Hamlet of Aklavik

Background Report for Water Licence Renewal

2019

Prepared by: Hamlet of Aklavik

SAO Fred Behrens

May 2019

1. Introduction

Prepared by the SAO for the Hamlet of Aklavik, the Hamlet of Aklavik's application for water licence renewal (2019) to the Inuvialuit Water Board (NWT WB). The report presents an overview of the community's drinking water, wastewater and solid waste infrastructure based on existing information.
A similar report was prepared for the Hamlet's last application in 2014. This report focuses on issues and improvements at the sewage and solid waste systems from 2014 to 2019. The report summarizes, the Hamlet's Annual Reports, and conversations with Hamlet staff.
No public consultation or data gathering has been completed to obtain feedback from the community for this 2019 water licence renewal. Information in the following report is presented through a combination of figures and text to provide a complete understanding of the community's infrastructure. The waste systems are illustrated in aerial photos, and tables are used throughout the report to summarize information. The variety of presentation techniques should make the information clear and convenient for all stakeholders in the application process.

2. Community Brief

The Hamlet of Aklavik ("Place of the Barren Land Grizzly Bear") is located on the west shore of the Peel Channel in the Mackenzie River Delta. The community is accessible year-round by air, and can be reached via an ice road from Inuvik in the winter.

Aklavik has a history of trapping and was used by the Gwich'in and Inuvialuit peoples as a spot to gather for trading. By the 1920's, Aklavik was a permanent settlement with a Hudson's Bay trading post, Anglican and Roman Catholic missions, and the RCMP regional headquarters. The community grew to around 1500 people by the 1950's, mainly due to the booming muskrat fur trade, and was the seat of government services in the Mackenzie Delta area. However, after severe flooding and erosion in the 1950's, the Federal Government began construction on Inuvik about 50 km to the east, and most services were moved from Aklavik to Inuvik. Although Aklavik's population declined as people moved to Inuvik, many residents chose to stay. Today, a large percentage of the community is Gwich'in or Inuvialuit and many residents practice traditional activities such as trapping, hunting and fishing.

Table 2-1 presents a brief profile of the community including size, terrain, climate and socio-economic characteristics.

Table 2-1: Profile of Aklavik

Location: 68° 13' N and 135° 0' W.
Population: 628 in 2012 (NWT Bureau of Statistics).
Residences: 228 in 2009 (NWT Bureau of Statistics).
Proximity: 58 air km west of Inuvik, 1143 air km northwest of Yellowknife.
Weather: Annual Daily Average = -8.2°C.
July Daily Average = 14.1°C and January Daily Average = -26.9°C.
(Canadian Climate Normals for nearby Inuvik, 1981 to 2010)
Precipitation: 11.5 cm of rainfall and 158.6 cm of snowfall annually.
Vegetation: Aklavik is within the Boreal forest zone. White spruce (upper delta) or balsam, poplar and black spruce (lower delta)
grow on high ground, and low-lying areas may have willows, alders, marshy vegetation and muskeg (GNWT, 1982).
Transportation: Accessible by air or ice road in winter, air or boat in summer.
Economy: Major activities include trapping, hunting and fishing.
Services: Public School, Health Centre, RCMP Station, Canada Post outlet, etc.
Geology/Terrain: The delta region surrounding Aklavik is characterized by alluvial deposits of fine sand and silt. Permafrost is continuous, with an active layer between 0.3 and 0.9 m thick. .Aklavik is about 10 m above sea level, or 3.5 m above summer water level, so flooding is occasionally a problem.

3. Infrastructure Descriptions

This section provides an overview of Aklavik's sewage and solid waste disposal systems. See **Figure 3-2** for the locations of the infrastructure described below.

The sewage lagoon and solid waste disposal facilities located at Clearing Lake were built in 1987.

3.1 Sanitary Sewage Facility

Aklavik's sewage is collected using trucked pump-out services. The sewage is treated at the Clearing Lake Sewage Lagoon approximately 2 km northwest of the community. See **Figure 3-3** for a site plan of the sewage lagoon.

Sewage is collected by a local contractor, K&D Contracting, using a 9000 L capacity vacuum truck. The sewage truck typically makes six trips/day from Aklavik to the Clearing Lake sewage lagoon.

The sewage is trucked to the lagoon site via a gravel/dirt road. Sewage is emptied into the lagoon at a truck dump on the east side of the lagoon. The trucks empty into the lagoon through a discharge chute which was built in 2011 or 2012.

The truck discharge area is identified by a sign. Surveillance Network Program (SNP) station number 570-4 is also posted at this location, although this station is not currently regulated by the Water Licence.

The Clearing Lake Sewage Lagoon is a natural lagoon that operates with continuous discharge into the adjacent natural wetland. **Figure 3-1** below illustrates the sewage treatment process. Freeze-up of the lagoon typically happens in early October, and break-up is in late May or early June.

The lagoon covers an area of approximately 290,000 m^2 and is about 1.5 m (5 ft) deep. The lagoon can therefore hold roughly 435,000 m^3 of sewage. For an average sewage input of 87 m^3/day (with sewage production assumed equal to potable water use), the lagoon theoretically provides a retention time of 5018 days (14 years).

Sewage trucked from Aklavik to Clearing Lake Sewage Lagoon

Treatment in natural sewage lagoon, estimated 14 years holding time

Continuous discharge to natural wetland

Figure 3-1: Aklavik Sewage Treatment Schematic

3.1.1 Effluent Discharge

Effluent discharges continuously from the Clearing Lake Sewage Lagoon into the adjacent wetland area. The outfall point is on the west side of the lagoon, across from the sewage truck discharge area.

The lagoon outflow point is SNP station 570-3. This station is accessed by canoe launched from the sewage truck dump area.

3.2 Solid Waste Facility

Solid waste is collected from Aklavik by truck and deposited at the Clearing Lake Solid Waste Facility (landfill) near the Sewage Lagoon. See **Figure 3-4** for a site plan of the landfill. There are no existing engineering drawings for the existing solid waste facility.

A local contractor, Michael Greenland, trucks Aklavik's solid waste to the landfill. Approximately four truckloads of solid waste are collected daily from Aklavik and taken 2 km north to the Clearing Lake landfill.

There is a gate at the entrance to the landfill site, located just past the tank farm. This gate is normally unlocked to prevent residents leaving garbage on the road if they can't access the landfill. The road continues a short distance past the landfill site to the sewage lagoon truck discharge area.

The Clearing Lake landfill is located east of the Clearing Lake Sewage Lagoon. The landfill is a ground-level site, with low berms surrounding the bulky metal waste and honey bag areas to control runoff from these areas. The entire site covers approximately 20,000 m_2 (235 m x 85 m). The landfill is not fenced, but is surrounded by trees, which help keep windblown debris contained. Berms and drainage ditches are used for runoff and drainage control.

There is no storage and treatment system for contaminated drainage water. Contaminated drainage due to spills is handled according to the Hamlet's Spill Plan (see Appendices A and B).

The landfill is organized to segregate some types of waste. Some signs are present, such as a "Danger: Solid Waste Site" near the entrance, "Metal Only", "No Dumping Garbage", etc. A bulky metal waste area is located north of the access road; this area is currently close to full. The rest of the landfill is south of the road. Hazardous wastes (tires, batteries, etc.) are separated somewhat from other wastes. The solid waste facility does not have a separate bermed area for storage of hazardous waste (do not accept hazardous waste). There is a partially bermed pit for honey bags, however, all residents of Aklavik now use trucked sewage pump out from tanks. Domestic waste is located in the area at the back (south side) of the landfill site. Segregation of waste at the landfill has been improving[1] and the Hamlet will continue to improve the separation and organization of hazardous wastes. In 2015 the Hamlet received funding to remove hazardous waste and appliances from the community solid waste site for final disposal in Whitehorse. In total the Hamlet removed 5 truck loads of appliances and other hazardous waste material. A rough estimate for the capacity of the entire landfill site is 40,000 m_3, assuming the entire site of 20,000 m_2 is built up to a height of 2 m. The domestic waste disposal area is about 45 m x 80 m (3,600 m_2), so the capacity of this area is approximately 7,000 m_3.

Hamlet staff currently do cover the solid waste site once annually and are looking to add another covering in early June. They use a D6 dozer to level and compact the residential /domestic solid waste material once weekly. The Hamlet Foreman inspects the solid waste site at least once per week. The Hamlet has not maintained site records for the solid waste facility to date. In 2019 the Hamlet if funding is available

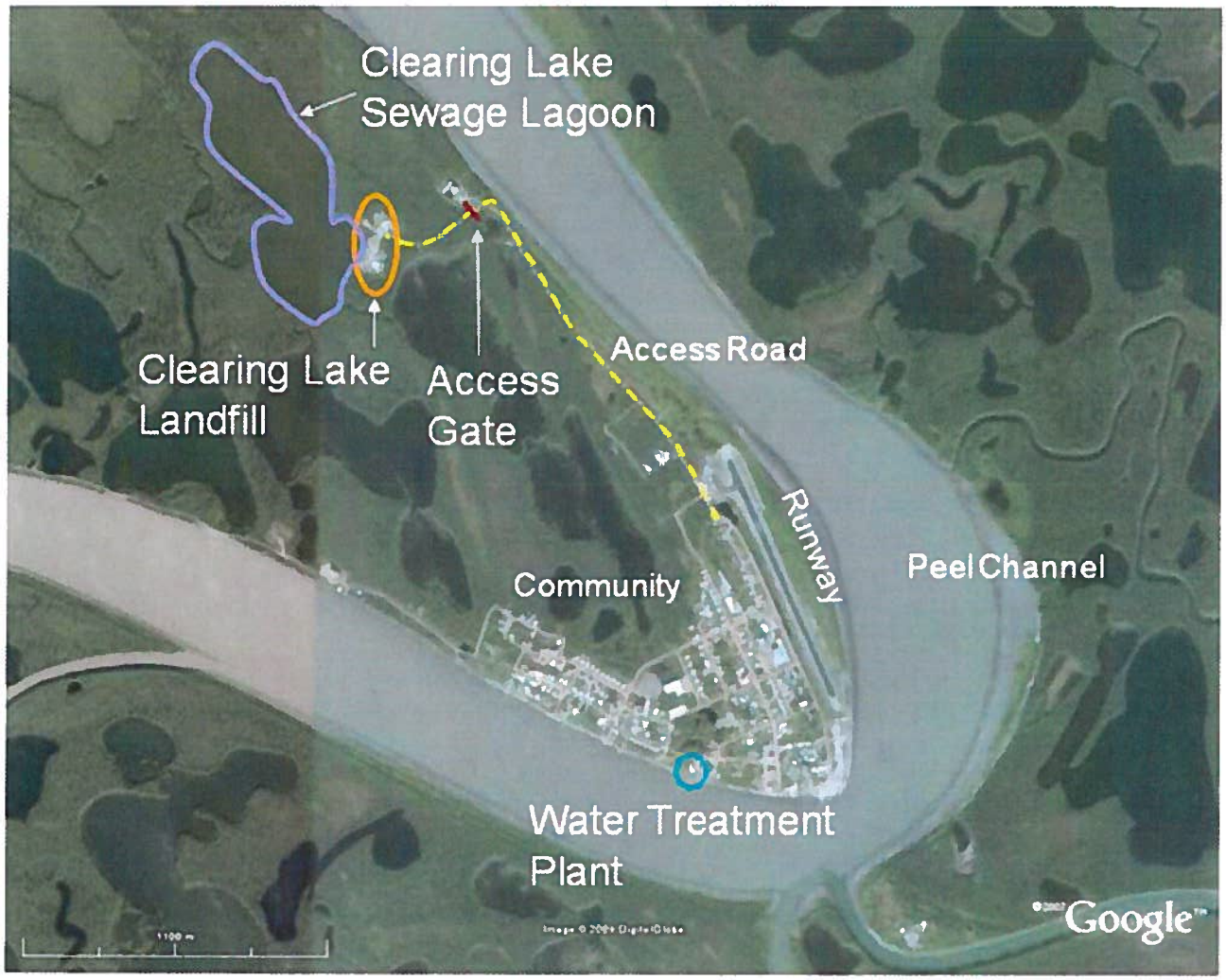


Figure 3-2: Infrastructure Locations

Figure 3-3: Sewage Lagoon Site Plan

Figure 3-4: Landfill Site Plan

plan to increase and reorganize the domestic waste site to basically extending it's life for another 20 years or more.

However, the Foreman intends to start keeping records as per the "2012 Hamlet of Aklavik - Operation and
Maintenance Plan: Solid Waste and Lagoon".

[1] *Jan Davies, Aboriginal Affairs and Northern Development Canada,* Water Licence Inspection Report (Aklavik), *August 26, 2011*

The landfill receives some industrial waste from housing construction and other contractors.
One domestic solid waste area at the Clearing Lake landfill was filled in 1993. A new section was cleared and the old cell was partially covered with soil.
The Hamlet currently does not incinerate waste at the landfill.

4. Water Licence and Annual Reports

4.1 Water Licences and Amendments

Aklavik's Water Licence was first issued as N3L4-0570 in 1984 by the Northwest Territories Water Board (NWT WB).

The Hamlet currently holds Licence N3L3-0570 with the NWT WB for municipal waste disposal, and Licence G99L3-003 with the Gwich'in Land & Water Board (GLWB) for municipal water use. **Table 4-1** provides a summary of the Hamlet's recent water licences. The Hamlet is currently applying for a renewal of Licence N3L3-0570 with the NWT WB.

Table 4-1: Summary of Recent Water Licences

Effective Date	Expiry Date	Water Board Licence #	Licence Scope
August 1, 2009	November 30, 2019	Gwich'in LWB G99L3-003	Municipal Water Use
Nov. 30 2014	November 30, 2019	IWB N3L3-0570	Municipal Waste Disposal

Aklavik's current Water Licence requires that the Hamlet conduct a Surveillance Network Monitoring Program (SNP).

There is one SNP monitoring station at Aklavik's waste disposal site, SNP 570-3, at the point where effluent discharges from the Sewage Lagoon. The Hamlet's SNP requires that effluent from the Sewage Lagoon be sampled at 570-3 once in spring, immediately after break-up of the Lagoon, and once in fall, prior to freeze-up. To meet the current Licence requirements, effluent leaving the lagoon at SNP 570-3 must meet the effluent quality standards in **Table 4-2** below.

Table 4-2: Sewage Lagoon Effluent Quality Standards

Sample Parameter	Maximum Average Concentration
Faecal Coliforms	10,000 coliforms per 100 mL
Biological Oxygen Demand (BOD_5)	120 mg/L
Oil and Grease	5 mg/L and no visible sheen
Total Suspended Solids (TSS)	180 mg/L
pH	Between 6 and 9

4.2 Water Licence Annual Reports

The Hamlet submitted Water Licence Annual Reports for 20014, 2015, 2016, 2017and 2018.

The amount of sewage generated at Aklavik is assumed to be the same as the amount of potable water used. Average water use was 31,640 m_3 per year from January 2009 to December 2012. This is an approximate use of 138 litres per capita per day. The annual water use is shown in **Table 4-3**.

Table 4-3: Water Consumption by Group User (cubic metres)

Year	Residential	Commercial	Government	Total
2014	12,664,437	2,568,348	17,435,535	32,668,320
2015	12,443,753	2,786,731	16,643.776	31,874,260
2016	12,386,735	2,774,339	16,242,567	31,403,641
2017	11,653,429	2,947,983	15,465,374	30,066,786
2018	12,114,219	2,458,238	16,850,457	31,422,913

The Hamlet took at least three samples of sewage lagoon effluent over the course of the current Water Licence, but only one set of laboratory results was included in the Hamlet's annual reports and available for this report.

Table 4-4
below summarizes the sampling done from 2014 to 2018 at the sewage lagoon discharge location SNP 570-3.

Table 4-4: Sewage Lagoon Effluent Quality at SNP 570-3

Parameter	Units	Sept. 9, 2017
		During inspection by ENR staff there was evidence of erosion around the discharge chute and sewage being spilled below the chute all has been contained
Organics -Physicals		
Solids total suspended	<3 mg/L	

5. Past Performance

5.1 Inspection Reports, 20014-2018

This section summarizes the ENR and Environmental Health Inspections on Aklavik's water, waste water and solid waste infrastructure.
inspections are done to provide a general summary of the state of the infrastructure and current operation of the facilities operating under a water licence, highlight any concerns, and determine a community's compliance or noncompliance with its water licence.
The following table presents a summary of comments from Inspection Reports from 2014 to 2018.
Table 5-1 presents comments on the Hamlet's facilities identifies in the N3L3-0570 water license.

5.2 Compliance Reports:

All reports Over the course of 2018 there were a number of non-compliance issues all related to the discharge of sewage outside of the chute. The Hamlet staff and the Local sewage contractor MDHL worked together to find the problem and repair the leak once and for all. Since early 2019 there has not been any issues with the chute or discharging outside of the chute.

5.3 Emergency Release of Sewage:

There has not been a emergency release of sewage since June 2013 which was authorized by AANDC Water Resources. It is also anticipated that this should not occur again as the Hamlet staff survey the dump road elevation and added material to bring the elevation of the dump road to the same level as the Airport Runway.

TaBLE 5-1: Summary of ENR & Enviromental Health Inspections 2014-2018		
Inspection Details	Concerns	Notes
24-Aug-17	Soild Waste	
by Alicia McRae	Five gallon paint pail spilled and spread around	Hamlet staff removed all paint and oil containers
	open five gallon pails of oil and leaking. Sheen of oil	and placed oil in large totes for disposal and
	all over pools of water	disposed of paint. Also cleaned up all batteries
	Batteries disposed of all over the waste site,	and sent out of community for disposal
	not segreagated	ensured proper segreagation of materials
	Appliances dumped all over not in signed area	cleaned up wind blown material
	no fencing, lots of wind blown debris	
	Sewage Area	
	Evidence of sewage being discharged outside of the	repaired discharge chute to ensure no sewage
	lagoon near the discharge chute.	is discharged outside of the lagoon or chute
	Operator must ensure all sewage is contained within	also repaired base to ensure positive drainge
	the lagoon and Chute	to the lagoon. Repaired Discharge chute of any
	Evidence of erosion around the discharge chute and	holes or other damage
	the chute has a hole in it causing pooling and damage	
	to the pad	
Feb. 14, 2018	Sewage Lagoon	
Shawn Hardy	no real issues a black plastic barrel appeared next	barrel is used for contractor to empty truck pumps
	to the discharge chutes with a white funnel in the	excess hydrolic fluid normal operations
	barrel showing a pink fluid	
	no issues	

Feb. 14, 2018	Solid Waste Site	
Shawn Hardy		
	Signs posted to indicate segration	working to clean up and expand solid waste site
	Overall good segragation piles of household wastes	project planned for 2019 provided funding is
	Need better coverage of garbage area	approved.
	no barriers or fencing to enclose site	will include 5 cells developed and fencing along
	no other issues noted	with other barriers installed (plan attached)
	large metal storage area is getting close to lagoon	
	better segragation of waste and coverage	
Feb. 14, 2018	Water Plant Operator	
By: Jaime Goddard		Plant is running well, need to keep up with
	Continued trining of backup operators to provide	maintenance.
	better coverage	
		Work needed in landfill to improve segregation
		SAO looking at improvements with Gerald Enns

Community	Aklavik	**Circuit Rider Trainer(s)**	Jaime Goddard
Date	Feb 14, 2018	**Plant Operator(s)**	Kelly Arey
Weather	-40, sun	**Other Attendees**	Shawn Hardy (EHO)

Activities Since Last Circuit Rider Trip:

Replacement of damaged inline chlorine meter.
Electrician replaced electronics for valves that were burned out due to power fluctuations.
Repair of leak at treated water tank (seems to be an ongoing issue)

Activities During Circuit Rider Trip:

Reviewed sampling requirements
Discussed backup operator certification
Reviewed recent maintenance activities
Landfill and lagoon inspection

Planned Future Activities

Hamlet is looking into surge protection for the WTP building to protect electronics, as they have had frequent problems.

Records Review (e.g. Log sheets, O&M checklists, etc.)

Ok

Training Delivered

Review of sampling requirements with Kelly. The two backup operators were not present.

Safety

Eye Wash	Not checked
Fire Extinguishers	Present
PPE	Not checked

MSDS	Not checked
Daily Safety Meetings	Not checked
Other	Not checked

Raw Water System	
Source	Peel River
Pump Status (duty/stand-by/spare)	Have issues with organic material that clogs the pumps from time to time, no current problems.
Heat Trace	Not checked
Water Quality	Good
Issues	None
Last Inspected	Not checked

Truckfill	
Flow Meter	Not checked
Heat Trace	Not checked
Pump Status (duty/stand-by/spare	Not checked
Issues	None noted

Chlorine System/Disinfection	
Type	Chlorine
Usage	Not checked
Storage	Not checked
Last UV bulb change	n/a
Other	n/a

Filtration	
Pressure Readings	Not checked
Filter Condition	Good. Tank was cleaned in January.
Extra Filter Media	Not checked
Alarm Status	Ok
Backwash Cycle	Not checked
CIP	n/a
Other	Working well.

Coagulation	
Type	Not checked

Dose	Not checked
Aluminum Level	Ok
pH	Ok
Storage	Ok. Recent pipe leak at tank repaired. All operators know this should be checked frequently as there have been leaks in the past.
Other	n/a

Treated Water Storage	
Turbidity	Ok
Capacity/Level	Not checked
Chlorine Level	Ok
Fire Storage	Not checked
Last cleaned/Inspected	Not checked
BacT sample history	Ok. Expired reagents disposed of and replaced by EHO.
Usage Demand (days of storage and capacity	Not checked
Other	n/a

Building Systems	
Heating type	Not checked
Fuel Level	Not checked
Last serviced	Not checked

Backup Generator	
Generator Hours	Not checked
Last serviced	Not checked

Other comments from operator:

Backup operator attendance is improving. An additional backup has recently been hired and is being trained.
The new chlorine meter has been working well. Kelly is looking at a filter that the manufacturer suggests to go ahead of the meter.

