency plan as provided for in the Operation Maintenance Plan;
    ii. report the incident immediately *via* the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
    iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

5. In the absence of a contingency plan contained within an approved Operation and Maintenance Plan, and should during the period of this Licence an unauthorized discharge of waste occur, or if such a discharge is foreseeable, the Licensee shall:

    i. take whatever steps are immediately practicable to protect human life, health and the environment;
    ii. without delay seek guidance from the Departments of Community Government and Transportation and Sustainable Development with regards to mitigation and remedial actions required to address the discharge;

ii. report the incident immediately *via* the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

1. The Licensee shall submit to the Board for approval an Abandonment and Restoration Plan at least six (6) months prior to abandoning any facilities and the construction of new facilities to replace existing ones. The Plan shall include, but not be limited to where applicable:

   i. water intake facilities;
   ii. the water treatment and waste disposal sites and facilities;
   iii. petroleum and chemical storage areas;
   iv. any site affected by waste spills;
   v. leachate prevention;
   vi. an implementation schedule;
   vii. maps delineating all disturbed areas, and site facilities;
   viii. consideration of altered drainage patterns;
   ix. type and source of cover materials;
   x. future area use;
   xi. hazardous wastes; and
   xii. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

2. The Licensee shall implement the plan specified in Part G, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part G, Item 1 if not approved. The revised Plan shall be submitted to the Board for approval within thirty (30) days of receiving notification of the Board's decision.

4. The Licensee shall complete the restoration work within the time schedule specified in the Plan, or as subsequently revised and approved by the Board.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain Monitoring Stations at the following locations:

Monitoring Station	Description
KUG-1	Raw water supply at Coppermine River prior to treatment
KUG-2	Effluent discharge from the Final Discharge Point of the Solid Waste Disposal Facilities
KUG-3	Raw Sewage at truck offload point
KUG-4	Effluent discharge from the Final Discharge Point of the Sewage Disposal Facilities

2. The Licensee shall sample monthly at Monitoring Station KUG-2 and KUG-4 during the months of May to August, inclusive. Samples shall be analyzed for the following parameters:

BOD	Faecal Coliforms
pH	Conductivity
Total Suspended Solids	Ammonia Nitrogen
Nitrate-Nitrite	Oil and Grease (visual)
Total Phenols	Sulphate
Sodium	Potassium
Magnesium	Calcium
Total Arsenic	Total Cadmium
Total Copper	Total Chromium
Total Iron	Total Lead
Total Mercury	Total Nickel
Total Zinc	

3. The Licensee shall measure and record in cubic metres the monthly and annual quantities of water pumped from Monitoring Station KUG-1 for all purposes.

4. The Licensee shall measure and record in cubic metres the monthly and annual quantities of raw sewage offloaded from trucks at Monitoring Station KUG-3 for all purposes.

5. Additional sampling and analysis may be requested by an Inspector.

6. The Licensee shall conform to the Quality Assurance/Quality Control (QA/QC) Plan which shall be provided to the Licensee by the NWB within 60 days of the issuance of this licence.

7. All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or by such other methods approved by the Board.

8. All analyses shall be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory, or as otherwise approved by an Analyst.

9. The Licensee shall measure and record the annual quantities of sewage solids removed from the Sewage Disposal Facility.

10. The Licensee shall, unless otherwise requested by an Inspector, include all of the data and information required by the "Monitoring Program" in the Licensee's Annual Report, as required *per* Part B, Item 1.

11. Modifications to the Monitoring Program may be made only upon written approval of the Chief Administrative Officer.

Appendix G
Test Pit Logs

Test Pit Logs

TP-1

0 – 0.1 m	Organic layer – black, damp with fine roots
0.1 – 0.8 m	Sand – well sorted, damp to wet., medium grained. Water seepage at 0.5 m below surface.

TP-2

0 – 0.2 m	Organic layer – black, damp with fine roots
0.2 – 0.9 m	Sand – well sorted, medium grained, loose, damp. Clumps of black organics scattered in the sand making up approximately 10 percent
0.9 m	Permafrost

TP-3

0 – 0.2 m	Organic layer – black, damp with fine roots
0.2 – 0.8 m	Sand – slightly silty, light brown, well sorted, medium grained, loose, small patches of dark organics within sand, damp to wet. Water seepage into test pit at 0.4 m below surface.

TP-4

0 – 0.1 m	Organic layer – black, damp with fine roots
0.1 – 0.9 m	Sand – light brown, medium grained, well sorted, damp to wet. Occasional small clump of organics.

Sample collected from 0.5 m for geotechnical analysis

TP-5

0 – 0.1 m	Organic layer – black, damp with fine roots
0.1 – 0.8 m	Sand – brown, medium grained, well-sorted, damp, water seepage at approximately 0.7 m. Patches of black damp organics as 0.1 to 0.2 m sized clumps within the sand. Sample collected from 0.5 m for geotechnical analysis
0.8 m	Permafrost.

TP-6

0 – 0.1 m	Organic layer – black, damp with fine roots
0.1 – 0.8 m	Sand – light brown, damp, well sorted, medium grained. Water seepage at 0.7 m
0.8 m	Permafrost.

TP-7

0 – 0.1 m	organic layer – black, damp with fine roots
0.1 – 0.8 m	Sand – light brown, medium, grained, damp, loose, sides caving. Water seeping in at 0.7 m below surface.

Sample collected from 0.5 m for geotechnical analysis.

TP-MSW-1

0 – 0.2 m	Organic layer – black, damp, turf roots
0.2 – 0.8 m	Sand – well sorted, medium grained, loose, damp to wet. Water infill test pit to 0.2 m below surface. No evidence of landfill impacts
0.8 m	Permafrost.

Collected soil sample for geotechnical analysis at 0.5m. Collected groundwater water sample (MSW-1) for laboratory analysis.

TP-MSW-2

0 – 01. m	Organic layer – black, damp with turf roots
0.1 – 0.9 m	Sand – well sorted, medium grained, loose, damp. Water seepage fills test pit to 0.4 m. No evidence of any landfill related impact
0.9 m	Permafrost.

Soil sample collected for geotechnical analysis at 0.5 m. Groundwater sample (MSW-2) collected for laboratory analysis.

TP-8

0 – 0.1 m	Organic layer – black, damp
0.1 – 0.8 m	Sand – medium grained well sorted, loose, damp to wet
0.8 m	Permafrost.

TP-CON-1

0 – 0.1 m	Organic layer – disrupted by pervious surface disturbance
0.1 – 0.9 m	Sand with gravel – fine to coarse grained sand with scattered fine to coarse gravel and occasional cobble. Poorly sorted mixture of glacial deposition of a variety of rock types. Damp, loose, well drained to 0.5 m below surface. Water seepage at 0.5 m below surface

Dug next to contaminated soil stockpile. No evidence of staining or odours or impacts from the stockpiles.

0.9 m	Permafrost.