Noted challenges for Operator:

Power fluctuations cause issues with valves and pumps.

Suggested improvements:

Continued training of backup operators to provide coverage when Kelly is away.

Conclusion:

Plant is running well, need to keep up with ongoing maintenance including leaks.

Other comments:

Work needed at the landfill to improve segregation and maximize use of space – the SAO is looking into some improvements and has been in touch with Gerald Enns at MACA.

Northwest Territories Health and Social Services

Environmental Health Inspection Report

Name of Facility or Operation	Date (d/m/y)
Sewage Lagoon	February 14, 2018

Mailing Address: P.O. Box 88 X0E 0A0

Physical Address: Aklavik, NT

Type of Inspection: ☐ Tobacco ☑ Other: GNWT General Sanitation Regulation ☑ Routine ☐ Complaint ☐ Follow-up

Under authority of the *Public Health Act* and/or *Tobacco Control Act*, an inspection of the above listed facility/operation was conducted and the following observations and/or Orders are made. Required Correction Dates are listed.

Item Number	Observations and Corrective Actions	Correction Date (if applicable)
–	2 off-loading chutes present, only one in use. No issues noted with the active chute.	
–	No obvious issues noted with freeboard and berms. Limited visual inspection due to snow cover.	
*	Note: A black plastic barrel (appearing to be used to store liquid) was observed close to the off-loading chute on the right. A white plastic bucket (flipped upside down) was observed on top of the barrel and seemed to cover a funnel and pink-coloured liquid (which would have been poured into the barrel). Will discuss with the Hamlet the nature of this barrel and its contents.	
	No additional issues noted at time of inspection.	
	Report reviewed with ~~water plant operator~~ acting SAO Roxanne John Kelly Arey, in absence of the Hamlet foreman & SAO.	

Public Health Officer's Name (print): Shawn Hardy

X Public Health Officer's Signature: Shawn Hardy — Date (d/m/y): Feb 14/18

Owner/Operator (please print): X Roxanne John

X Owner/Operator's Signature: Roxanne John — Date (d/m/y): Feb. 14. 18

Yellowknife Ph: (867) 669-8979 Fax: (867) 669-7517 •
Inuvik 4840 Ph: (867) 777-7250 / 777-7220 Fax: (867) 777-3255 4842 •
Hay River Ph: (867) 874-7261 Fax: (867) 874-7211

NWT1049/0411

File Copy

Northwest Territories

ENVIRONMENTAL HEALTH INSPECTION REPORT CONT'D

Solid Waste Disposal Site
P.O. Box 88
AKlavik, NT X0E 0A0

Re: Inspection under the GNWT General Sanitation Regulation

- Signs posted to indicate areas to segregate different wastes. Large metal (vehicles) waste currently kept near lagoon.
- Overall good segregation. Piles of household wastes will need better coverage.
- No barriers or fencing currently being used to enclose the site.
- Hamlet is giving consideration to future plans for the site, as it approaches capacity.

No other issues noted at time of inspection.

Person in charge: X Fred DeHrens
Signature: Fred DeHrens

EHO: Shawn Hardy
Signature: Shawn Hardy

Date: December 20, 2017

Northwest Territories

ENVIRONMENTAL HEALTH INSPECTION REPORT CONT'D

Sewage Lagoon
P.O. Box 88
Aklavik, NT X0E 0A0

Re: Inspection under the GNWT General Sanitation Regulation

- 2 offloading chutes present, only one in regular use. No leaks or issues observed.

- Observable freeboard appeared acceptable.

Overall no issues observed at time of inspection.

Person in Charge: x Fred Behrens
Signature: Fred Behrens

EHO: Shawn Hardy
Signature: Shawn Hardy

Date: December 20, 2017

NWT 4247/0393

Northwest Territories Health and Social Services

Environmental Health Inspection Report

Name of Facility or Operation: Solid Waste Disposal Site	Date (d/m/y): February 14, 2018
Mailing Address: P.O. Box 88 X0E 0A0	
Physical Address: Aklavik, NT	

Type of Inspection
☐ Tobacco ☑ Other: GNWT General Sanitation Regulation ☑ Routine ☐ Complaint ☐ Follow-up

Under authority of the *Public Health Act* and/or *Tobacco Control Act*, an inspection of the above listed facility/operation was conducted and the following observations and/or Orders are made. Required Correction Dates are listed.

Item Number	Observations and Corrective Actions	Correction Date (if applicable)
*	Space where large metal wastes are being stored is getting close to capacity.	
*	Improvement needed regarding: - Covering of waste - Segregation of waste, including segregation of hazardous wastes.	
	Will discuss with Hamlet its plans for short-term and long-term management of wastes.	
	acting SAO Roxanne John	
	Report reviewed with ~~hunter plant operator, Kelly Arey,~~ in the absence of Hamlet foreman and SAO.	

Public Health Officer's Name (print): Shawn Hardy

X Public Health Officer's Signature: Shawn Hardy — Date (d/m/y): Feb 14/18

Owner/Operator (please print): X Roxanne John

X Owner/Operator's Signature — Date (d/m/y): Feb. 14. 18

Yellowknife Ph: (867) 669-8979 Fax: (867) 669-7517 •
Inuvik 4840 Ph: (867) 777-7250 / 777-7220 Fax: (867) 777-3255 4842 •
Hay River Ph: (867) 874-7261 Fax: (867) 874-7211

NWT1049/0411

File Copy

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

Telephone: 867-678-6671
Fax: 867-678-6699

September 27, 2017

Hamlet of Aklavik
P.O. Box 88
Aklavik, NT X0E 0A0

Attention: Fred Behrens, Senior Administrative Officer

File Number **N3L3 - 0570**
Type of Operation **CLASS B - MUNICIPAL**
Location

Dear Mr. Behrens,

An inspection of the above noted operation was conducted on by Water Resource Officer Lloyd Gruben and Environment Protection Officer, Alicia McRae on August 24, 2017. Enclosed is a copy of the Municipal Water Inspection Report.

There were a number of violations indentified as depicted during the inspection. Some of the violations relate to spillage of sewage at sewage disposal chute, empty engine oil containers, opened and spilled five gallon paint pails at the solid waste disposal site, open and spilled used engine oil at the local SWD, batteries disposed all over the site, flouresecent bulbs, propane bottles disposed all over the site. Overflowing used engine oil pails at the Hamlet shop.

Please note that it is the Hamlet responsibility to ensure compliance with all terms and conditions of its Water Licence. The Department of Environment and Natural Resources is available to assist you in achieving this goal.

A copy of this report will be sent to the Inuvialuit Water Board and Gwich'in Land and Water Board for their review and public records. If you have any questions/concerns regarding the enclosed, please do not hesitate to contact me at 867 678 6676.

«INSP_TYPE» WATER USE INSPECTION REPORT

Sincerely,

Lloyd Gruben
Water Resource Officer
Environment an Natural Resources
Inuvik Region

Cc:

Norman Snowshoe – A/Regional Superintendent – GNWT -ENR

Mardy Semmler – Executive Director, Inuvialuit Water Board

Bijaya Adhikara – Science and Regulatory Coordinator

Alecsandra MacDonald - Regulatory Specialist GLWB

Leonard Debastien – Executive Director = GLWB

Freda Wilson - IWB

«INSP_TYPE» WATER USE INSPECTION REPORT

WASTE DISPOSAL – SEWAGE

Disposal Method		Primary Treatment					
Mechanical	N	Camp Sump	N	Natural Water Body	Y	Wetland Treatment	Y
Continuous Discharge	Y	Intermittent Discharge	N	Seasonal Discharge	N	Land Spread	N
Accelerated Biological	N	Other	N/A				

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable N/I - Not Inspected**

Discharge Quality	N/I	Decant Process & Structures	N/A	Discharge Measurement Device	N/I
Freeboard	N/I	Sludge Disposal Method	N/A		
Periods Of Discharge	Continuous			SNP Samples Collected	Y
Effluent Discharge Rates	Natural outflow into the wetland and occasional decants				

Sewage Comments:

There was evidence of sewage being discharged outside of the sewage lagoon, near the discharge pad of the Sewage Disposal Facilities (SDF). Operator must ensure that all sewage is discharged into the sewage lagoon as authorized under the Water Licence. During inspection, sewage was noticed under the sewage discharge chute. Under further inspection, hole was noticed in the discharge chute causing sewage leakage during discharge. Discharging excess or buildup of sewage directly onto the ground is considered an unauthorized discharge of hazardous wastes and cannot continue. If excess sewage cannot be discharged in the chute then it must be contained in a sealed container until it can be discharged properly

There is evidence of erosion at the sewage disposal chute currently in use. The Chute has a hole causing pooling of sewage below the chute and damaging the pad.

Sewage is being spilled around and beneath the sewage chute. Operator must ensure that all sewage is discharged in the chute and any spilled sewage is being contained. Recommend adding a catchment basin which can be emptied in the chute when at capacity or on a daily basis.

Area will need to be monitored during the spring and summer that any spilled during the offload will drain into the lagoon or into batchment basin.

Recommend stabilizing sewage disposal site for safety reasons as pad is sinking and potholes

Empty engine oil containers noticed by the Sewagse Disposal Site

«INSP_TYPE» WATER USE INSPECTION REPORT

During inspection, five gallon pail of paint was noticed spilled over and all around

Open five gallon pails of used engine oil filled to the brim and leaking all over. Sheen of oil noticed all over pools of water

Batteries disposed of all over the solid waste site, not segregated

Empty propane bottles disposed all over, no segregation

Appliances dumped all over, not dumped in appropriate place where signage notes appliances

No fencing, lot of wind blown debris all over. Blown into creek and area around the solid waste site

FUEL STORAGE

Indicate: A - Acceptable U - Unacceptable N/A - Not Applicable N/I - Not Inspected

Owner:	Hamlet of Aklavik	Operator:		Condition of tanks:	A
Berms & Liners	A	Water within Berm:	None	Evidence of Leaks:	None

Drainage Pipes	N/A	Pump Station and Catchment Berm	N/A	Runoff Diversion	N/A
Pipeline Condition	N/A				

Fuel Storage Comments:
Inspected all fuel storage areas. All Hamlet buildings have new double walled tanks in place with good padding. No stress on pipes.

DAM – STRUCTURAL CONDITION OF DAM

Dam	

Indicate: A - Acceptable U - Unacceptable N/A - Not Applicable N/I - Not Inspected

Required Freeboard											
Crest	Cracking		Subsidence		Heaving		Wave Erosion		Brushing Required		
Upstream Face	Cracking		Surface Erosion		Gullying		Wave Erosion		Brushing Required		
Downstream Face	Cracking		Surface Erosion		Gullying		Wave Erosion		Brushing Required		

Structural Condition Of Dam Comments:

«INSP_TYPE» WATER USE INSPECTION REPORT

WASTE DISPOSAL - TAILINGS

Disposal Method		N/A					
Tailings Pond	N	Natural Lake	N	Underground	N	Other	

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable** **N/I - Not Inspected**

Conveyance Lines	N/A	Runoff Diversion	N	Dams, Dykes	N
Freeboard	A	Seepages	N	Dyke Inspection	N
Erosion	N	Pond Treatment	N/I	Construction	N
Periods Of Discharge				SNP Samples Collected	ENR

Tailings Comments:

WASTE DISPOSAL – MINING – OTHER

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable** **N/I - Not Inspected**

Ore & Waste Rock Stockpiles	N/A	Chemical Storage	N/A
Ground Water Discharge	N/A	Mine Water Discharge	N/A

Mining-Other Comments:

WASTE DISPOSAL – SOLID WASTE

Disposal Method							
Open Dump	N	Landfill	Y	Burn & Landfill	N/I	Underground	N
Offsite Removal	N	Other	N/A				
Owner / Operator	Hamlet of Aklavik						

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable** **N/I - Not Inspected**

Runoff Diversion	N/A	SNP Samples Collected	No

Solid Waste Comments:

«INSP_TYPE» WATER USE INSPECTION REPORT

DAM – SPILLWAYS and DISCHARGE STRUCTURES

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable** **N/I - Not Inspected**

Intake Structures		Discharge Structures	
Seepage		Erosion	
Downstream Discharge		Stage Discharge Curves	
Forebay Level		Tail Race Level	
Flow rate (Power House)			
Flow rate (Spillway)			
Power Production			
Forebay Max Level			
Forebay Min Level			

Spillways and Discharge Structures Comments:

SURVEILLANCE NETWORK PROGRAM

Samples Collected Licencee	
Samples Collected ENR	Samples taken as per water licence

Signs Posted: SNP	None	Warning	

Surveillance Network Program Comments:

Had to find area of where sdamples to be taken

GENERAL CONDITIONS/REPORTS/PLANS

Indicate: **A - Acceptable** **U - Unacceptable** **N/A - Not Applicable** **N/I - Not Inspected**

C &R Plan		Records & Reporting		Final Report	
Geotechnical Inspection		Posting, Signage		Contingency Plan	
Restorations Activities		Spills		O&M Plan	
Maintenance		Modifications		Annual Report	

General Condition Comments:
During inspection of Hamlet shop, five gallon pails overflowing with oil and water

«INSP_TYPE» WATER USE INSPECTION REPORT

ADDITIONAL COMMENTS/REMARKS

MATTERS FOR FOLLOW UP

Sewage Disposal Site needs repairs in the chute as holes were noticed causing leakage during offload

Sewage disposal pad cracking and potholes need repairs done.

Solid Waste Site needs more signage and segregation.

Fencing needed to catch all wind blown debris

NON-COMPLIANCE/VIOLATIONS OF ACT OR LICENCE

Annual reporting needs to be in by April 30 of every year

Inspector's Signature: Floyd Sink

5.4 Environmental Impact:

The Hamlet's solid waste and sewage generation has not changed significantly from the previous term of the water license; therefore, no new impacts are expected from continued use of the facility. However, no studies have been completed to verify this. The Hamlet has not retained a consultant to assess the effects of the wetland from lagoon discharges. However, as described in section 4.2 of this report, based on available information, the lagoon effluent meets the water quality requirements int eh current water license.

6. recent and Planned Improvements:

6.1 Recent Improvements:

The Hamlet has made improvements to its waste infrastructure and operation., records and reporting practices in the past five years, including:

Repaired and leveled the two chutes for better operation during the winter months
Removed 5 Truck loads of material from solid waste site, including appliances, empty barrels, old fuel tanks, batteries, as well as scrap metal. Initiated 2015

2016 Hired consulting firm to identify new solid waste site west of the community. Identified 15 various sites from community going west towards the mountains. Conclusion of study is that with no road to access any sights going west it would be very expensive and undesirable to consider any sights. Local residents have also voiced their concern regarding relocation. Also considered removing old vehicles out of community however not enough funding was available at that time. Also covered domestic waste with river silt and compacted it as well. The Hamlet also took over operations of the Water Plant and the production of water for the community as of April 1, 2017

2017 covered domestic waste with river silt as well as arranged other material in segregated areas better.

2018 again covered domestic waste and segregated paper and cardboard to be burned was covered and never burnt.

6.2 Planned Improvements:

The Hamlet intends to hire a consultant to develop further the design for the expansion of the solid waste site to allow for 20 more years of usage as described in the attached document "Aklavik Solid Waste Site Improvements" as submitted to the Investing in Canada Infrastructure Program. Also, for 2019 it is planned to work with MACA to remove the old vehicles located within our community. With these two initiatives we will remove years of stored dead vehicles and steel as well as expand the life of our existing waste site by a good 20 years. With the added benefits of upgrading our operations manual at the same time.

Aklavik Solid Waste Site Improvements

Assumptions

Aklavik needs to build capacity to dispose of solid waste.

There is a planning study for a new disposal site but it is not considered feasible at this time due to financial constraints to constructing a road.

The current solid waste site (on the southern side of the road) can be utilized with careful management and following the mounding method (i.e. build a cell on top of an existing disposal cell).

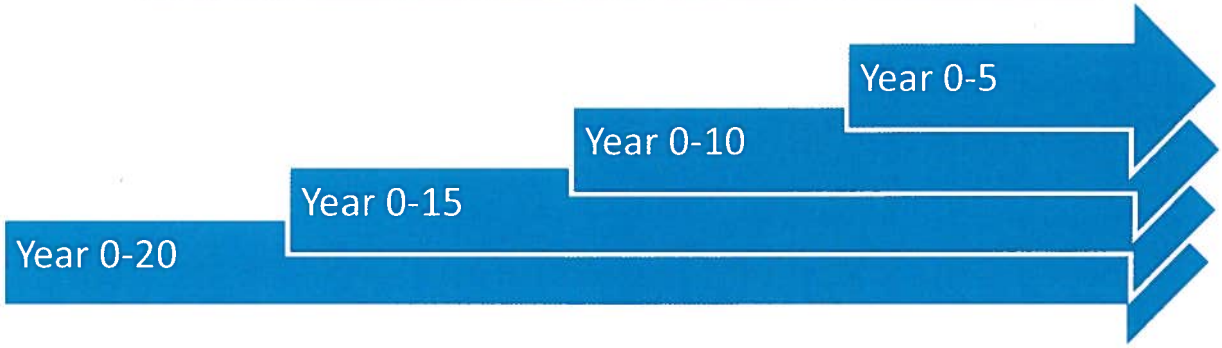
Removing vehicles, appliances, and heating oil tanks from the North side of the road is a work in progress.

Estimated Volume of Waste Generated in a 20 Year Period

Solid waste volume calculations for the Hamlet of Aklavik are made with the following assumptions.

- An average per capita volume of solid waste is 0.017 m3/person/day.
- A compaction ratio of 3:1.
- A slow population growth rate.
- A daily/intermediate cover ratio of 5:1 (solid waste : cover material).

Estimated Volume of Airspace Required for Solid Waste Over 20 Years	
Elapsed Years	**Volume (m3)**
0-5	7,500
0-10	16,000
0-15	26,500
0-20	36,000



Area of Land Suitable for Mounding Solid Waste at the Current Site

The current site appears to have nearly extended laterally as much as possible. It is constrained by water on three sides and a road to the North. It may be possible to clear some tree's to the South and

Northeast in order to develop a footprint of approximately 16,000 square meters. The dimensions of this footprint are approximately 175 m x 95 m. This is outlined in Figure 1.

Three advantages to continuing to use the current site are as follows:

I. The area is already disturbed and contains solid waste, thereby preventing the disturbance of another site.
II. The preexisting solid waste has raised the elevation of the site in relation to it's immediate surroundings. A new site would likely require considerable amount of fill as a base layer as the surrounding area is quite low.
III. It is more cost effective to use the current disposal site then to construct a road and a new disposal site.

Figure 1: GNWT ATLAS image with a proposed landfill footprint of Est. 95 m x 175m

Available Airspace and Volume of Berms

One important objective of managing a solid waste site is to maximize the use of available airspace to dispose of solid waste.

Volume of Airspace = Asset = Place to dispose solid waste

The available airspace can be maximized by placing solid waste in a sequential pattern that minimizes roads, and berms. A simple fill sequencing plan using the mounding method is outlined in **Figure 2** and **Appendix 1** where solid waste is placed in rectangular strips in sequence from the back (South) towards the front (North) over an estimated 20 year period.

Based on the outside dimensions of 175m x 90m the volume of berms required to enclose the perimeter and place solid waste is calculated with the following assumptions.

- Lift One: Berm Height = 2 m
- Lift Two: Berm Height = 1.5m
- 3:1 slopes on the inside and outside of berms

These berms would contain airspace of approximately **38,000 cubic meters**.

The volume of granular required to construct the berms is approximately **10,800 cubic metres**.

Final cover of the solid waste site is estimated to require approximately **7,700 cubic metres**.

The berms for a 20 year lifespan for the solid waste site could be constructed in phases as described in the table below.

Phase	North & South	East	West	Length of Berm	Volume of Granular
Year 0-5	95	40	40	175	3500
Years 5-10		45	45	90	1800
Years 10-15		50	50	100	2000
Years 15-20	95	40	40	175	3500
Sub Total: Amount for Length of berms				**540**	**10800**
Amount of Granular Required for Intermediate Cover					**6,000**
Amount of Granular Require for Closure					**7,700**
Total Estimated Amount of Granular for 20 Year Life					**24,500**

Draft Budget for Phase I Years 0-5

It may not be feasible to complete the construction of a 20 year solid waste site in one project however the berms can be built in phases as the edge of the active face of the solid waste site continues to advance from South → North.

This draft budget outlines what would be required to clear the space and develop the plans for a 20 year site and include enough budget to construct the Southern segment of the solid waste site.

Description	cubic metres	Cost
Design Drawings		$ 50,000
Project Management		$ 25,000
Site Elevation Survey and Engineered drawings		$ 35,000
Site Grading (2 pieces, $250/hr., 10 days)		$ 40,000
Mobile Litter Fence x 4[1]		$ 40,000
Granular at $110 per cubic meter	3700	$ 410,000
Total		**$ 600,000**

Figure 2: Illustration of the Mounding Method outlined in the MACA Solid Waste Guide

3.8 MOUNDING TO PROVIDE ADDITIONAL LIFE

With any of the recommended methods, additional life can be added to a site by mounding as shown in Figure 3-4. Slopes should be maintained for safe operation of equipment, prevent erosion, and minimize costs for cover material. Geotextile fabrics will promote slope stability.

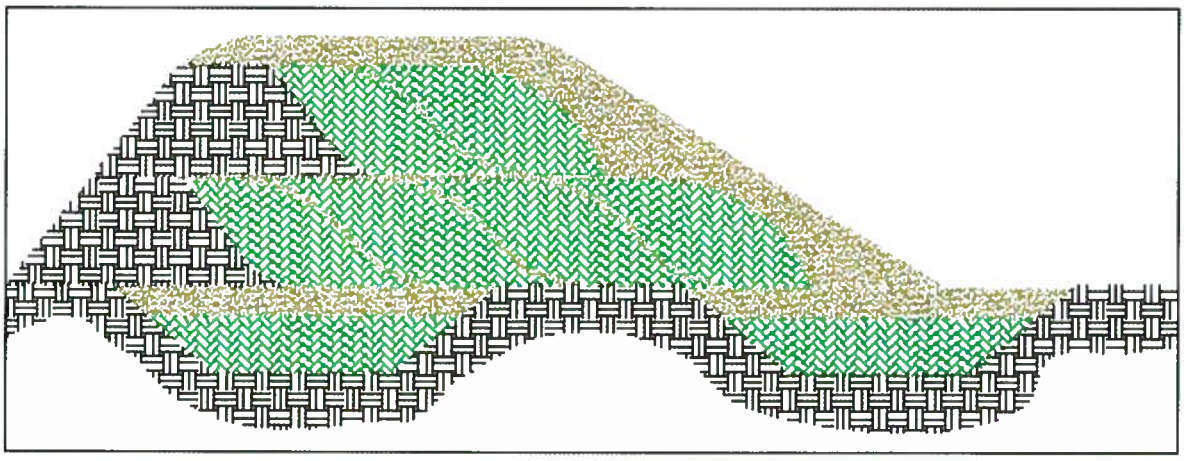


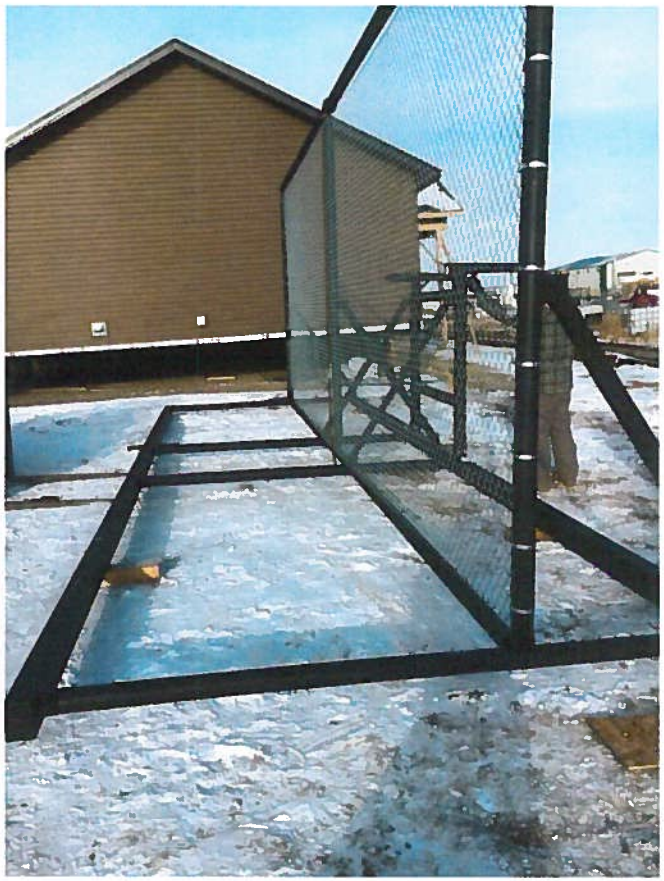
Figure 3-4 Mounding Concept

[1] Examples displayed in the Appendix

Appendix 1 : Simplified Fill Sequencing plan for the Solid Waste Site.

Appendix 1 : Simplified Fill Sequencing plan for the Solid Waste Site.

THE BULL LITTER FENCE WITH CANOPY



Supplier	website	fence			price	Number	Cost	Transpor-tation	Total
		length feet	height feet	weight lb.					
Metta Technologies	http://www.mettatechnologies.com/	24	15		$5,180	4	$20,720	$19,548	$ 40,268
Wind & Sun Protection Inc.	http://www.windandsunprotection.com/	30	9	2800	$5,300	4	$21,200	$15,000	$ 36,200

7. Conclusions and Recommendations

Over the most recent term of its Water License (2014-2019), the Hamlet of Aklavik has had non-compliance issues related to the SNP, records and reporting of the Water License.

The Hamlet appears to be complying with the Water Licence sewage lagoon effluent quality requirements, based on the analysis results for the one sample. Further sampling will take place as identified as need of improvement. As recommended with two samples annually taken, once after breakup and once prior to freeze up.

Some significant improvements have been made over the term of the current Water Licence. Annual reporting has been completed for each year, much improved compared to previous licence period. Efforts have been made to layout and operate the Solid Waste Site in a more efficient and effective manner and identify ways to extend the life of this facility, as descried in Section 6.1.

The Hamlet will continue to work on managing and segregating waste at the landfill. The Hamlet also intend to extend the life of our existing facility by expanding the area and utilizing cells on a 5-year rotation. This will extend the life for 20 years approximately.

Appendix A

Spill Contingency Plan

Spill Contingency Plan for the Hamlet of Aklavik, NT

Water Licence Number N3L3-0570

Created in May 2011

Prepared for and by the Hamlet of Aklavik

Preface

Table of Contents

Preface i

1. Introduction and Project Details 1

1.1. General 1

1.2. Effective date 1

1.3. Distribution list 1

1.4. Purpose and scope 2

1.5. Hamlet environmental policy 2

1.6. Sites descriptions 2

1.7. Identification of special areas that can potentially be impacted 2

1.8. Hazardous materials stored on site 2

1.9. Preventive measures 3

1.10. Maps 3

1.10.1. Building, Roads, Airstrips and water Bodies 3
1.10.2. Storage Locations of each Hazardous Material and Spill Kit 3
1.10.3. Probable Spill Location 3

2. Response Organization 4

2.1. Notification 4

2.2. Response Team Organization 4

3. Action Plan 6

3.1. Potential spill sizes and sources 6

3.1.1. Sewage spills from trucks 6
3.1.2. Sewage spills from Sewage Disposal Facilities 6
3.1.3. Spills from fuel storage 6
3.1.4. Fuel spill from motorized equipment 7
3.1.5. Gasoline spill from motorized equipment..**Error! Bookmark not defined.**
3.1.6. Propane spill 7
3.1.7. Oil spill 7

3.2. Procedures for Initial Action 7

3.3. Procedures for Containing and Cleaning up the Spill 8

3.3.1. Sewage infrastructure 8
3.3.2. Lagoon dam structure 9
3.3.3. Containment of Spill on open water 9
3.3.4. Containment of Spills on Ice 10
3.3.5. Containment of Spills on Snow 12
3.3.6. Containment of Spills on Land 12
3.3.7. Fire or Explosion 13

3.4. Procedures for Transferring, Storing, and Managing Spill-Related Wastes 14

3.5. Procedures for Restoring Affected Areas, Providing Inspectors with Status Updates and Cleanup Completion 14

4. Resource Inventory 15

4.1. On-Site Resources 15

4.1.1. Contents of Spill Kits 15
4.1.2. Earth moving and other equipment 15
4.1.3. Tool kit 15

4.2. Off-Site Resources 15

5. Training Program 16

6. References 17

Schedule A: NT-NU Spill Report Form 18

Schedule B: Immediately Reportable Spill Quantities 20

1. Introduction and Project Details

Under the *Northwest Territories Waters Act* (*NWTWA*) and Section 6 g (i) and (ii) of the *Northwest Territories Waters Regulations* (*NWTWR*) all applicants where the undertaking involves the handling or storage of petroleum products or hazardous materials, must prepare (i) a plan for the safe handling, storage and disposal thereof, and (ii) a contingency plan for their containment and for the clean-up thereof in the event of a spill.

1.1. General

This Spill Contingency Plan provides for the prompt and coordinated response of the Hamlet to spills located on Hamlet property and to assist any agency located within the Hamlet of Aklavik corporate boundaries.

Contact information: Hamlet of Aklavik
P.O. Box 88
Aklavik, NT
X0E 0A0
Phone: 867-978-2351 or 867-978-2361
Fax: 867-978-2434
Email: saoaklavik@permafrost.com

Attention: Senior Administrative Officer (SAO)

1.2. Effective date

The effective date of this Spill Contingency plan is May 27, 2011

1.3. Distribution list

This plan and the most recent revisions have been distributed to:

Table 1.1: Distribution list

Organization	Title	Date distributed
Environment Canada- Environmental Protection	Carey Ogilvie- Head Phone: 867-669-4737	
Government of NWT- Environmental Protection Division	Ken Hall-Manager Phone: 867-873-7654	
Government of NWT- MACA	Lorrie Fyfe-Manager Phone: 867-777-7121	
Gwich'in Land and Water Board (GLWB)	Paul Sullivan-Chair Phone: 867-777-7960	
Hamlet of Aklavik	Hamlet Foreman	
Indian and Northern Affairs Canada- North Mackenzie District, NWT Region	Conrad Baetz-Manager Phone: 867-777-8901	

Organization	Title	Date distributed
Indian and Northern Affairs Canada- Water Resources	Robert Jenkins-Head Phone: 867-669-2574	
Northwest Territories Water Board (NWTWB)	Eddie Dillon-Chair Phone: 867-678-2942	

1.4. Purpose and scope

The purpose of this plan is to outline response actions for potential spills. The plan identifies key response personnel and their roles and responsibilities in the event of a spill, as well as the equipment and other resources available to respond to a spill. It details spill response procedures that will minimize potential health and safety hazards, environmental damage, and clean-up requirements. The plan has been prepared to ensure quick access to all the information required in responding to a spill.

1.5. Hamlet environmental policy

1.6. Sites descriptions

The Hamlet of Aklavik is responsible for the operation and maintenance of their waste disposal facilities (Sewage Disposal Facilities and Solid Waste Disposal Facilities) and water supply facilities.

The Hamlet of Aklavik is located on the west shore of the Peel Channel in the Mackenzie River Delta, at latitude 68°13'00" North and longitude 134°59'00" West, in the Northwest Territories.

1.7. Identification of special areas that can potentially be impacted

Following is a list of special places that will receive additional consideration should a spill occur in this area:

- Bodies of water within the community; and
- Town infrastructure (i.e. community hall, school, youth center, etc.)

1.8. Hazardous materials stored on site

There are X hazardous materials storage areas in the Hamlet of Aklavik. Table 1.3 presents a list of hazardous materials on-site, the type of storage container, the average and maximum quantities stored and their storage location.

Table 1.2: List of hazardous materials stored on-site, type of storage container, the normal and maximum storage quantities, and storage locations.

Material	Storage container	Average on-site	Maximum on-site	Storage location and uses

1.9. Preventive measures

Planning for an emergency situation is imperative. Due to the nature of the materials stored in the Hamlet of Aklavik facilities, adequate training of staff is critical. The storage areas for hazardous materials are to be lined with impermeable liners and bermed with 110% containment. Planking can be used to protect the liner from the fuel drums and cylinders.

Spill kits are located at GIVE NAME of the LOCATION of SPILL KITS. See section 4 called "Resource Inventory" for details on spill kit contents. Does the Hamlet of Aklavik Forman conducts monthly visual inspections to check for leaks or damage to the storage containers, as well as for stained or discolored soils around the storage areas and adjacent motorized equipment. If so, does he use a checklist to ensure no areas have been missed and results of the inspections are recorded by the Hamlet of Aklavik? If a check list is used, you need to put it in schedule C.

1.10. Maps

1.10.1. Building, Roads, Airstrips and water Bodies

1.10.2. Storage Locations of each Hazardous Material and Spill Kit

1.10.3. Probable Spill Location

2. Response Organization

The Hamlet of Aklavik has established procedures in the event of a spill.

2.1. Notification

- Any community employee or member of the public discovering a spill will immediately take steps to notify the Hamlet Foreman. If a spill is discovered during normal working hours, the employee will also contact the Hamlet of Aklavik Office at 867-978-2351 or 867-978-2361.
- If a spill is discovered after normal working hours, the person will use the most expedient method at his disposal to contact the Hamlet Foreman.
- The Hamlet Foreman will also notify the community's SAO as soon as possible if he/she haven't been notified already.
- The Hamlet of Aklavik Forman or SAO is responsible for notifying the Government of the Northwest Territories 24 hour Spill Report Line at 1-867-920-8130, collect calls accepted.
- The Hamlet Foreman is responsible to fill out the NWT Spill Report (see appendix A).

2.2. Response Team Organization

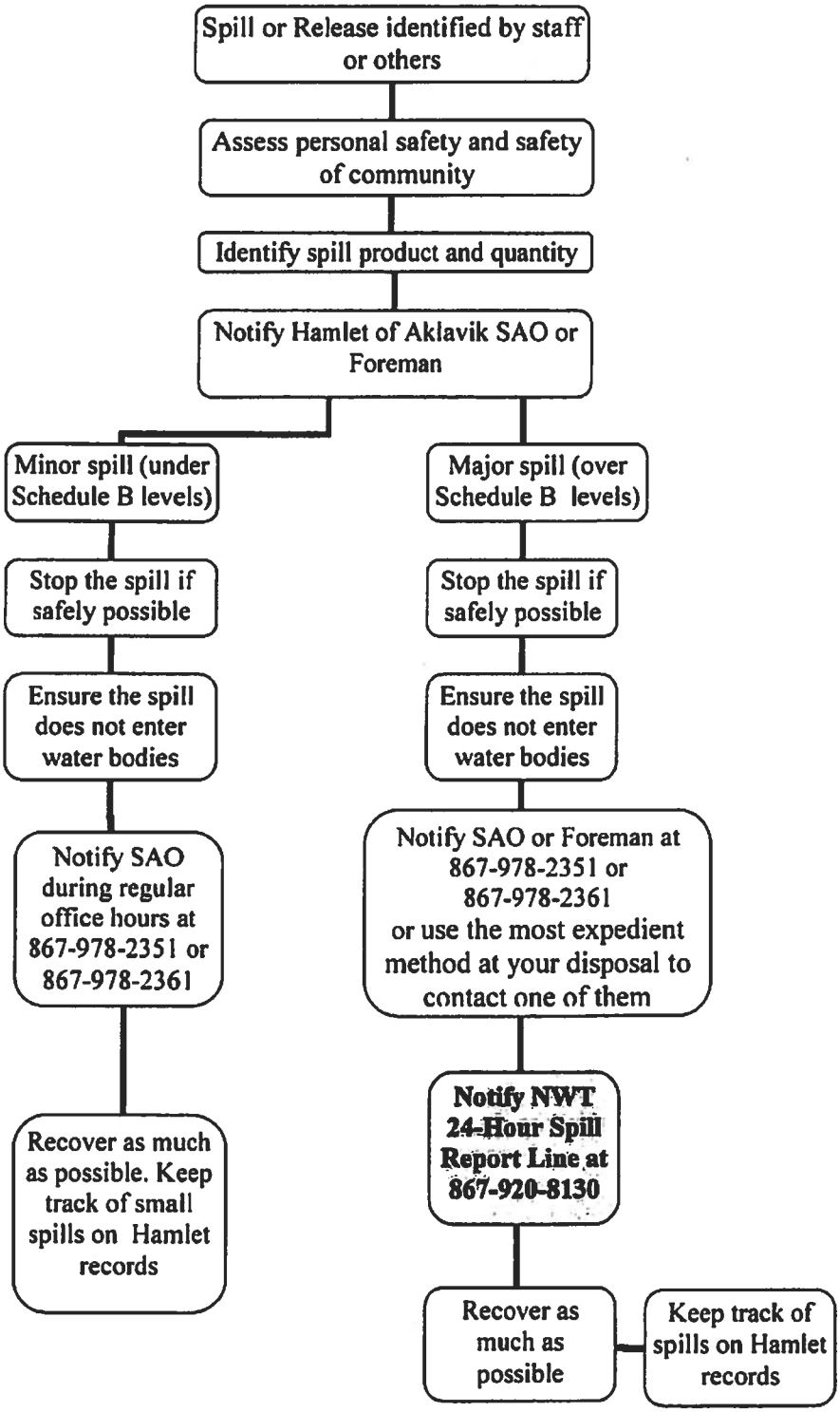
The flow chart depicted in Figure 2.1 identifies the response organization and when applicable their alternates, as well as the chain of command for responding to a spill or release. The duties of various response personnel are summarized, contact information is provided including 24-Hour phone numbers for responsible people and the location of communications equipment on site is discussed.

An immediately reportable spill is defined as a release of a substance that is likely to be an imminent human health or environmental hazard or meets or exceeds the volumes outlined in appendix B. It must be reported to the NWT 24-Hour Spill Report Line at 867-920-8130. Any spills less than these quantities do not need to be reported immediately to the spill reporting line. Rather, these minor spills will be tracked and documented by the Hamlet and submitted to the appropriate authority upon request or at a pre-determined reporting interval. If there is any doubt that the quantity spilled exceeds reportable levels, the spill will be reported to the NWT 24-Hour Spill Report Line.

In the event of a spill involving danger to human life the closest phones or CB radios will be used to contact emergency response personnel in the Hamlet of Aklavik.

The person that discovers the spill will inform the SAO or Hamlet Forman and, they will report the spill to the NWT 24-Hour Spill Report Line as necessary. The Hamlet Forman will also inform the Hamlet office of minor spills that are under the thresholds identified on Schedule B for tracking on the Hamlet records. If spills occur outside regular office hours, the Hamlet Forman should be contacted using the most expedient method available to contact him.

Figure 2.1: Flow Chart of response



3. Action Plan

3.1. Potential spill sizes and sources

In this section the potential spill event and spill volume are presented for the primary hazardous materials stored in the Hamlet of Aklavik facilities. The most likely spill discharge volume is indicated and the spill clean up procedures will focus on spills of this quantity. A worst case scenario is also presented.

3.1.1. Sewage spills from trucks

Sewage holding tanks could fail from hairline cracks, corrosion and collision or from wear and tear due to the environment. Routine inspections consist of looking for sewage coming out of the tanks from crack or failure of the tank wall. Owners should visually inspect their tanks several times a year. Failure of a Sewage Truck or any equipment used while pumping sewage into the truck from a tank or out of the truck to the sewage disposal facility can also be prevented by routine inspections by the owner of all equipment and connections. The Hamlet is responsible of cleaning in the event of a spill. The Hamlet of Aklavik has X sewage truck of VOLUME liters, which mean that in the event of a spill, the spill is likely to be under MAX VOLUME of TRUCK CAPACITY L.

3.1.2. Sewage spills from Sewage Disposal Facilities

The truck turn-around pad and sewage discharge chute associated with sewage disposal facility structures, and drainage courses are inspected on an annual basis by the Hamlet Foreman. In addition, during the summer months the integrity of the structures is visually checked by the Hamlet staff. In the event of a spill, the spill is likely to be under the capacity of the sewage treatment facility which is ENTER THE CAPACITY OF THE SEWAGE.

3.1.3. Spills from fuel storage

Many buildings within the Hamlet have fuel storage for home and building heating. There could be minor leaking or large puncture from drum or tank in/outside fuel storage areas. Piping failure is also a source of spills from fuel storage tanks. In the event of a spill at a privately owned structure, owners are responsible for the cleaning of the spill, unless the spill threatens a special area like the school. Should this happen, the Hamlet's response will be to protect that special area. The discharge of the spill is likely to be under X L/tank and in the worst case scenario the spill will be from the full fuel storage tank.

3.1.4. Fuel spill from motorized equipment

Fuel spills can occur when overfilling motorized equipment, spills can also come from drum or hose while filling the motorized equipment, from drum in/outside the storage area. Fuel spills from accidents involving personal vehicles and fuel carriers will be addressed as they pertain to special areas. Clean up will be the responsibility of the individuals or organizations involved. Regular maintenance and oil checks of all motorized equipment are also undertaken to avoid preventable leaks. The discharge of the spill is likely to be less than X Liters.

3.1.5. Propane spill

Propane is extremely volatile and is the most flammable material stored on site, thus the Fire Department should be the first responder in all cases. All non-responders must be kept well away from the area.

Propane spill can occur when the cylinder has a leak in or outside fuel storages area, when propane lines not properly connected to equipment (i.e. kitchen stove, dryer). The complete volume of the cylinder will be released if a leak develops; therefore safety during emergency response to a propane spill is of the utmost concern.

3.1.6. Waste Oil or Lubricating Oil spill

Waste Oils or lubricating oil spill could come from a variety of sources including new supplies but mainly from waste oils stored in drums that are leaking. The discharge of the spill is likely to be under XL/drum. In the worst case scenario the complete cotenant of the drum will spill.

3.2. Procedures for Initial Action

1. Be alert and consider your personal safety first;
2. Assess the hazard to persons in the vicinity of the spill and where possible take action to control danger to human life (ensure safety of everyone);
3. Assess the situation and make arrangements for first aid and removal of injured personnel. Take the necessary action where possible to secure the site to protect human safety;
4. Assess spill hazards and risks;
5. Identify the material or products involved in the spill;
6. If applicable and only if it is safe to do so, remove or shut off all ignition sources;
7. If safe try to take the appropriate action to stop the spill (e.g. shut off pump, replace cap, tip drum upward, patch leaking hole, create a ditch to stop flow etc). Use the contents of the nearest spill kit to aid in stopping the spill if it is safe to do so;
8. Take all necessary action to contain or prevent the spread of the spilled (e.g. use contents of spill kits to place sorbent material on the spill, or use shovel to dig dike to contain spill. Methods will vary depending on the nature of the spill);
9. Gather information on the status of the situation;
10. No matter what the volume is, contact the Hamlet Foreman and SAO to report the spill;

11. As soon as possible and if required, contact the NWT 24 Hour Spill Report Line at 1-867-920-8130;
12. If required, complete a spill report form (attached in appendix A).

3.3. Procedures for Containing and Cleaning up the Spill

First, initiate spill containment by first determining what will be affected by the spill. Second, assess speed and direction of spill and cause of movement (water, wind and slope). Third, determine best location for containing spill, avoiding any water bodies. Have a contingency plan ready in case spill worsens beyond control or if the weather or topography impedes containment.

3.3.1. Sewage infrastructure

1. Any person who sees a liquid flowing or seeping from a sewage holding tank, a sewage truck or a connection from the truck to a hose or the lagoon should report this to the Hamlet Foreman, the homeowners and the trucking company.

2. The Hamlet Foreman should, upon notification, determine the extent and size of the spill. Therefore, the Hamlet Foreman is responsible to take the appropriate action and use the reporting procedures to notify the proper authorities. Since spills of sewage involve an infectious substance that may cause health problems, the local nursing station and Environmental Health Officer should be notified of the spill.

3. If the area in which the spill occurred is accessible to the public or domestic pets, the contaminated area must be clearly marked or cordoned off to restrict access. Keep children and interested bystanders away from cleanup activities.

4. If the spilled material can't be recovered using hand tools, a commercial vacuum / pump truck should be called to remove all visible liquid and solid material. Any spill resulting from the failure of a sewage truck or its connections would necessitate the procurement of vacuum trucks to contain the sewage while any soil or ground material contaminated by the spill is recovered and properly disposed of according to an Environmental Health Officer.

5. Protective clothing (at a minimum, rubber or latex gloves and rubber boots) should be worn when cleaning up a sewage spill. (Dispose of gloves and wash rubber boots when leaving spill site).

6. When the area is visibly clean, lime will be spread on the ground where the spill took place under the instructions of an Environmental Health Officer. Lime can be obtained from a variety of hardware stores. Please note that hydrated lime is a caustic material and can be dangerous to handle and apply. Lime should only be used or applied by people experienced in using this material.

7. If no lime is available, a chlorine/water solution (bleach) should be applied to the spill area to disinfect. To make a 5% chlorine solution, add 3/4 cup (180 ml) Clorox bleach to one (1) gallon of water. Only use bleach that has "sanitizes" or "kills germs" on the label. Do not mix cleaning/disinfecting products or

chemicals. Cleaning products can react with one another to produce toxic vapor or liquid substances.

8. Notify the Hamlet of Aklavik when the clean up is done.

9. When the spill area has been cleaned (24 hours after the chlorine solution or hydrate lime has been spread), the barriers can be removed and access to the area restored.

10. Any repairs or replacement of the failed tank should take place under acceptable engineering standards.

3.3.2. Lagoon dam structure

The lagoon is designated as an exfiltration lagoon. Liquid flows continuously through and under the lagoon berm and is directed toward further treatment in the wetlands.

1. Any person who sees a liquid flowing from a breach (a hole) in the lagoon dam structures should report this to the Hamlet Foreman.

2. The Hamlet Foreman should, upon notification, determine the extent and size of the problem. Therefore, the Hamlet Foreman is responsible to take the appropriate action and use the reporting procedures to notify the proper authorities.

3. Any spill resulting from the failure of a lagoon dam structure would likely necessitate the construction of a berm to contain the sewage while either temporary or permanent repairs are carried out on the failed structure. A qualified Engineer and contractor would be engaged to undertake the work.

4. Rebuilding the dam or establishing a cofferdam with course materials, clay and sandy materials would contain the spill. Any sewage should be contained with berms or impoundment basins and pumped back into the lagoon. Any repairs to the failed structure would take place to acceptable engineering standards.

3.3.3. Containment of Spill on open water

Spills on water such as rivers, streams or lakes are the most serious types of spills as they can negatively impact water quality and aquatic life. All measures need to be undertaken to contain spills on open water.

For spills in open water, containment procedures will vary depending on whether the material floats or sinks, and whether the water is flowing or standing.

1. In the event of a spill, any person who found it should report this to the Hamlet Foreman.

2. The Hamlet Foreman should, upon notification, determine the source, the extent and size of the spill. Therefore, the Hamlet Foreman is responsible to take the

appropriate action and use the reporting procedures to notify the proper authorities.

3. If the area in which the spill occurred is accessible to the public or domestic pets, the contaminated area must be clearly marked or cordoned off to restrict access. Keep children and interested bystanders away from cleanup activities.

4. Protective clothing (at a minimum, rubber or latex gloves and rubber boots) should be worn when cleaning up a spill. (Dispose of gloves and wash rubber boots when leaving spill site).

5. Assess speed and direction of spill.

6. Determine best location for containing spill.

7. For floating materials, a surface boom shall be deployed. Booms are commonly used to recover fuel floating on the surface of a lake or slow moving streams. They are released from the shore of a water body to create a circle around the spill. If the pill is away from the shoreline a boat will need to be used to reach the spill and the boom can be set out. More then one boom may be used at once. Booms may also be used in streams and should be set out at an angle to the current. Booms are designed to float and some have sorbent materials built into them to absorb fuels at the edge of the boom. Fuel contained within the circle of the boom will need to be recovered using sorbent materials or pumps and placed into barrels for disposal. If a boom can't be installed, weirs may be constructed, especially in shallow areas.

8. Weirs can be used to contain spills in streams and to prevent further migration downstream. Plywood or other materials found on site can be placed into and across the width of the stream, such that water can still flow under the weir. Spilled fuel will float on the water surface and be contained at the foot of the weir. It can then be removed using sorbents, booms or pumps and placed into barrels.

9. The On-Scene Coordinator will have to judge whether the impact of the spill will be most reduced by carrying out a containment procedure or by immediately attempting to remove any containers from the water. This will depend on the equipment available and how long it will take for additional equipment to arrive. Removed containers should be placed on an impermeable contained surface (example poly liner in a depression) or an overpack drum to prevent further seepage.

3.3.4. Containment of Spills on Ice

Spills on ice are generally the easiest spills to contain due to the predominantly impermeable nature of the ice.

For spills on Ice, containment procedures will vary depending on whether the material stays on the ice or sinks into it.

1. In the event of a spill, any person who found it should report this to the Hamlet Foreman. The Hamlet Foreman should, upon notification, determine the source, the extent and size of the spill. The Hamlet Foreman is responsible to take the appropriate action and alert the necessary people.

2. Use the reporting procedures to notify the proper authorities.

3. If the area in which the spill occurred is accessible to the public or domestic pets, the contaminated area must be clearly marked or cordoned off to restrict access. Keep children and interested bystanders away from cleanup activities.

4. Protective clothing (at a minimum, rubber or latex gloves and rubber boots) should be worn when cleaning up a spill. (Dispose of gloves and wash rubber boots when leaving spill site).

5. Assess speed and direction of spill.

6. Determine best location for containing spill.

7. Spills on ice can be affected by the strength of the ice and the floating or sinking characteristics of the materials. The safe bearing capacity of ice has to be carefully assessed. For good ice the following thickness table can be used to estimate the load capacity:

Thickness		**Load**	
Mm	Inches	Kg	Tons
80	3	181	.2
150	6	907	1.0
230	9	5443	6.0
500	20	9071	10
760	30	18143	20
1010	40	36287	40

8. If the spill does not penetrate the ice, and the ice is safe to work on, sorbent materials are used to soak up spilled fuel. Remaining contaminated ice/slush can be scraped and shoveled into a barrel. However, all possible attempts should be made to prevent spills from entering ice covered waters as no easy method exists for containment and recovery of spills if they seep under ice.

9. If the spill penetrates the ice, dykes can be used to contain fuel spills on ice. By collecting surrounding snow, compacting it, mounding it and watering it down to form a dyke down slope of the spill, a barrier is created thus helping to contain the spill. The collected fuel can then be pumped into barrels or collected with sorbent materials.

10. For significant spills on ice, trenches can be cut into the ice surrounding and/or down slope of the spill such that fuel is allowed to pool in the trench. It can then

be removed via pump into barrels, collected with sorbent materials, or mixed with snow and shoveled into barrels.

3.3.5. Containment of Spills on Snow

Snow is a natural sorbent, thus as with spills on soil, spilled can be more easily recovered. Therefore, snow should be used as much as possible when it is available.

1. In the event of a spill, any person who found it should report this to the Hamlet Foreman. The Hamlet Foreman should, upon notification, determine the source, the extent and size of the spill. The Hamlet Foreman is responsible to take the appropriate action and alert the necessary people.

2. Use the reporting procedures to notify the proper authorities.

3. If the area in which the spill occurred is accessible to the public or domestic pets, the contaminated area must be clearly marked or cordoned off to restrict access. Keep children and interested bystanders away from cleanup activities.

4. Protective clothing (at a minimum, rubber or latex gloves and rubber boots) should be worn when cleaning up a spill. (Dispose of gloves and wash rubber boots when leaving spill site).

5. Assess speed and direction of spill.

6. Determine best location for containing spill.

7. Small spills on snow can be easily cleaned up by raking and shoveling the contaminated snow into empty barrels, and storing these at an approved location.

8. Dykes can also be used to contain fuel spills on snow. By compacting snow down slope from the spill, mounding it to form a dyke and watering it down, a barrier is created thus helping to contain the spill. The collected fuel/snow mixture can then be shoveled into barrels, or collected with sorbent materials.

3.3.6. Containment of Spills on Land

Spills on land include spills on rock, gravel, soil and/or vegetation. It is important to note that soil is a natural sorbent, thus spills on soil are generally less serious then spills on water as contaminated soil can be more easily recovered. Generally spills on land occur during the late spring, summer or fall when snow cover is at a minimum. It is important that all measures be undertaken to avoid spills reaching open water bodies.

1. In the event of a spill, any person who found it should report this to the Hamlet Foreman. The Hamlet Foreman should, upon notification, determine the source, the extent and size of the spill. The Hamlet Foreman is responsible to take the appropriate action and alert the necessary people.

2. Use the reporting procedures to notify the proper authorities.

3. If the area in which the spill occurred is accessible to the public or domestic pets, the contaminated area must be clearly marked or cordoned off to restrict access. Keep children and interested bystanders away from cleanup activities.

4. Protective clothing (at a minimum, rubber or latex gloves and rubber boots) should be worn when cleaning up a spill. (Dispose of gloves and wash rubber boots when leaving spill site).

5. Assess speed and direction of spill.

6. Determine best location for containing spill.

7. In all cases of liquid spills, the initial containment step is to prevent further dispersion. This is done with cut-off ditches and dyking with soil as needed around the spill utilizing mobile heavy equipment. If necessary, absorbents (example Zorbal, Hazorb Pillows, peat moss, sawdust) or gelling agents (example - Chemgel) should be spread to prevent further spread or seepage.

8. Dykes can be created using soil surrounding a spill on land. These dykes are constructed around the perimeter or down slope of the spilled fuel. A dyke needs to be built up to a size that will ensure containment of the maximum quantity of fuel that may reach it. Fuel that pool up can be removed with sorbent materials or by pump into barrels. If the spill is migrating very slowly a dyke may not be necessary and sorbents can be used to soak up fuels before they migrate away from the source of the spill.

9. If you can't build a dyke, trenches can be dug out to contain spills as long as the top layer of soil is thawed. Shovels pick axes or a loader can be used depending on the size of trench required. It is recommended that the trench be dug to the bedrock or permafrost, which will then provide containment layer for the spilled fuel. Fuel can then be recovered using a pump or sorbent materials. Once the soil has been removed it should be replaces with clean soil to avoid slumping.

3.3.7. Fire or Explosion

1. In all cases the first step is to clear people from the surrounding area. Particular care must be taken to prevent inhalation of vapors that are products of combustion.

2. When fire is associated with a spill of hazardous material, the local fire department must be the first responder to fire and explosion occurrence in all cases.

3. The fire department will take all the necessary measures to extinguish the fire.

4. If necessary, the fire department will construct dykes down slope from liquid spills, to minimize spreading of fire and contain unburned fluid. Foam, CO2 or water will then be used as appropriate for the fire.

3.4. Procedures for Transferring, Storing, and Managing Spill-Related Wastes

Loose material should be scooped up (using equipment appropriate to the spill size) and transferred into containers. Any soil beneath the spill, which may have been contaminated, should also be removed where possible, and disposed of with the recovered material.

In most cases, spill cleanups are initiated at the far end of the spill and contained moving toward the source of the spill. Sorbent socks and pads are generally used for small spill clean up. A pump with attached fuel transfer hose can suction spills from leaking containers or large accumulations on land or ice, and direct these larger quantities into empty drums. Hand tools such as cans, shovels, and rakes are also very effective for small spills or hard to reach areas. Heavy equipment can be used if deemed necessary, and given space and time constraints.

Used sorbent materials are to be placed in barrels for future disposal. All materials mentioned in this section are available in the spill kits located at the Hamlet office and Hamlet Forman truck. Following clean up, any tools or equipment used will be properly washed and decontaminated, or replaced if this is not possible.

For most of the containment procedures outlined in Section 3.3, spilled petroleum products and materials used for containment will need to be placed into containers such as empty waste oil/fuel containers and sealed for proper disposal. Does the Hamlet disposed of contaminated soil, snow or any hazardous material in a specific area of the solid waste facility. After the clean up of a sewage spill, is the contaminant disposed at the sewage waste facility.

3.5. Procedures for Restoring Affected Areas, Providing Inspectors with Status Updates and Cleanup Completion

Once a spill of reportable size has been contained, the Hamlet of Aklavik will consult with the regulatory authorities to determine the level of cleanup required. The Regulator may require a site specific study to ensure appropriate clean up levels are met. Criteria that may be considered include natural biodegradation of oil, replacement of soil and revegetation. Also, the soil will be remediated to meet Government of Northwest Territories (GNWT) soil criteria and water will be addressed so that it meets the Canadian Council of Ministers of the Environment (CCME) requirements for the protection of aquatic life.

4. Resource Inventory

4.1. On-Site Resources

Spill kits are indicated in figure 1.6. The contents are described below. In addition, earth moving and other equipment located in the Hamlet of Aklavik is also listed below.

4.1.1. Contents of Spill Kits

4.1.2. Earth moving and other equipment

4.1.3. Tool kit

4.2. Off-Site Resources

Environment Canada	Emergencies Duty Office	1-866-845-6047*
Environment Canada	Northern Division	1-867-920-8130*
Fisheries and Oceans Canada (Inuvik)	Manager	1-867-777-7520
GNWT Environment and Natural Resources		1-867-678-6650
GNWT territorial emergency Management	Measures Office	867-873-7554*
Hamlet of Aklavik	SAO	867-978-2351 or 867-978-2361
Hamlet of Aklavik	Foreman	867-xxx-xxxx
Hamlet of Aklavik Health Center		867-978-2516 or 867- 978-2160
Indian and Northern Affairs Canada	Inspector	1-867-777-8900
Inuvialuit Land Administration	Main Office	1-867-977-7100
NWT 24-Hour Spill Line**		1-867-920-8130*
NWT Emergency Services Division-MACA	Manager	1-867-873-7554*
RCMP		867-978-1111
Environmental Health Officer		1-867-777-7250 or 1-867-7220
Tele-Care Health Line		1-888-255-1010
Volunteer Fire Hall		867-978-2222

*24 Hour phone line

** Can be call collect

5. Training Program

Training will comprise of the following:

6. References

Water Resources Division Indian and Northern Affairs Canada. (2007). Guideline for Spill Contingency Planning.

Green Engineering Ltd. (2010). Background Report for the Hamlet of Aklavik.

Google Earth, 2010

Schedule A: NT-NU Spill Report Form

Northwest Territories · Nunavut · Canada

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		
C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)		
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN		
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS		
F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION		
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION		
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES	
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT	
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS			

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC | SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN | FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

PAGE 1 OF _____

Instructions for Completing the NT-NU Spill Report Form

This form can be filled out electronically and e-mailed as an attachment to spills@gov.nt.ca. Until further notice, please verify receipt of e-mail transmissions with a follow-up telephone call to the spill line. Forms can also be printed and faxed to the spill line at 867-873-6924. Spills can still be phoned in by calling collect at 867-920-8130.

A. Report Date/Time	The actual date and time that the spill was reported to the spill line. If the spill is phoned in, the Spill Line will fill this out. **Please do not fill in the Report Number:** the spill line will assign a number after the spill is reported.
B. Occurrence Date/Time	Indicate, to the best of your knowledge, the exact date and time that the spill occurred. Not to be confused with the report date and time (see above).
C. Land Use Permit Number /Water Licence Number	This only needs to be filled in if the activity has been licenced by the Nunavut Water Board and/or if a Land Use Permit has been issued. Applies primarily to mines and mineral exploration sites.
D. Geographic Place Name	In most cases, this will be the name of the city or town in which the spill occurred. For remote locations - outside of human habitations - identify the most prominent geographic feature, such as a lake or mountain and/or the distance and direction from the nearest population center. **You must include the geographic coordinates** (Refer to Section E).
E. Geographic Coordinates	This only needs to be filled out if the spill occurred outside of an established community such as a mine site. Please note that the location should be stated in degrees, minutes and seconds of Latitude and Longitude.
F. Responsible Party Or Vessel Name	This is the person who was in management/control/ownership of the substance at the time that it was spilled. In the case of a spill from a ship/vessel, include the name of the ship/vessel. Please include full address, telephone number and e-mail. Use box K if there is insufficient space. **Please note that, the owner of the spilled substance is ultimately responsible for any spills of that substance, regardless of who may have actually caused the spill.**
G. Contractor Involved?	Were there any other parties/contractors involved? An example would be a construction company who is undertaking work on behalf of the owner of the spilled substance and who may have contributed to, or directly caused the spill and/or is responding to the spill.
H. Product Spilled	Identify the product spilled; most commonly, it is gasoline, diesel fuel or sewage. For other substances, avoid trade names. Wherever possible, use the chemical name of the substance and further, identify the product using the four digit UN number (eg: UN1203 for gasoline; UN1202 for diesel fuel; UN1863 for Jet A & B)
I. Spill Source	Identify the source of the spill: truck, ship, home heating fuel tank and, if known, the cause (eg: fuel tank overfill, leaking tank; ship ran aground; traffic accident, vandalism, storm, etc.). Provide an estimate of the extent of the contaminated/impacted area (eg: 10 m^2)
J. Factors Affecting Spill	Any factors which might make it difficult to clean up the spill: rough terrain, bad weather, remote location, lack of equipment. Do you require advice and/or assistance with the cleanup operation? Identify any hazards to persons, property or environment: for example, a gasoline spill beside a daycare centre would pose a safety hazard to children. Use box K if there is insufficient space.
K. Additional Information	Provide any additional, pertinent details about the spill, such as any peculiar/unique hazards associated with the spilled material. State what action is being taken towards cleaning up the spill; disposal of spilled material; notification of affected parties. If necessary, append additional sheets to the spill report. Number the pages in the same format found in the lower right hand corner of the spill form: eg. "Page 1 of 2", "Page 2 of 2" etc. **Please number the pages to ensure that recipients can be certain that they received all pertinent documents.** If only the spill report form was filled out, number the form as "Page 1 of 1".
L. Reported to Spill Line by	Include your full name, employer, contact number and the location from which you are reporting the spill. Use box K if there is insufficient space.
M. Alternate Contact	Identify any alternate contacts. This information assists regulatory agencies to obtain additional information if they cannot reach the individual who reported the spill.
N. Report Line Use Only	**Leave Blank. This box is for the Spill Line's use only.**

Schedule B: Immediately Reportable Spill Quantities

TDG Class	Substance for NWT 24 Hour Spill Line	Immediately Reportable Quantities
1 2.3 2.4 6.2 7 None	Explosives Compressed gas (toxic) Compressed gas (corrosive) Infectious substances Radioactive Unknown substance	Any amount
2.1 2.2	Compressed gas (flammable) Compressed gas (non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100 L
3.1 3.2 3.3	Flammable liquids	> 100 L
4.1 4.2 4.3	Flammable solids Spontaneously combustible solids Water reactant	> 25 kg
5.1 9.1	Oxidizing substances Miscellaneous products or substances excluding PCB mixtures	> 50 L or 50 kg
5.2 9.2	Organic peroxides Environmentally hazardous	> 1 L or 1 kg
6.1 8 9.3	Poisonous substances Corrosive substances Dangerous wastes	> 5 L or 5 kg
9.1	PCB mixtures of 5 or more ppm	> 0.5 L or 0.5 kg
None	Other contaminants (e.g. crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, waste water, etc.)	> 100 L or 100 kg
None	Sour natural gas (i.e. contains H2S) Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more

In addition, all releases of harmful substances, regardless of quantity, are to be reported to the NWT spill line if the release is near or into a water body, is near or into a designated sensitive environment or sensitive wildlife habitat, poses imminent threat to human health or safety, poses imminent threat to a listed species at risk or its critical habitat, or is uncontrollable.

Appendix B

Spill Contingency Plan Update

Spill Contingency Plan

Hamlet of Aklavik

Section 1.3

Updated Distribution List:

Dept. of MACA – Dana Morn – 867-777-7120
Inuvialuit Water Board- Mardy Semmler – 867-678-2942
Hamlet of Aklavik – Dean Arey – 867-978-2351
Dept. of Lands - Dan Carmichael – 867-777-8901
Dept. of Lands _ Donald Arey – 867-777-8906
Gwich'in Land and Water Board - Elizabeth Wright - 867-777-4954

Section 1.5 Environmental Policy – see next page

The Hamlet of Aklavik

Environment Policy

Policy:

1. The Hamlet shall maintain and manage its Disposal Site in accordance with the Operation and Maintenance Plan of the Hamlet of Aklavik.

2. The Hamlet will provide collection of regular household and light commercial waste from all Hamlet residents and businesses within the boundaries of the Hamlet.

3. Recycling initiatives will be encouraged and a program will be implemented being modified as more and more products are being accepted by the GNWT Dept. of EN&R's recycling program.

4. A household Hazardous Special Waste collection program will be organized annually for use by our residents.

5. The Hamlet shall endeavour to educate all residents, visitors and property owners to the different programs and services offered within the Hamlet geared to waste collection, disposal and diversion.

6. The Hamlet shall attempt to participate in all funding programs offered through the Government of the NWT and various other sources for projects improving effectiveness and efficiency and increasing waste diversion.

7. The Hamlet will attempt to ensure all hazardous material is contained and safe from accidental spillage and educate the residents as to what must be done in the event of a hazardous material spill within the community boundaries.

8. To protect the environment and residents from harmful material that may be within the Municipal Boundaries

Section 1.8

There is 1 hazardous materials storage areas in the Hamlet of Aklavik, Table 1.2 presents a list of hazardous materials on-site, the type of storage container, the average and maximum quantities stored and their storage location.

Table 1.2: List of hazardous materials stored on-site, type of storage container, the normal and maximum storage quantities, and storage locations.

Material	Storage Container	Average On-site	Maximum on-site	Storage Location and uses
Waste oil	Plastic reinforced tote	25 lt	100 lt	Stored at solid waste site no uses currently waste

Section 1.9 **Preventative Measures**

Planning for an emergency situation is imperative. Due to the nature of the materials stored in the Hamlet of Aklavik facilities, adequate training of staff is critical. The storage areas for hazardous materials are to be lined with impermeable liners and bermed with 110% containment. Planking can be used to protect the liner from the fuel drums and cylinders.

The spill kit is located in the 4 bay garage located in the centre of the community, the contents of the spill kit is part of section 4 "resource Inventory" for details on spill kit contents. The Hamlet of Aklavik Foreman conducts monthly visual inspections to check for leaks or damage to the storage containers, as well as for stained and discolored solid around the storage area and any dead equipment or vehicles also located at the solid waste site.

1.10 **Maps**

1.10.1 Building, Roads, Airstrips and water Bodies

1.10.2 **Storage Locations of each Hazards Material and Spill Kit**

Google earth

miles 1
km 2

Action Plan

3.1 Potential spill sizes and sources

In this section the potential spill event and spill volume are presented for the primary hazardous materials stored in the Hamlet of Aklavik facilities. The most likely spill discharge volume is indicated and the spill cleanup procedures will focus on spills of this quantity. A worst case scenario is also presented.

3.1.1 Sewage Spills from Trucks

Sewage holding tanks could fail from hairline cracks, corrosion and collision or from wear and tear due to the environment. Routine inspections consist of looking for sewage coming out of the tanks from crack or failure of the tank wall. Owners should visually inspect their tanks several times a year. Failure of a Sewage Truck or any equipment used while pumping sewage into the truck from a tank or out of the truck to the sewage disposal facility can also be prevented by routine inspections by the owner of all equipment and connections. The Hamlet is responsible of cleaning in the event of a spill. The Hamlet of Aklavik does not own any sewage trucks ourselves as services are contracted to K&D Contracting who has 2 sewage trucks, one has the capacity of 10,000 lts. With the other holding 12,000 lts., which means that in the event of a spill, the spill is likely to be under 12,000 lts. The maximum Truck Capacity.

3.1.2 Sewage spills from the Sewage Disposal Facility

The truck turn-around pad and sewage discharge chute associated with sewage disposal facility structures, and drainage courses are inspected on an annual basis by the Hamlet Forman. In addition, during the summer months the integrity of the structures is visually checked by the Hamlet staff. In the event of a spill, the spill is likely to be under the capacity of the sewage treatment facility which is 435,000 m3.

3.1.3 Spills from Fuel Storage

Many buildings within the Hamlet have fuel storage for home and building heating. There could be minor leaking or large punctures from drum or tank in/outside fuel storage areas. Piping failure is also a source of spills from fuel storage tanks. In the event of a spill at a privately owned structure, owners are responsible for the cleaning of the spill, unless the spill threatens a special area like the school. Should this happen, the Hamlet's response will be to protect the special area. The discharge of the spill is likely to be under 10 lts/tank and in the worst case scenario the spill will be from the full fuel storage tank.

3.1.4 Fuel spill from motorized equipment

Fuel spills can occur when overfilling motorized equipment, spills can also come from drum or hose while filling the motorized equipment, from drum in/outside the storage area. Fuel spills from accidents involving personal vehicles and fuel carriers will be addressed as they pertain to special areas. Clean up will be the responsibility of the individuals or organizations involved. Regular maintenance and oil checks of all motorized equipment are also undertaken to avoid preventable leaks. The discharge of the spill is likely to be less than 10 liters.

3.1.5 Propane spill

Propane is extremely volatile and is the most flammable material stored on site, thus the Fire Department should be the first responder in all cases. All non-responders must be kept well away from the area.

Propane spill can occur when the cylinder has a leak in or outside fuel storages area, when propane lines not properly connected to equipment (i.e. Kitchen stove, dryer). The complete volume of the cylinder will be released if a leak develops; therefore safety during emergency response to a propane spill is of the utmost concern.

3.1.6 Waste Oil or Lubricating Oil Spill

Waste Oils or Lubricating oil spill could come from a variety of sources including new supplies but mainly from waste oils stored in drums that are leaking. The discharge of the spill is likely to be under 10 l/drum. In the worst case scenario the complete content of the drum will spill.

4. Resource Inventory

4.1 On-Site Resources

Spill kits are indicated in figure 1.6. The contents are described below. In addition, earth moving and other equipment located in the Hamlet of Aklavik is also listed below.

4.1.1 Contents of Spill Kits

Description for 55 Gallon Drum Spill Kit - Oil Only

The Oil Only 55 Gallon Drum can be easily opened and closed for a fast response to a medium sized spill of oil based materials. Drum meets UN specifications.
Contents:

- (50) - 15" x 19" Pads
- (4) - 3" x 12' SOCs
- (8) - 17" x 19" Pillows
- (1) - Pair Nitrile Gloves
- (5) - Disposal Bags
- Goggles
- Emergency Response Handbook

4.2 Off-Site Resources

Hamlet of Aklavik	SAO	867-978-2351
Hamlet of Aklavik	Foreman	867-978-2351
Aklavik Health Center	NIC	867-978-2516/2361
Inuvialuit Land Admin.	Main Office	867-977-7100
NWT 24 hour Spill Line		867-920-8130
NWT Emergency Services -	Manager	767-9161 ext. 21023
RCMP - Aklavik		867-978-1111
Environmental Health Office		867-777-7250/7220
Tele-Care Health Line		867-767-9054
Volunteer Fire Dept. Aklavik		867-978-2222
Dept. of Lands	Dan Carmichael	867-777-8901
Dept. of Lands	Don Arey	867-777-8906
Environment and Natural	Ian McLeod	867-978-2248
Resources Aklavik		

4.1.2 **Earth Moving and other Equipment**

Hamlet owned equipment includes: Kamatso Loader, Champion Grader.

Equipment owned by K&D Contracting: D6 dozer, D8 Dozer, 2 Cat Loaders, 3 Track Back hoes of various sizes, 2 tandem axle dump trucks.

4.1.3 **Tool Kit**

Hamlet owned hand tools include; 4 shovels, 6 racks, 1 wheel barrel, 4 ea PPE for staff, 4 ea protective Tyvek coveralls, 4 ea hard hats, Safety Glasses, work gloves, ear plugs, 2 first aid kits. Also have fully

5. Training Program

Training will be comprised of the following:

Foreman and Heavy Equipment operator currently have first aid, WHIMIS, and Dangerous Goods Handling and Transportation. Also through our fire department we are currently in a membership drive to get more volunteers to join, once we have enough members we will bring in a trainer to train new members on Fire truck operations, handling of dangerous goods, first responder training. We will continue to provide any and all staff or volunteers with training to ensure all are current and up to date on all required safety and hazardous material handling as well as first aid, CPR and other important training components that are required but not mentioned here.

Much the same as the Hamlet did during the Mock airport disaster training exercise held in April 2014. We will notify all relevant regulators of any and all mock spill exercises we will hold and a record of all staff training and when the training takes place will be documented and installed in each staff member's personal file. Along with any certificates the staff may earn from the exercises or any other training we have staff participate in.

Appendix C

Solid Waste Facility Siting Study

Detailed Site Analyses & Schematic Design

Municipal Solid Waste Facility Siting Study

Final

November 9, 2016

Prepared for:
Hamlet of Aklavik
Attn. Mr. Fred Behrens, SAO
PO Box 88
Aklavik, NT
X0E 0A0

Prepared by:
KAVIK-STANTEC Inc.
Inuvik, NT

Project Number: 144902298

KAVIK-STANTEC


KAVIK-STANTEC

Table of Contents

1	**INTRODUCTION**	**1**
1.1	BACKGROUND	1
1.2	PLANNING ANALYSIS SCOPE	1
1.3	COMMUNITY INFORMATION	2
1.4	GEOTECHNICAL INFORMATION	3
2	**SCOPING STUDY**	**5**
2.1	SELECTION CRITERIA FOR SCOPING STUDY	5
2.2	INITIAL ANALYSIS OF SELECTED SITES FROM SCOPING STUDY	5
3	**WASTE GENERATION**	**6**
3.1	POPULATION PROJECTION	6
3.2	CAPACITY REQUIREMENTS	6
4	**SITE DEVELOPMENT AND AREA REQUIREMENTS**	**8**
4.1	SITE DEVELOPMENT	8
4.2	AREA REQUIREMENTS	8
4.3	EARTH MANAGEMENT	8
4.4	CLIMATE CHANGE	9
5	**ASSESSMENT OF SOLID WASTE SITES**	**10**
5.1	ASSESSMENT CRITERIA	10
5.2	SCREENING OF SITES	10
6	**ASSESSMENT OF WASTEWATER SITE ASSOCIATED WITH SOLID WASTE SITE**	**12**
6.1	ASSESSMENT CRITERIA	12
6.2	ASSESSMENT OF WASTEWATER SITES	12
6.3	WASTEWATER DISCHARGE PATHWAYS	13
7	**COST DEVELOPMENT FOR SOLID WASTE SITES**	**15**
7.1	BASIS OF OPINION OF PROBABLE COST (CAPITAL COST) FOR LANDFILL DEVELOPMENT	15
7.2	CAPITAL COSTS OF SOLID WASTE SITES (TABLE)	15
7.3	LIFE CYCLE COST EVALUATION	16
8	**DISCUSSION**	**17**
9	**CONCLUSIONS**	**18**
10	**RECOMMENDATIONS**	**19**
11	**CLOSURE**	**20**

List of Tables

Table 2-1 Scoping Study Site Descriptions 5
Table 3-1 Population Projections and Capacity Requirements 6
Table 5-1 Assessment of Solid Waste Sites 11
Table 6-1 Assessment of Adjacent Water Bodies 12
Table 7-1 Cost Estimates for Landfill Site Development Options 16
Table 10-1 Recommended Sites 19

Appendices

APPENDIX A Figures
APPENDIX B Cost Summary
APPENDIX C Population Project and Waste Generation
APPENDIX D Life Cycle Evaluation Table
APPENDIX E Aklavik Solid Waste Management Review

1 INTRODUCTION

1.1 Background

The Hamlet of Aklavik is in need for a new landfill site, and has retained Kavik-Stantec to complete a Municipal Solid Waste Facility Siting Study to determine an optimum location for the new landfill and an associated site for a new sewage lagoon.

A report commissioned by the Hamlet of Aklavik in 2009 estimated that the existing site had a remaining service life of five years. The disposal facility has also been experiencing operational problems in the recent years, in particularly related to the river floods in the spring, and drainage issues. The 2009 report stated that "a new landfill outside of the floodplain in the area of the Richardson Mountains is the preferred option to be further evaluated by the community."

The Hamlet did not accept this recommendation, and identified their own future site within the delta, approximately 7 kilometers from the community along the winter road to gravel source 469. The identification of this alternate site prompted the Hamlet to advance a planning study to consider additional landfill sites within the delta area west of the community.

The objective of this report is to present preliminary assessments of 15 potential solids waste sites that were identified as part of a scoping study completed by Kavik-Stantec, and submitted with the proposal for this work. The basis for these assessments is a previously submitted technical memo that presented the available background information associated with the solids waste in Aklavik.

1.2 Planning Analysis Scope

Phase 1 – Background Technical Memorandum:

- Discuss and affirm project scope with Hamlet of Aklavik, in particular the scoping study and its area limitations, prepared by Kavik-Stantec as part of the proposal preparation and proposal submission;
- Based upon the area defined in the scoping study, review of all available information and documentation relating to the physical and environmental conditions of the area;
- Using population data and anticipated solids waste generation rates, determine the general area requirements for the new site of a 40-year planning horizon;
- Determine a general site development plan for a landfill scenario in Aklavik to ascertain the anticipated operating footprint for the 40-year planning horizon;
- Determine what available topographical maps, satellite imagery and aerial photographs may be applied to evaluate the terrain, accessibility, hydrology, geography, and geology for the 15 identified sites identified in the scoping study;

- Study available geotechnical information and geologic maps to determine anticipated soil types and soil profile characteristics; information obtained may provide an indication of the most likely subsoil and associated geotechnical conditions prevailing within the area; and
- Review of relevant adjacent granular management plans to gain a more detailed understanding of the nearby gravel sources readily available for this project.

Phase 2 – Solid Waste Facility Analysis:

- Review the potential commercial and industrial development and assess the impact on allowing this waste stream into the new landfill;
- Using available topographic maps, satellite imagery and aerial photographs, evaluate the terrain, accessibility, hydrology geography and geology for the 15 sites identified in the scoping study;
- Screen out those of the 15 sites that do not meet the area requirements or other environmental related requirements;
- Review the potential sites for inclusion of a future sewage lagoon;
- Prepare budgetary capital costs, and operation and maintenance estimates for the screen sites;
- Prepare draft report for review;
- Complete community visit and consultation; and
- Prepare final report.

1.3 Community Information

LOCATION

The Hamlet of Aklavik is located on the Peel Channel of the Mackenzie River Delta, 113 km south of the Arctic Coast, and 55 kilometres west of Inuvik. Its geographic coordinates are 68.219916 N latitude and -135.007788 W longitude. Aklavik has a population is 668 in 2015 (Northwest Territories Bureau of Statistics, 2016). The population is comprised primarily of persons in Inuvialuit and Gwich'in background, and the community falls into two different land claim settlement regions, the Inuvialuit Settlement Region (ISR) and the Gwich'in Settlement Region (GSR).

The community is accessible by air and barge during the summer months and by ice road directly from Inuvik in the winter.

TERRAIN, VEGETATION, AND GEOLOGY

Aklavik is within the Boreal forest zone, with vegetation that includes white spruce (upper delta) or balsam, poplar and black spruce (lower delta) grow on high ground, and low lying area may have willows, alders, marshy vegetation and muskeg.

Aklavik is approximately seven meters above sea level, and is subject to periodic flooding. The lands which comprise the municipality fall within a Flood Risk Area under the Canada-NWT Flood Damage Reduction and Flood Risk Mapping Agreement (May 2, 1979).

Aklavik is within the delta region and is characterized by alluvial deposits of fine sand and silt. The stratified layers extend to about 11 meters below the surface. Aklavik is situated in an area of discontinuous permafrost, with an active layer of 300 to 900 mm.

CLIMATE

The climate of Aklavik is characterized by cool summers, and long, cold winters. The daily average temperature of the warmest month in Aklavik is 13.9°C and the coldest month is -26.3°C. The annual precipitation as rainfall is 12.8 millimeters and 136.3 centimetres of snow.

1.4 Geotechnical Information

The Hamlet of Aklavik is in the Mackenzie Delta therefore it is situated on alluvial deposits of find sand and silt. The stratified layers extend to about 11 meters below the surface.

A geotechnical investigation for a proposed Water Treatment Plant upgrades in Aklavik was completed in 2009. A borehole was drilled to a depth of 9.1 m below the existing grade. The borehole log showed a soil stratigraphy of gravel and sand fill over organic sand over silt.

The fill was 0.6 m deep. The fill consisted of gravel graded up to 100 mm in size and course- and fine-grained sand with some fines. It was brown to dark brown in color and contained small ice crystals.

The organic sand below the fill contained various amount of organic materials, consisting of rootlets and tree branches, was frozen and very moist when thawed. The moisture content near the top layer was about 10 %, increasing with depth to about 36%. The organic sand was 1.4 m in thickness.

The silt below the organic sand went to the depth of the drill hole (9.1 m). This layer consisted of some clay with trace of fine grained sand and gravel. Silt is defined as fine sand, clay, or other material carried by running water and deposited as a sediment. It was medium brown in color and frozen. Ice crystals at about 5 to 20% were to a depth of 7m. The moisture content at 3 m was 40% and at 8.5 m was 20%.

The following is an excerpt from the National Research Council Canada Associate Committee on Soil and Snow Mechanism, Technical Memorandum No. 36, April 1955:

> "Frozen ground was encountered from 8 inches to 24 inches below the surface depending on the thickness of the moss cover. The soil to the 35-foot depth is predominantly a series of stratified silts, fine sands, and organic material. The complete absence of coarse-grained soils was striking for not even a pebble was encountered in any of the holes. The organic material ranged from black, hairline streaks to strata 2 feet thick. Plastic soils such as lean clays were scarce and when found were usually associated with organic deposits. Ice segregation in the Aklavik fine-grained soils consisted predominantly of horizontal ice lenses up to ¾ inch thick, although small and random vertical ice formations were observed. Moisture or more correctly "ice contents", in the

first 6 feet ranged from 45 per cent to 340 per cent but averaged 140 per cent. Below 6 feet they averaged about 55 per cent. Thus the volume of ice within the first 6 feet is 4 to 5 times the volume of soil. If the first 6 feet of soil were thawed and the water drained away, then ground settlements up to 4 feet or 5 feet could be expected. Results from these investigations may be considered as indicative of conditions existing in the delta as a whole."

2 SCOPING STUDY

Kavik-Stantec completed a scoping study as part of the proposal preparation. The results of this scoping study are presented in Figure 1, **Appendix A**.

2.1 Selection Criteria for Scoping Study

The scoping study used satellite imagery to identify the winter road access to the granular deposits to the west. A 2 kilometre corridor on each side of the winter access road was identified as a reasonable limit to potential sites. Satellite imagery as used to identify potential sites for further analysis each with a 200 meter separation from the center of site to the adjacent open water.

2.2 Initial Analysis of Selected Sites from Scoping Study

An initial analysis of the 15 sites identified from the scoping study (See **Table 2-1**) identifies initial site areas varying from 90,000 m² to over 200,000 m². The access to these sites would involve a combination of an all-weather access road along the existing winter road, and a site access road. The site access roads vary in length from less than 100 metres to 2,000 metres.

Table 2-1 Scoping Study Site Descriptions

Site Number	Site Area (m²)	Site Access Road (m)	All Weather Road km
1	187,000	1,200	16.6
2	156,000	1,400	15.6
3	160,000	100	14.9
4	162,000	10	14.6
5	199,000	730	14.2
6	124,000	1,100	12.9
7	142,000	80	13.0
8	193,000	1,100	12.8
9	162,000	730	12.4
10	137,000	1,200	7.5
11	94,000	10	6.6
12	212,000	2,000	6.6
13	160,000	1,900	5.9
14	116,000	710	3.3
15	118,000	700	2.7

3 WASTE GENERATION

3.1 Population Projection

The predicated population values were attained from the Bureau of Statistics and are illustrated in the **Table C-1, Appendix C.** The solid waste management system is to be designed of a 40-year planning horizon. Population projections were available up to 2031, and values were extrapolated form this data were used to estimate the population up to 2054.

The population of Aklavik has been increasing over the past year. Based on the recent number, the GNWT Bureau of Statistics has projected that the population will steadily increase.

3.2 Capacity Requirements

To estimate the solid waste generation, a generation rate of 0.014 m^3 / (p*d), at a 1% growth rate and a starting population of 668. The total amount of solid waste generation over a 40-year planning horizon was estimated to be 200,000 m^3. The compacted waste (3 to 1 compaction ratio) after a 40-year planning horizon would be 66,000 m^3. This value is used to determine the appropriate size needed for landfill in the Hamlet of Aklavik.

Table 3-1 Population Projections and Capacity Requirements

Year	Planning Year	Population	Annual Volume (m^3)	Total Volume (m^3)	Total Compacted Volume (m^3)
1	2015	668	3955	3955	1318
2	2016	660	4000	7954	2651
3	2017	662	4045	11999	4000
4	2018	663	4091	16090	5363
5	2019	664	4138	20228	6743
6	2020	666	4185	24413	8138
7	2021	667	4233	28646	9549
8	2022	668	4281	32927	10976
9	2023	670	4330	37257	12419
10	2024	671	4380	41637	13879
11	2025	672	4430	46068	15356
12	2026	673	4481	50549	16850
13	2027	675	4533	55081	18360
14	2028	676	4585	59666	19889
15	2029	677	4638	64304	21435
16	2030	679	4691	68995	22998
17	2031	680	4745	73740	24580
18	2032	681	4800	78541	26180
19	2033	682	4856	83396	27799

20	2034	684	4912	88309	29436
21	2035	685	4969	93278	31093
22	2036	686	5027	98305	32768
23	2037	687	5085	103390	34463
24	2038	689	5145	108535	36178
25	2039	690	5205	113739	37913
26	2040	691	5265	119005	39668
27	2041	693	5327	124332	41444
28	2042	694	5389	129721	43240
29	2043	695	5452	135173	45058
30	2044	696	5516	140690	46897
31	2045	698	5581	146271	48757
32	2046	699	5647	151918	50639
33	2047	700	5713	157631	52544
34	2048	702	5781	163412	54471
35	2049	703	5849	169260	56420
36	2050	704	5918	175178	58393
37	2051	705	5988	181166	60389
38	2052	707	6059	187225	62408
39	2053	708	6131	193356	64452
40	2054	709	6204	199560	66520

4 SITE DEVELOPMENT AND AREA REQUIREMENTS

4.1 Site Development

The general site development configuration for Aklavik is present in Figure 2, **Appendix A**. The general feature of the site development includes areas for bulky waste, hazardous or special waste, recycled waste (waste diversion), and landfilled waste. There was no evidence of significant use of honey bags at the Aklavik landfill. The site configuration includes fencing, and drainage management features, both on site drainage and off site drainage.

The operational site development for landfilled waste presented in Figure 3 and 4, **Appendix A** shows the development of waste cells with a cross section 10 to 15 meters wide, and berms on either side of the cell, with a berm height of 1 to 1.5 meters. The waste deposition in the working area of each cell is accomplished in an active are that is periodically consolidated and then compacted. The intermediate cover is added to the compacted area, and compacted.

Working areas and intermediate cover are used as an isolated provision to reduce the opportunity for contaminated on site drainage, and fire protection.

4.2 Area Requirements

Table C-1, **Appendix C** presents the populations estimate, and waste generation for a 40-year planning horizon. The anticipated waste generation is 200,000 m^3; the compacted waste (3 to 1 compaction ratio) volume would be 66,000 m^3. This value is used to determine the appropriate size needed for landfill in the Hamlet of Aklavik.

In applying the waste cell configuration for the 66,000 m^3 for 1.5 meter berm height, and developing a second phase of the landfill on top of the initial phase (3.0 meters in total) would produce a needed landfilling area of approximately 22,000 m^2 (area for household waste, etc.).

For the purpose of site screening, and to accommodate the area requirements for bulky waste, hazardous waste, and recycled waste, the needed landfilling area is being tripled for a **total area requirement of 66,000 m^2** (area for operator building, signage, storage, turnaround loop, etc.). The area tripled based on the assumption that the current operating area that has been developed with time by the Hamlet; it also adds an additional conservation factor in the site selection process.

4.3 Earth Management

The soil requirements for the site will include material for an access road, material for site movement area, material for berm construction, and material for intermediate cover, and ultimately final cover. Granular material is required for the site access road, and the site movement areas, but granular material is not necessarily needed for berm construction and cover materials. If granular is not used the Hamlet

has said that there is material available to use from a borrow site at the east end of the community. This site is replenished after each spring flood.

Berms may consist solely of high quality topsoils; as a cheaper alternative. Only the top foot needs to consist of high quality topsoil with -well-rained soil making up the remainder of the berm. Using gravel in the layers directly underneath the topsoil is not recommended because of the tendency of the soil to wash through the gravel. Clay usually makes up most the bottom layer because of its cohesive quality. It is possible to use a fill material such s rubble, asphalt, or gravel for the bulk of the berm if the material is capable of retaining stability without deteriorating or eroding and will compact well.

The earth management strategy will reduce the need for "higher quality" granular material and create an opportunity to use source 469, instead of source 467 (see Figure 1, **Appendix A**), which is approximately 5 kilometers closer to the community.

4.4 Climate Change

Climate change must be considered during the development of the new solid waste facility and lagoon. A report by the National Research Council (2011) confirms that the assumption of hydrological stationarity is no longer valid. It was found that anthropogenic land cover changes such as deforestation, wetland destruction, urban expansion, dams, irrigation projects, and other water diversions have a significant impact on the duration and intensity of floods and droughts. These land changes also have a large impact on downstream hydrology of all the world's river basins. The National Research Council (2011) concludes that the assumption of stationarity, in the design of water management systems, is no longer practical. This means that development within the Mackenzie River basin will have to be managed with a greater deal of uncertainty than in the past.

This same perspective applies to the Hamlet of Aklavik and its municipal infrastructure, including landfill and sewage treatment facilities located within the delta. There is a greater uncertainty in the river flooding with respect to frequency, duration, and extent of any flooding. Landfill facilities inherently apply berm structures as part of the facility development, therefore provisions for erosion protection may be a needed improvement in the construction. Since flooding is elevation dependent, building up the landfill area above the anticipated flood level may also be a mitigation opportunity.

5 ASSESSMENT OF SOLID WASTE SITES

5.1 Assessment Criteria

The 15 sites were evaluated with the available terrain, geologic and environmental information to develop a short list of sites for discussion with the community and for future detailed evaluation. The evaluation criteria for the 15 sites included: available areas, geological features based upon existing information, topography based upon existing topographic data, hydrology and hydrogeology base upon existing information, setbacks, and accessibility.

The selection of a landfill site may be incorporated with the selection of a sewage treatment and disposal site option in order to minimize the environmental impacts, capital costs, and operation and maintenance costs to some extent. The sites were assessed based on site area, active landfilled area, and proximity to the airport.

Of the 15 potential sites (**Table 2-1** and Figures 5 to 19, **Appendix A**) considered for landfill development based upon the scoping study, sites 5, 6, 11, 13, 14, and 15 will not be considered further because they do not meet the active landfill area requirements of 66,000 m^2. This was determined by measuring the usable site area then adding a 50 m buffer to provide a considerable distance from the adjacent water bodies. For planning purposes and simplicity of analysis these initial areas were measured using circles.

In addition, Site 15 will not be considered for further analysis given its proximity to the airport of less than 3 km. A separation of less than 3 kilometres from a waste management area and an airport is considered to present a bird hazard to aircraft from the potential movements of birds scavenging at the waste management area. Although the Canadian Manual of Airport Bird Hazard Control developed by Transport Canada recommends that activities such as landfills and lagoons pose a hazard to aircraft if located within 8 km, the NWT adopted a 3 km setback as part of an NWT specific study in 1990.

5.2 Screening of Sites

Table 5-1 shows the site area and the landfill development area for all 15 sites. The minimum area requirement for the active landfilled area is 66,000 m^2. Therefore, sites with less than 66,000 m^2 of active landfilled area (shown in **red**) were screened out from further consideration. The sites remaining from the screening are presented in Figure 20, **Appendix A**.

Table 5-1 Assessment of Solid Waste Sites

Site Number	Site Area (m^2)	Landfill Development Area (m^2)
1	187,269	118,618
2	126,959	71,341
3	159,763	96,531
4	161,959	98,685
5	97,039	49,477
6	108,315	58,376
7	141,608	82,885
8	145,631	86,684
9	161,952	97,928
10	137,323	79,370
11	94,343	47,244
12	211,590	138,616
13	104,544	55,799
14	115,707	63,366
15	117,588	65,079

6 ASSESSMENT OF WASTEWATER SITE ASSOCIATED WITH SOLID WASTE SITE

6.1 Assessment Criteria

The selection of the sewage site may be incorporated with the selection of the landfill site options in order to minimize the environmental impacts, capital cost, and operation and maintenance costs. An area of 285,000 m^2 was selected to be an appropriate threshold for an adjacent sewage lagoon to the solid waste management sites. The potential lagoon threshold area was based upon the area of the existing lagoon of 285,000 m^2, therefore any site with adjacent water bodies smaller than the existing lagoon size were should be eliminated from further consideration. An adjacent lagoon to the landfill sites was identified as part of the scoping study as a supplementary consideration for the evaluation of the sites.

6.2 Assessment of Wastewater Sites

An analysis of the adjacent ponds to the screened solid waste sites is presented in Figures 21 to 29, **Appendix A**. Site 4 (Figure 24, **Appendix A**) will not be considered further because the adjacent water bodies do not meet the minimum size requirements for the lagoon.

Site 1, 2, 3, 7, 8, 9, 10 and 12 are the remaining sites that require further investigation. The investigation should include the condition of the hydrography of the pond, the geometry of the pond, detailed topography of the area, the vegetation of any potential wetland, and the use of recreation and fishing.

Table 6-1 shows the remaining sites that were assessed for adjacent water bodies. Remaining sites were eliminated if the adjacent water bodies were smaller than 285,000 m^2, as show in **red**.

Table 6-1 Assessment of Adjacent Water Bodies

Site Number	Water Body	Perimeter (m)	Area (m^2)
1	1	5,962	778,207
2	1	6,827	517,292
3	1	1,976	182,318
	2	2,625	202,478
	3	1,305	110,242
	4	6,827	517,292
4	1	1,976	182,318
	2	2,625	202,478
7	1	5,491	435,938
	2	4,001	796,875
	3	2,084	158,455
8	1	5,491	435,938

	2	6,735	1,143,742
9	1	3,956	316,396
	2	4,001	796,875
10	1	1,073	44,237
	2	2,171	86,110
	3	3,264	234,807
	4	4,722	599,734
12	1	838	41,130
	2	5,706	570,904

6.3 Wastewater Discharge Pathways

The placement of a sewage lagoon in a delta is very difficult due to the large amount of water bodies in the surrounding area. During this elimination process, it was very important to map out the discharge pathways from each lagoon to eliminate an environmental and human health hazard. As seen in Figure 30, **Appendix A**, Sites 1, 2, 3, 7, 8, 9, and 10 have discharge paths that would flow in to the Peel Channel upstream of the Hamlet of Aklavik, and the discharge from these lagoon sites could potentially contaminate the community's drinking water source.

7 COST DEVELOPMENT FOR SOLID WASTE SITES

7.1 Basis of Opinion of Probable Cost (Capital Cost) for Landfill Development

The capital costs were developed from all the required components of an active landfill area. The components include:

- Primary Road Cost (all season access road)
- Secondary Road Cost (site access road from all season access road)
- Bulky, Recycled and Landfilled Waste Area
- Hazardous Waste Storage, Honeybag and Carcass, and Burn Pit Cells
- Site Operating Structures
- Blowing Debris Control
- On- and Off-Site Drainage Management
- Perimeter Fencing
- Double Swing Gate
- Site Signage
- Engineering and Contingency Allowance (40% of capital cost)

The cost estimates were developed from an estimation of unit values for each of the elements presented above based upon the general site configuration for a 40-year development area of 66,000 m^2. Unit costs to apply to each of the unit values are based upon solid waste, and transportation related work from Kavik-Stantec's in house data base for work in the Mackenzie Delta, and the Kitikmeot region of Nunavut. The costs used to develop the estimate were gleaned from the construction costs of a solid waste site development in Cambridge Bay, Nunavut that was completed in 2012. The 40% Engineering and Contingency Allowance is an overall contingency allowance for construction and engineering applied to the conceptual level of costing.

7.2 Capital Costs of Solid Waste Sites (Table)

The cost estimates for the landfill sites discussed in Section 2 are summarized in Table 7-1. The details of the cost estimate are present in **Appendix B**. Sites 10 and 12 have the lowest capital costs by margins of $7 million.

Table 7-1 Cost Estimates for Landfill Site Development Options

Site Number	Total Capital Cost	Annual O&M
1	$25,620,796	$512,416
2	$24,509,119	$490,182
3	$22,311,202	$446,224
7	$19,585,251	$391,705
8	$20,291,282	$405,826
9	$19,393,881	$387,878
10	$12,728,853	$254,577,
12	$12,339,433	$246,789

Note: The O&M costs per year are estimated based on 2% of capital cost.

The estimated costs DO NOT include:

- Costs associated with land acquisition
- Costs associated with restoration/post closure of existing waste facilities

7.3 Life Cycle Cost Evaluation

A Life Cycle Cost Evaluation has been created for the Aklavik Solid Waste Facility. The life cycle cost for sites 10 and 12 is the same with a value of $3.2 million (See details in Appendix D).

The following assumptions were made:

1. $3 per km for vehicle operation
2. Employee rate: $50/hour
3. Daily activities: Collect waste from Hamlet and transport it to the landfill ensure all waste stays in designated areas, clean up any spills immediately, clear snow from roads and disposal area and record O&M information as required.
4. Weekly activities: Pick-up windblown materials which has migrated past the disposal area and record O&M information as required.
5. Monthly activities: Grade and maintain access roads, cover waste with overburden, and record O&M information.
6. Yearly activities: Winter and access road maintenance, bi-annual water sampling and monitoring, and review of O&M records to assist with planning for upcoming year.
7. 260 days per year, 52 weeks, 12 months
8. Bi-annual water sampling and reports: 1 day and $1000 allowance each
9. A new truck in years 10, 20, 30 – value of $100,000
10. 0.05% Rate of Return for Present Value Factor (PVF)

8 DISCUSSION

In the planning analysis context, a number of issues need to be considered in conjunction with the discussion and ultimately the recommendation of potential waste management sites. For the development of the Hamlet of Aklavik integrated sewage and solids waste facilities, the following issues should be considered:

- Access to site
- Proximity issues (human activities, natural features, and local receptors)
- Site configuration
- Potential environmental or public health impacts
- Estimated capital cost to develop site; and
- Estimate operation and maintenance costs.

Other issues including surface materials, snow accumulation, local hydrology, and vegetation should also be considered although they are not taken into account at this stage due to the availability of limited information. Ultimately, the capital cost and Operation & Maintenance (O&M) Costs will lead to a preferred site.

The remaining sites include 1, 2, 3, 7, 8, 9, 10 and 12. These sites provide an adequate site area and active landfilled area; they also have one or more adjacent water body to be utilized for wastewater purposes. From the initial screening, the discharge paths into the Peel Channel are both upstream downstream of the Hamlet of Aklavik as shown in Figure 30. It is important that the discharge path is further investigated due to environment and public health hazards.

An overriding issue associated with the development of a new solid waste and sewage site for Aklavik is the site development in the delta area adjacent to the community in instead of a development outside the delta area, which was recommended in a previous planning study. A risk of flooding exists for any facility within the delta area; however the risk is diminished to some degree with a location that is not immediately adjacent to the Peel Channel.

A part of the subsequent phases of investigation, flood risk and flood proofing of any site must be considered in order to address anticipated regulatory concerns.

Redevelopment of the existing site is a reasonable consideration to obtain additional operating capacity for the facility. A solid waste management review is presented in Appendix E.

9 CONCLUSIONS

The waste generated over a 40-year planning horizon is 200,000 m^3 and with a 3 to 1 compaction ratio, this results in 66,000 m^3 of solid waste. The area requirement for the waste generation is 22,000 m^2 in ultimate development of a 3 metre high site. In order to make sure there is adequate space for cover material as part of proper waste disposal, the minimum area requirement was tripled, resulting in a minimum active landfill area of 66,000 m^2 for a 40 year operating horizon.

Limited information was available for a detailed consideration of the sites for topographic, hydrogeological, and biophysical characteristics as part of the planning analysis. The planning analysis was primarily base upon geographic characteristics of land areas, pond areas, and proximity to existing access.

Of the 15 original sites from the scoping study, 9 have sufficient area greater than 66,000 m^2, which includes a 50 m site buffer from the operating area to the adjacent pond areas. These sites are 1, 2, 3, 4, 7, 8, 9, 10, and 12, as shown in Figure 20.

In consideration of wastewater management areas adjacent to these 9 landfill sites, Site 4 was eliminated due to the small adjacent water body size. The sites that may accommodate both solid waste and wastewater are Sites 1, 2, 3, 7, 8, 9, 10 and 12.

The wastewater ponds for Site 1, 2, 3, 7, 8, 9, and 10 may discharge upstream of the community water supply, which poses a health hazard, therefore these sites may not be considered further for both solid waste and sewage.

The Opinion of the Probable Cost for the Capital Cost to develop these 8 sites range from $11.7 Million for Site 12, to $25.2 Million for Site 1. The operation and maintenance costs for the 8 sites range from $0.6 Million to $1.2 Million. The cost to each of the sites is the majority of the cost capital cost.

The least expensive sites to develop are Site 10 and 12 based upon Capital and O&M Costs. Site 12 may be developed for solid waste and sewage, and Site 10 may be development for solid waste only, due to the potential public health issue with a sewage discharge upstream of the community water supply. Development details for sites 10 and 12 are presented in Figures 32 and 33.

Redevelopment of the existing site is a reasonable consideration to obtain additional operating capacity for the facility, and achieve additional time for the planning, engineering, and construction of a new site.

10 RECOMMENDATIONS

Based upon the limited analysis, Sites 10 and 12 should be investigated further. Site 10 has the potential to be developed for solid waste only and Site 12 has the potential to be developed for solid water and sewage. These sites are recommended because they meet all of the selection criteria for site area, active landfilled area, adjacent water bodies and downstream discharge paths, and have the lowest capital and O&M costs.

Further site investigation complete on Sites 10 and 12 should include topographic, hydrogeological, geotechnical biophysical analyses, and flood risk analyses. The anticipated lagoon discharge channels for the sites should also be investigated in detail.

The Hamlet of Aklavik should engage a discussion with the regulators based upon the planning study results in order to develop the potential scope of the detailed investigations. The Hamlet should anticipate a strong reluctance for the regulators to consider waste management sites in the delta area in consideration of the issues that have occurred.

Cost sharing with an all-weather access to the granular sites should be considered and advanced by the Hamlet. This would be a great opportunity to share the enormous costs associated with the development of an all-weather access road.

Table 10-1 Recommended Sites

Site Number	Total Capital Cost	Annual O&M	Site Area (m^2)	Active Landfilled Area (m^2)	Water Body Area (m^2)
10	$12,728,853	$254,577	137,323	79,370	599,734
12	$12,339,433	$246,789	211,590	138,616	570,904

In consideration of the solid waste management review, Aklavik should advance improvements to the existing facility to increase the capacity and operating horizon.

11 CLOSURE

If you have any questions, please contact the undersigned.

Respectfully Submitted,

KAVIK-STANTEC INC.

Original signed by

Keri Johnson, M.A.Sc., RPP, P.Eng.
Senior Environmental Engineer
Tel: (780) 984-9085
Keneth.Johnson@Stantec.com

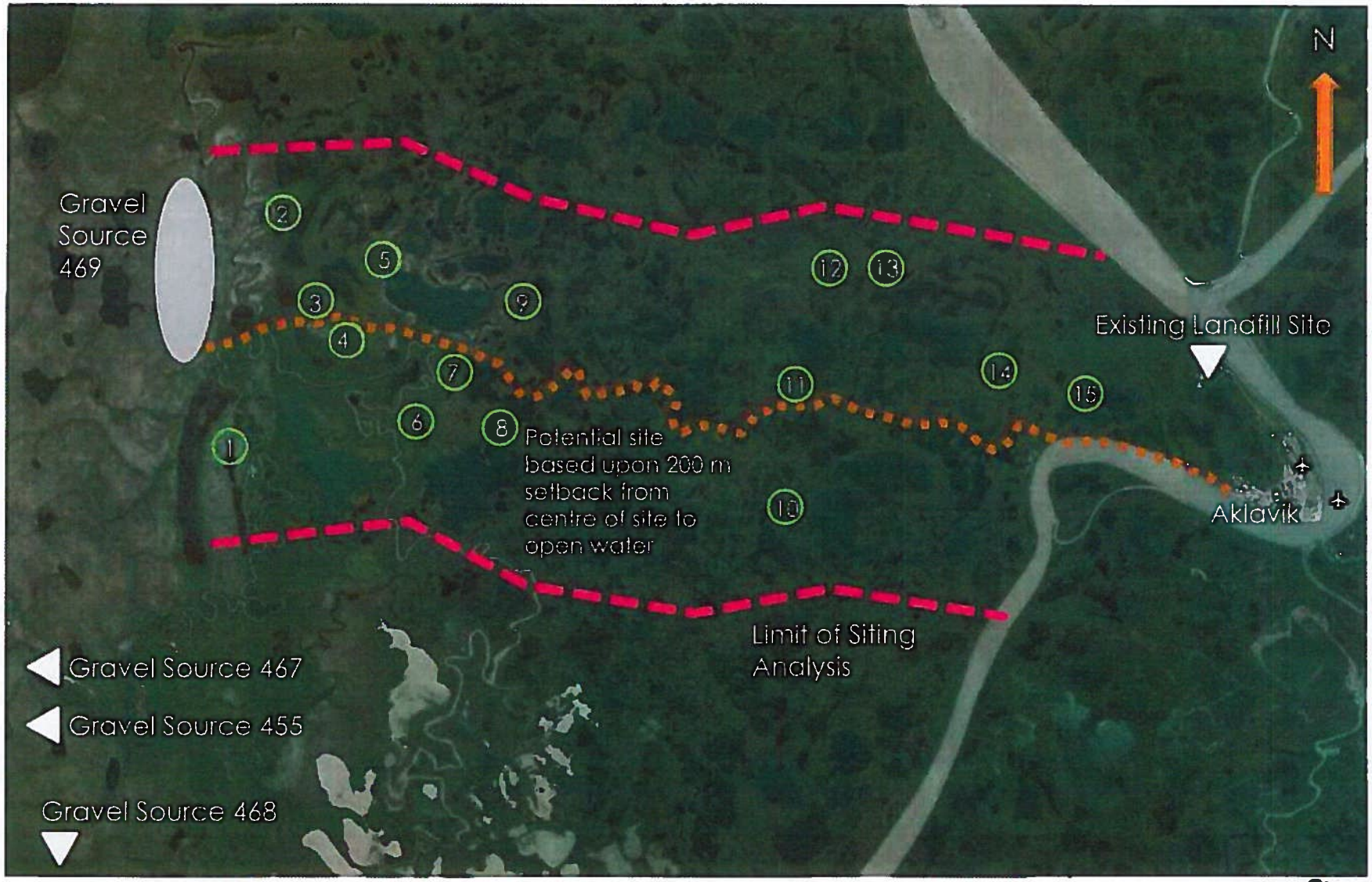
Original signed by

Jamie Davignon, B.A.Sc., EIT
Civil Designer
Tel: (867) 633-2400 ext. 123
Jamie.Davignon@Stantec.com

REGISTERED PROFESSIONAL ENGINEER
K.B. JOHNSON
NWT/NU

NOV 0 9 2016

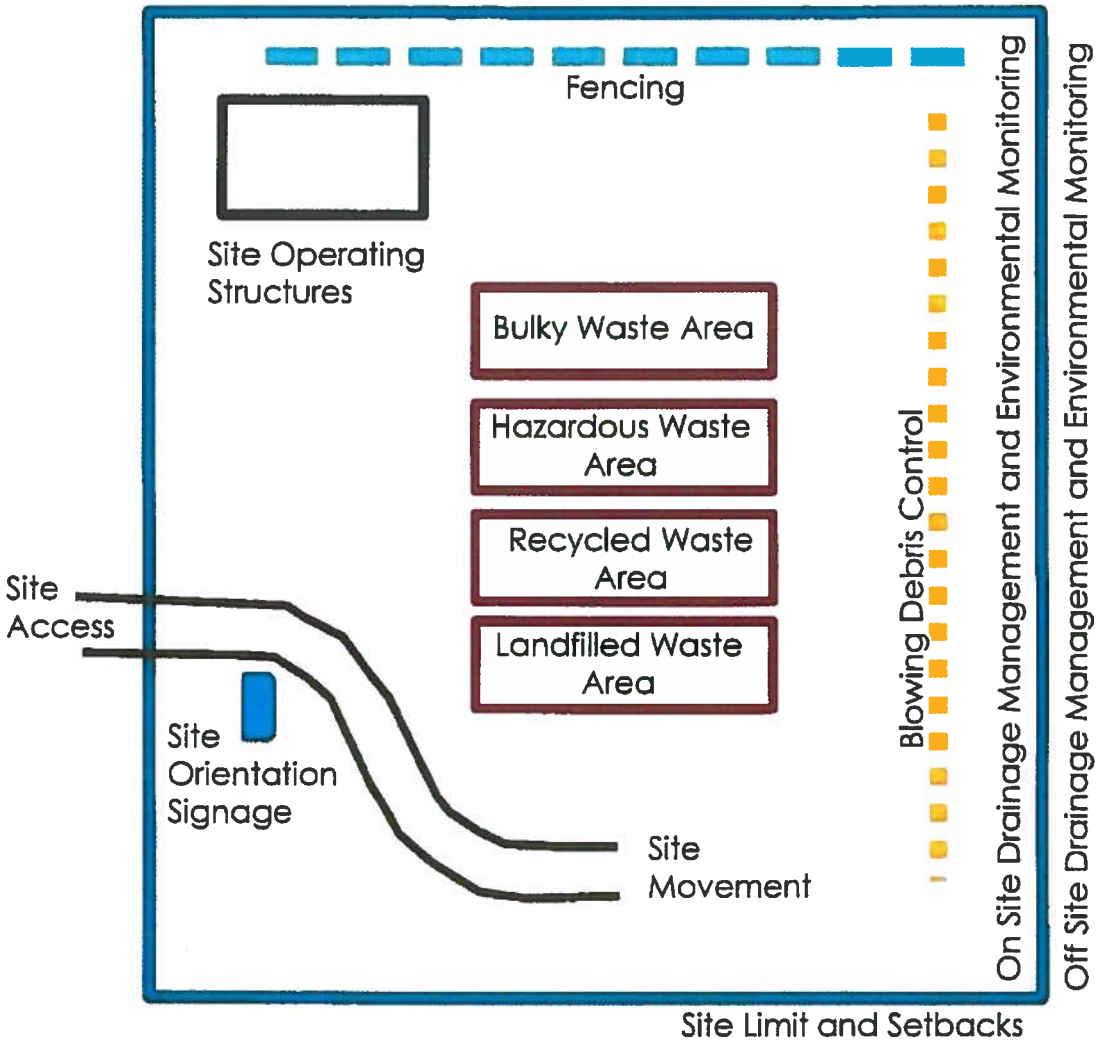
APPENDIX A Figures



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 1. Preliminary Site Identification
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

2 km
Scale

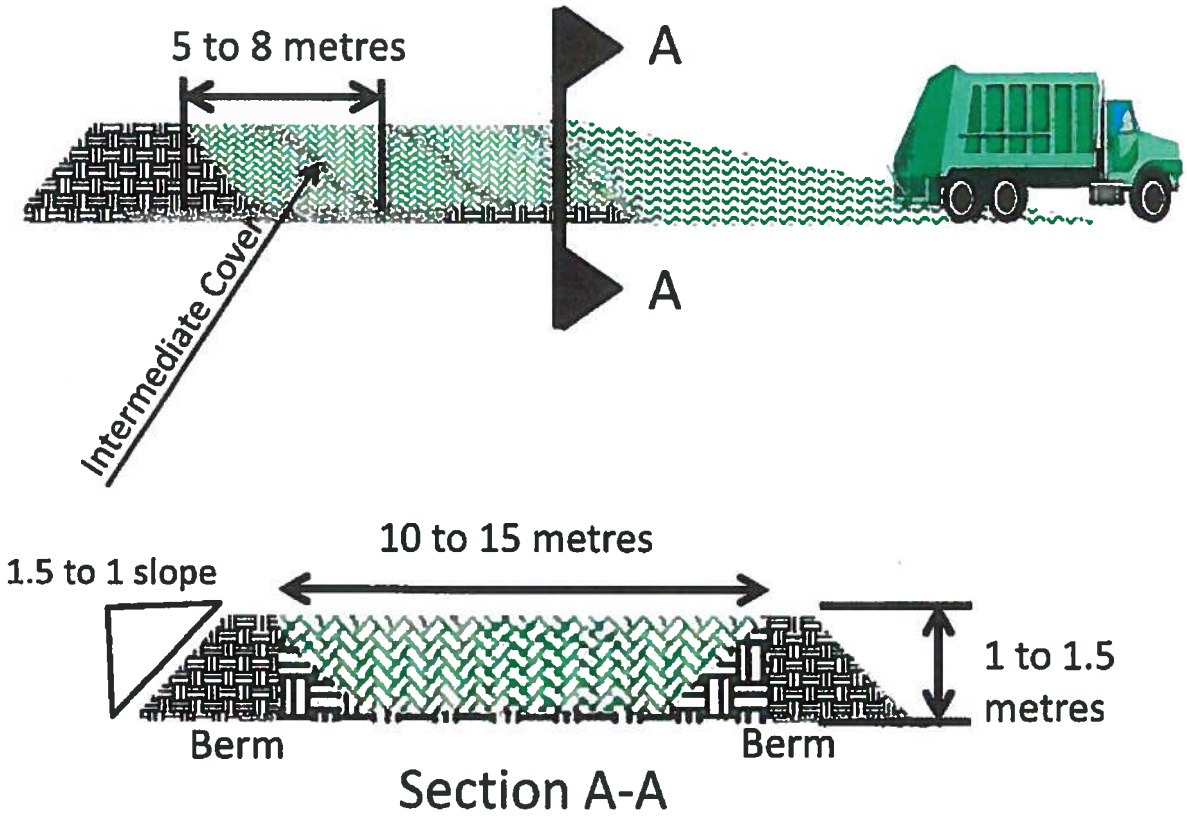
KAVIK-STANTEC



NOTES
- Hazardous waste includes paints, fuel, antifreeze, batteries, pesticides, fluorescent bulbs, propane cylinders, and household cleaners, and areas for bagged sewage and carcasses.
- Recycled or diverted waste includes tires, concrete, lumber, and may include a burn pit for clean combustible waste.

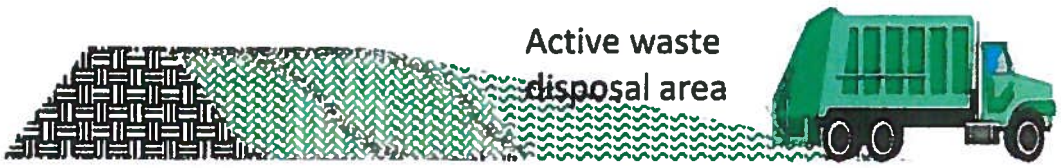
Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 2. GENERAL SITE CONFIGURATION
Prepared by Jamie Davignon, EIT. 2016 07 07

KAVIK-STANTEC



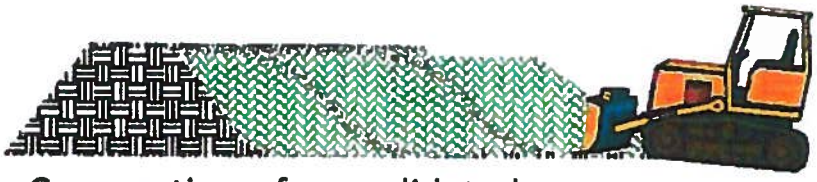
Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 3. WASTE CELL CONFIGURATION
Prepared by Ken Johnson, RPP, P.Eng. 2016 05 20

KAVIK-STANTEC



Working area in cell

Consolidation of waste in working area



Compaction of consolidated waste

Addition of intermediate cover

Compaction of intermediate cover

Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 4. WASTE CELL MANAGEMENT
Prepared by Ken Johnson, RPP, P.Eng. 2016 05 20

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 5. Site 1 – Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

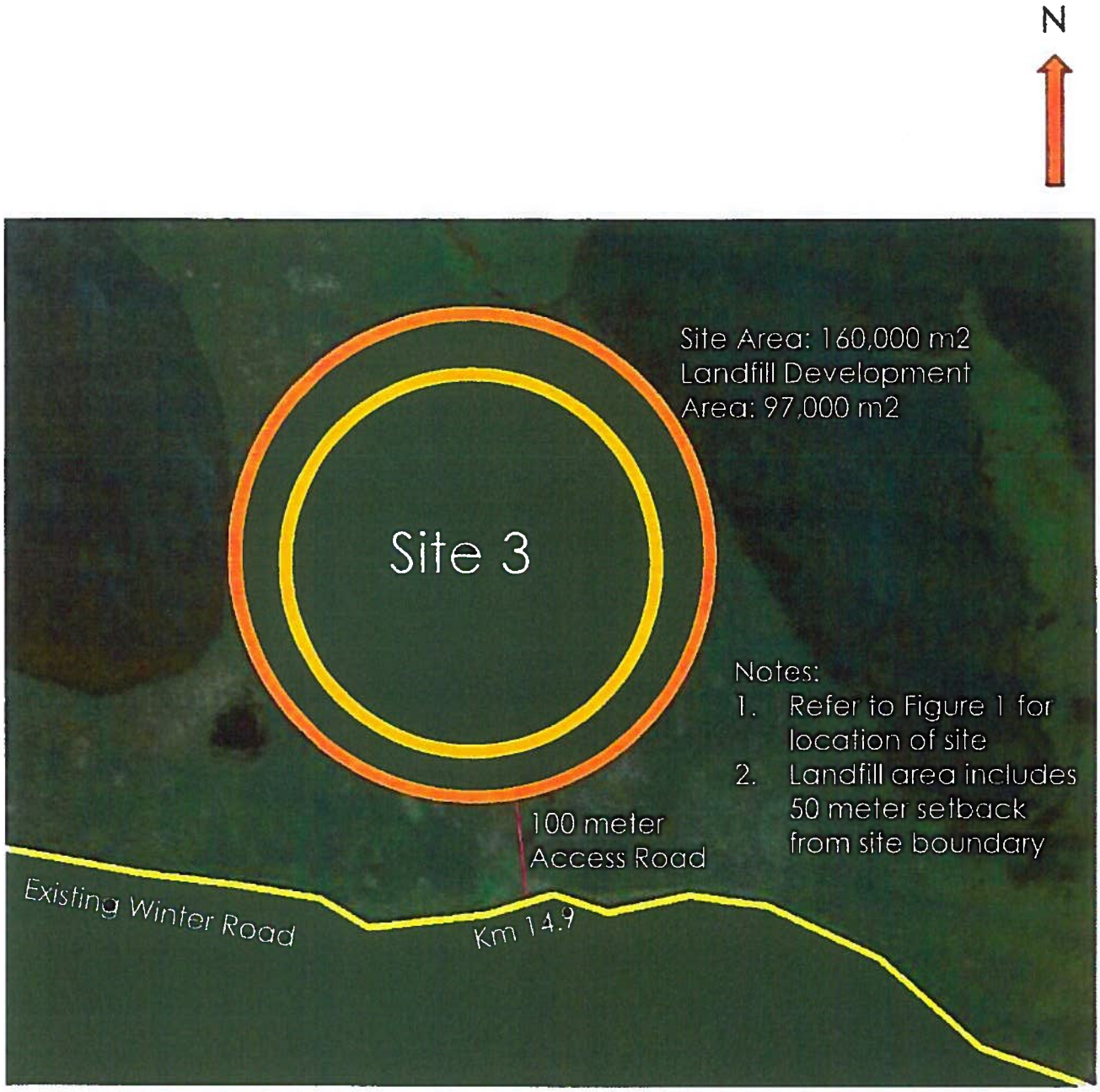
200 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 6. Site 2 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

200 m
Scale

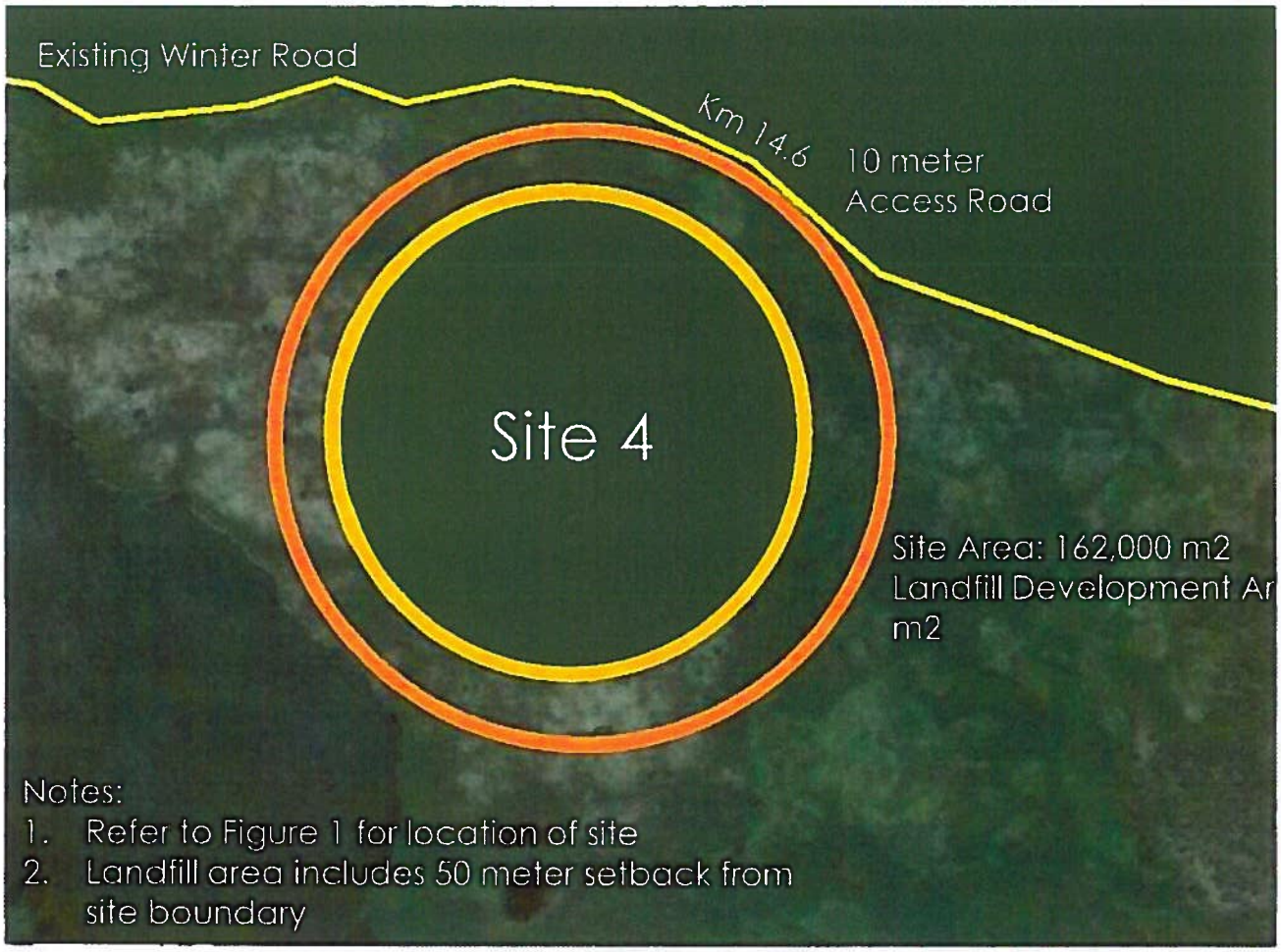
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 7. Site 3 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

100 m
Scale

KAVIK·STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 8. Site 4 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

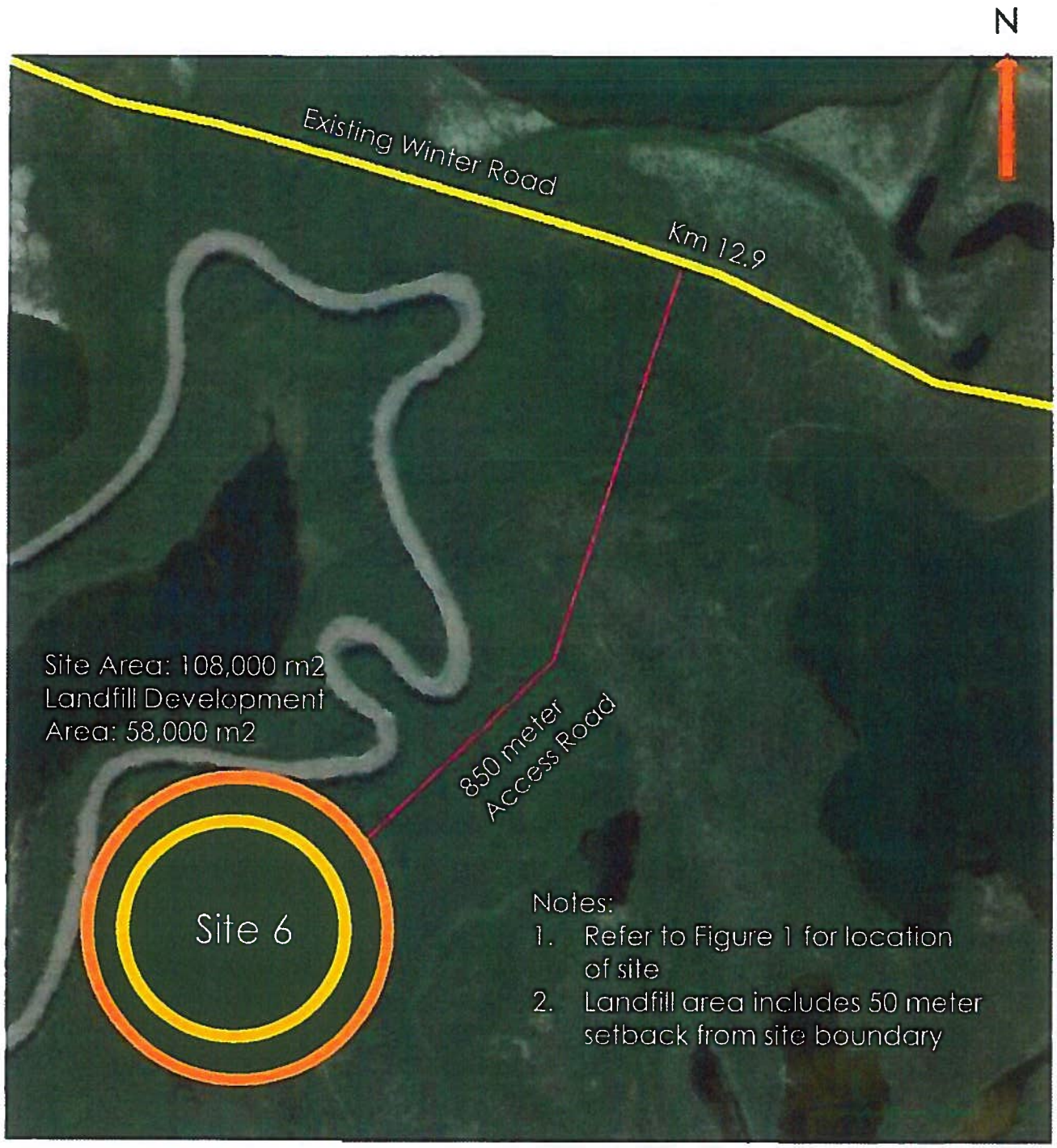
200 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 9. Site 5 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 10. Site 6 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 11. Site 7 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

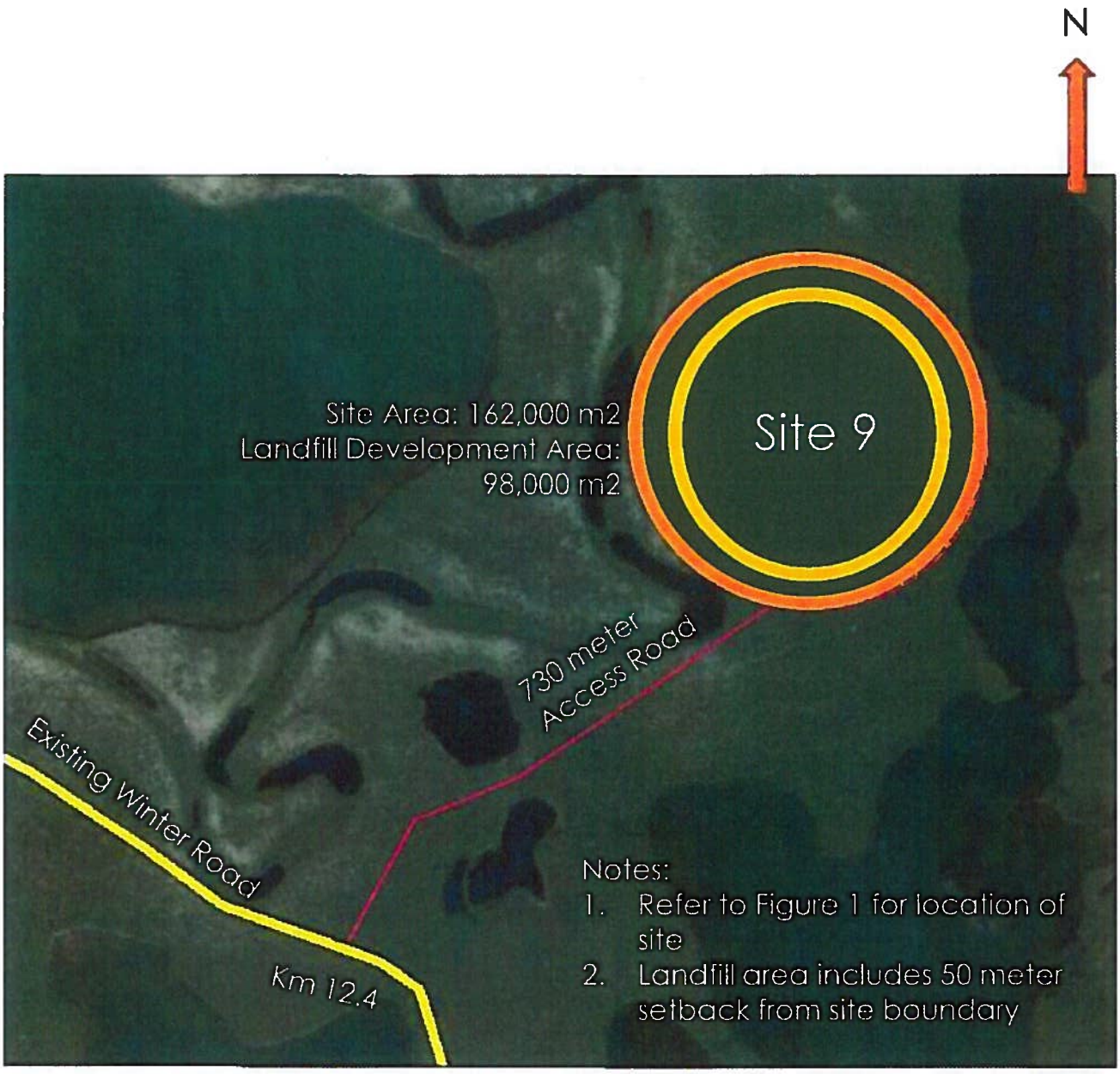
150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 12. Site 8 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 13. Site 9 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 14. Site 10 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 15. Site 11 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 16. Site 12 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

200 m
Scale

KAVIK-STANTEC

N

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 17. Site 13 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

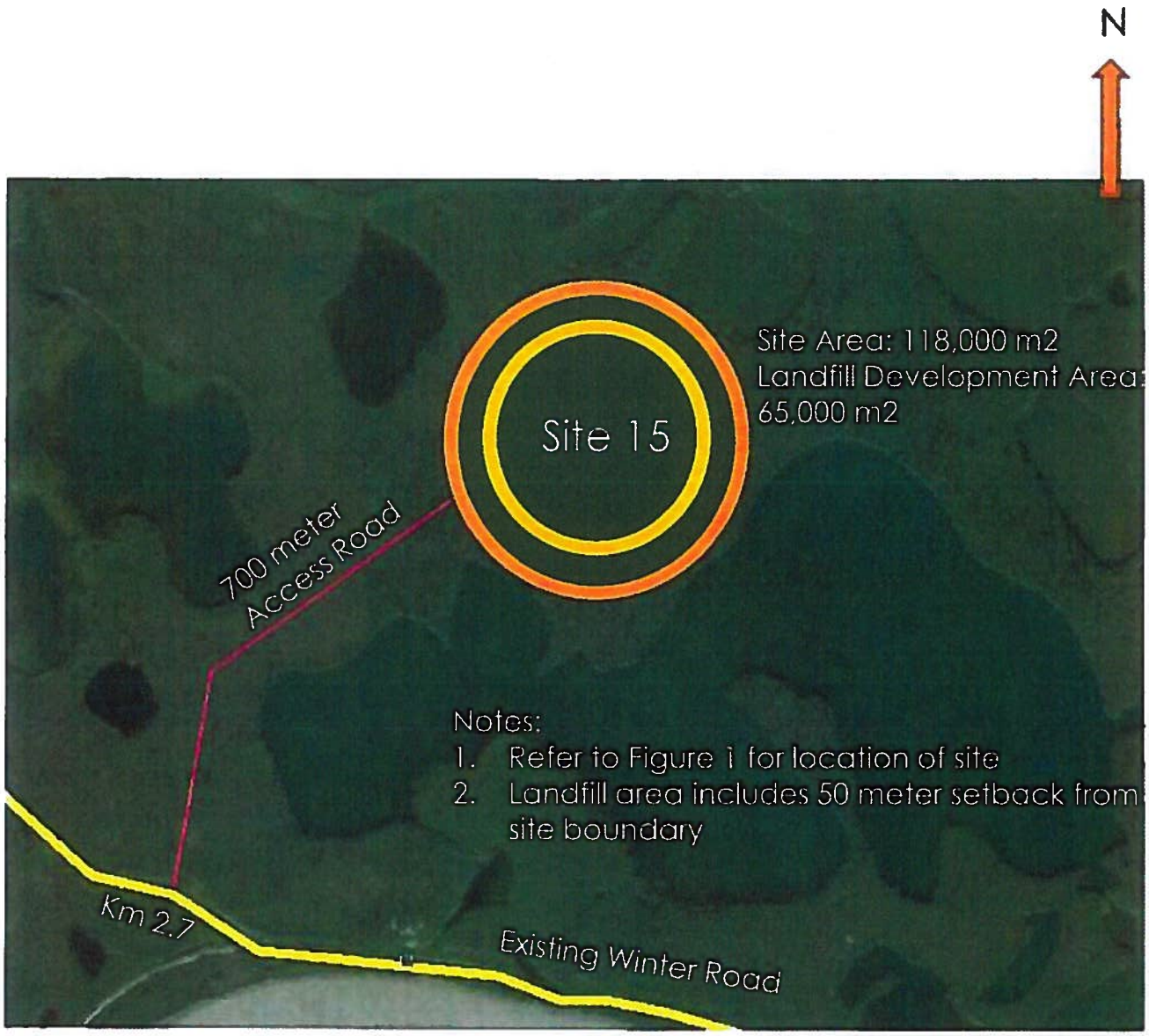
150 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 18. Site 14 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

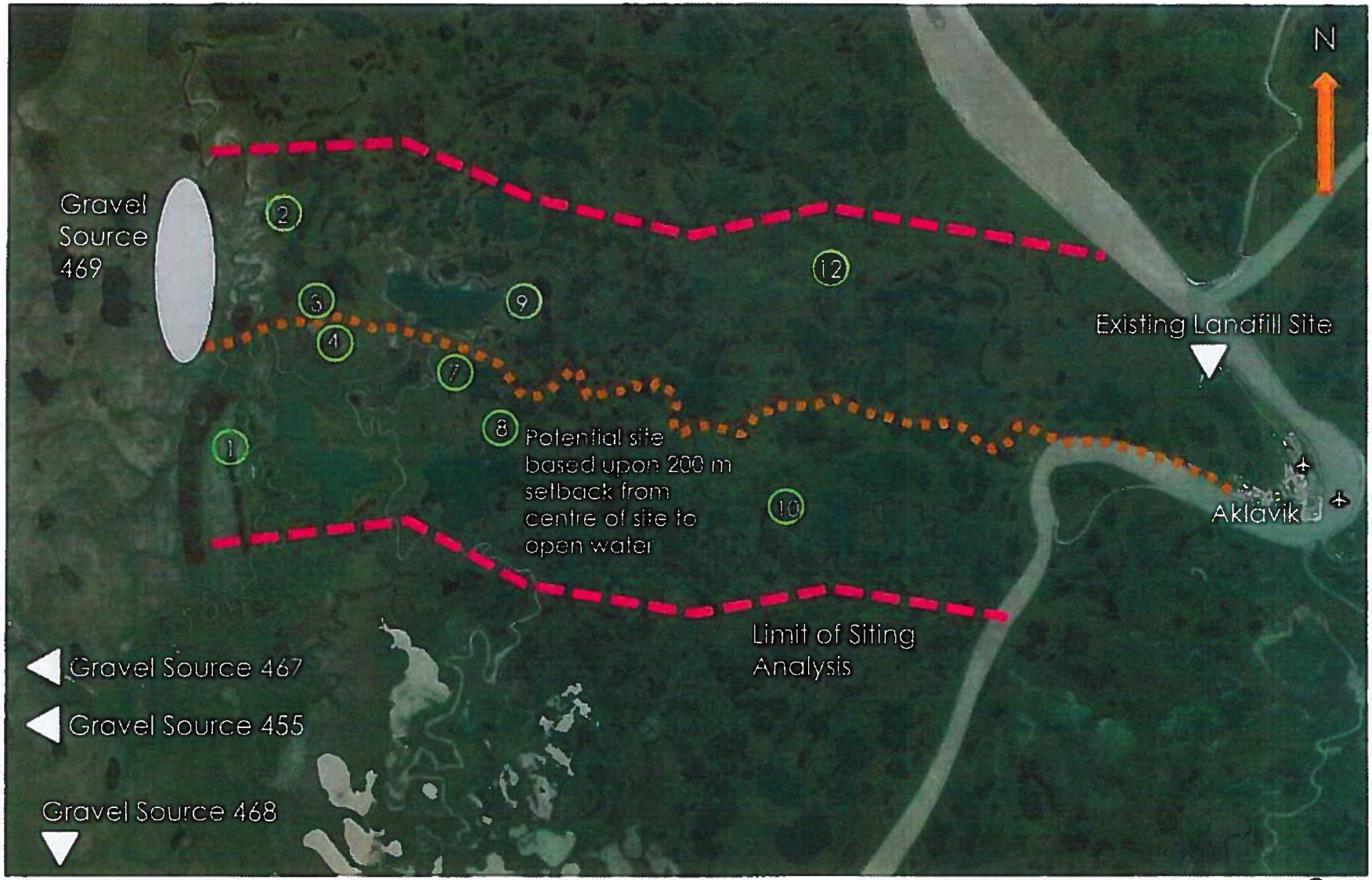
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 19. Site 15 - Envelope and Access
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

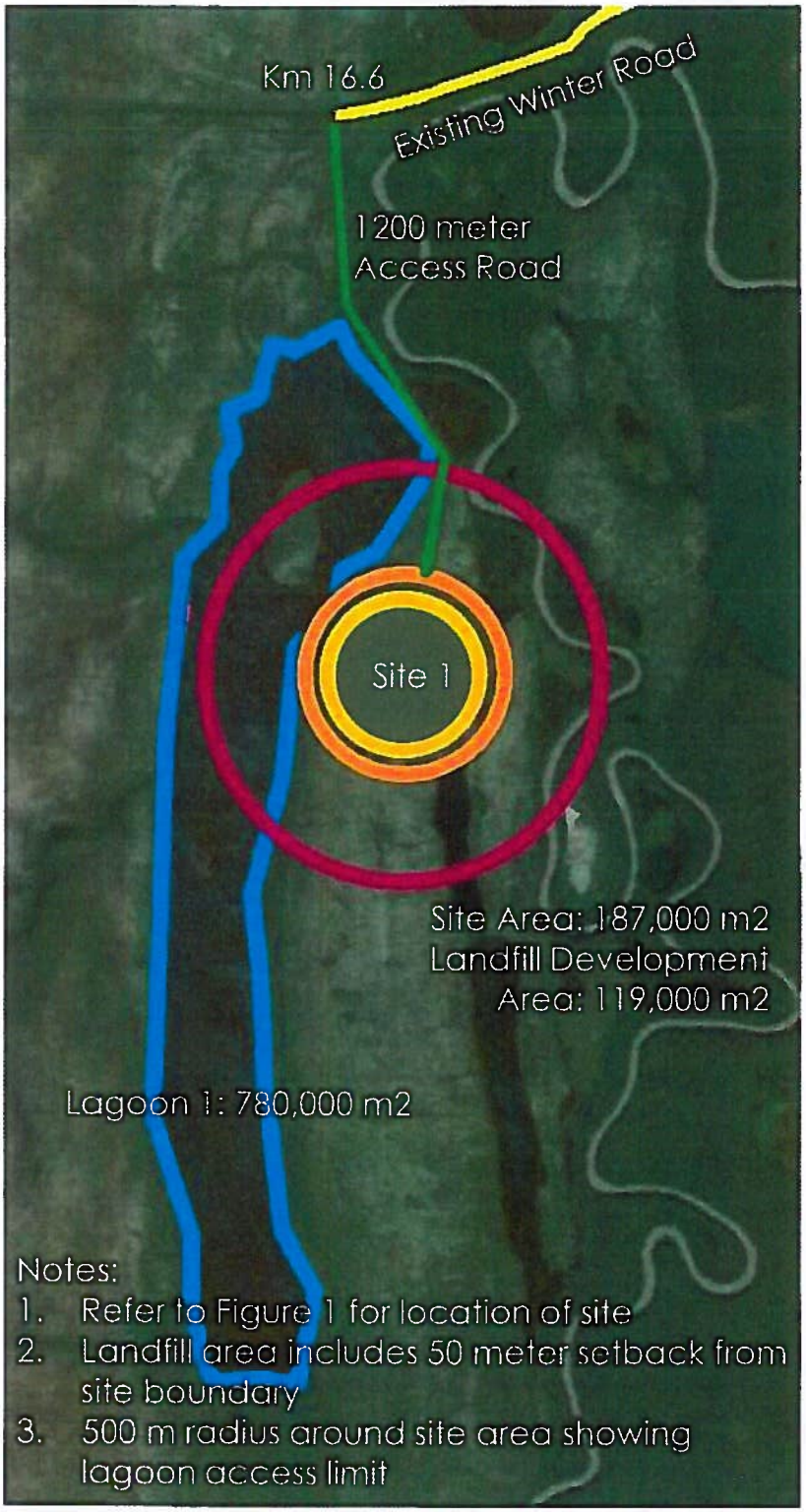
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 20. Screened Sites from Analysis
Prepared by Jamie Davignon, BASc, EIT, 2016 07 07

2 km
Scale

KAVIK-STANTEC



N

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 21. Wastewater Lagoon Ponds - Site 1
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

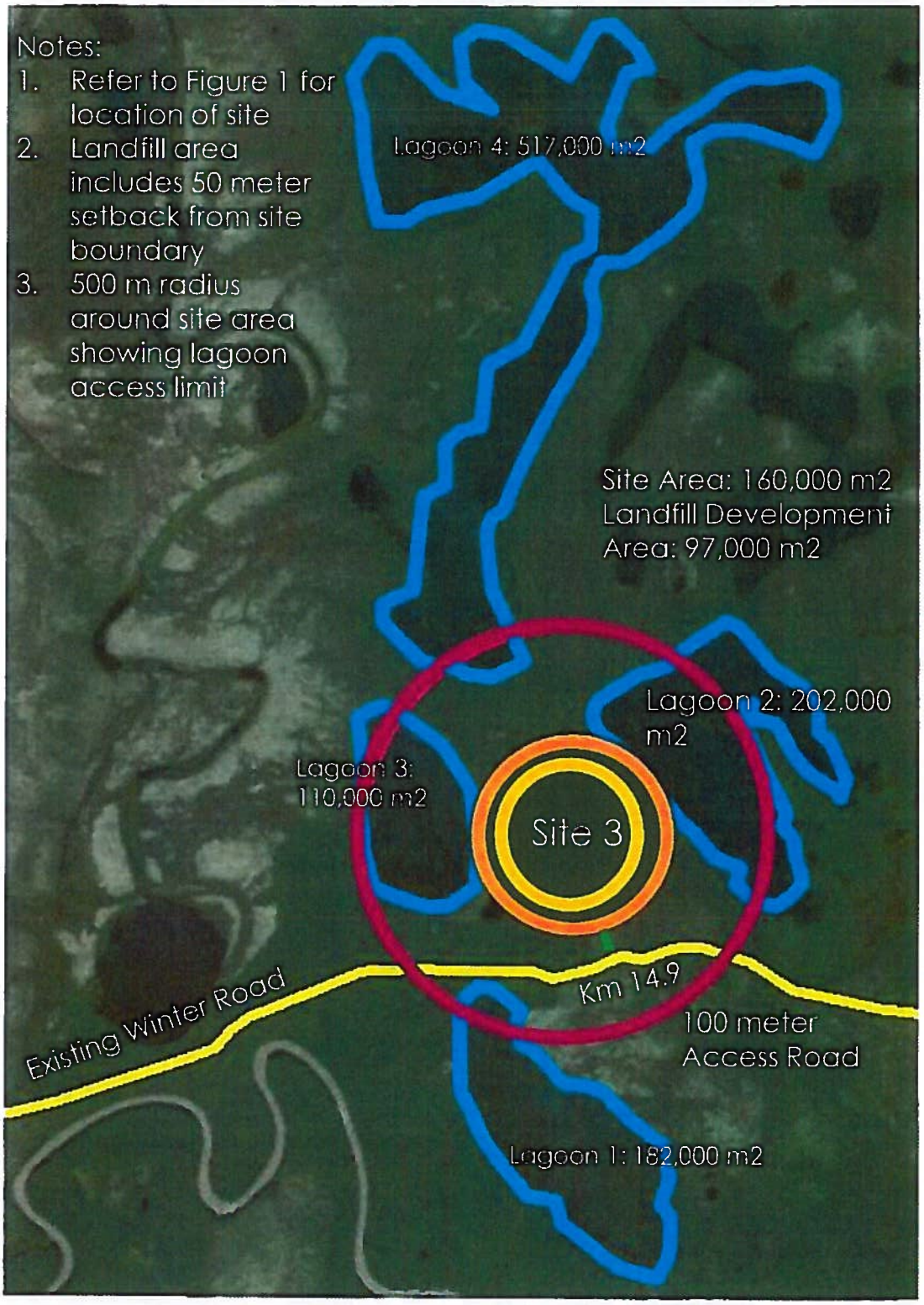
400 m
Scale

KAVIK-STANTEC

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 22. Wastewater Lagoon Ponds - Site 2
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

300 m
Scale

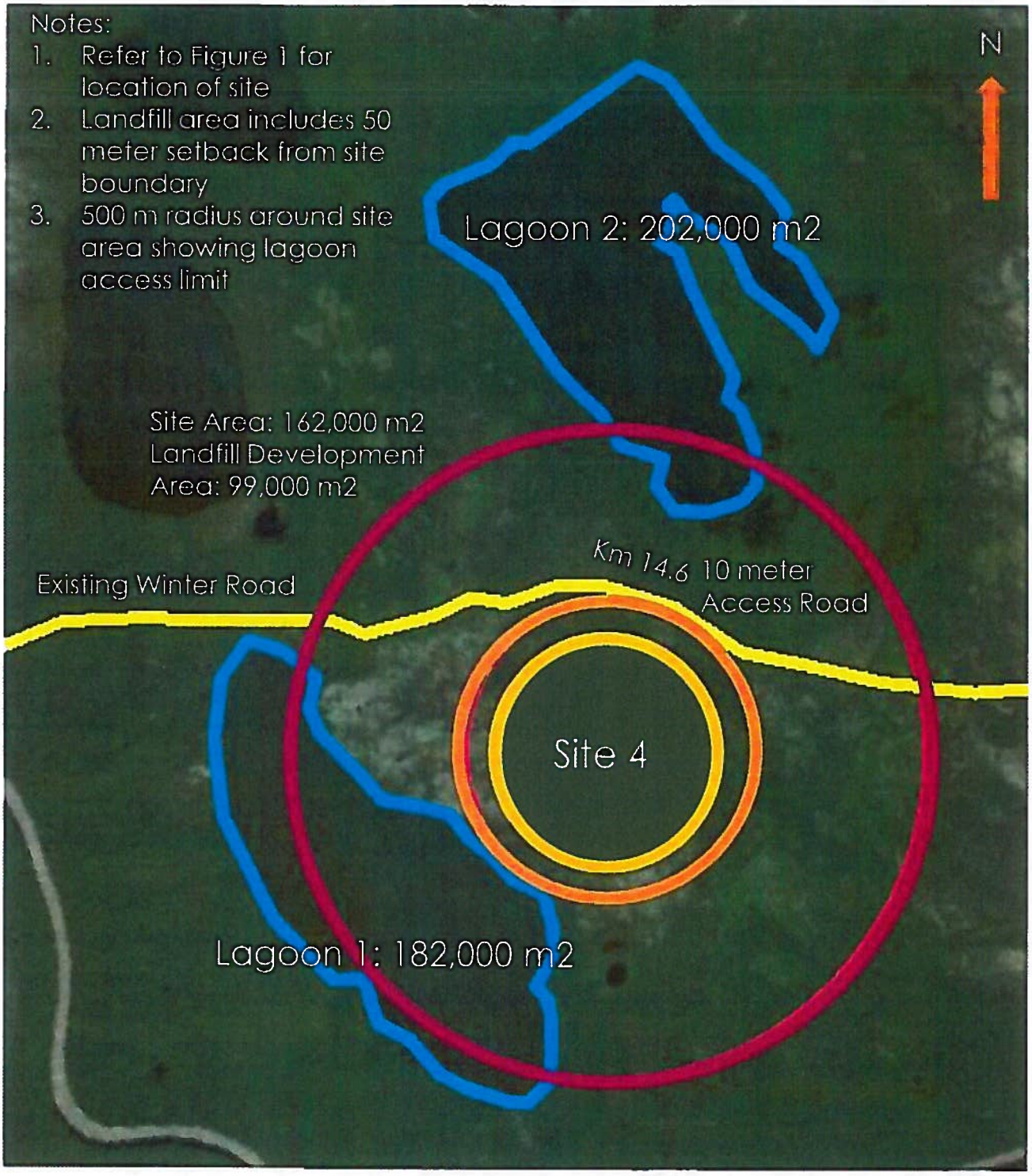
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 23. Wastewater Lagoon Ponds - Site 3
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

300 m
Scale

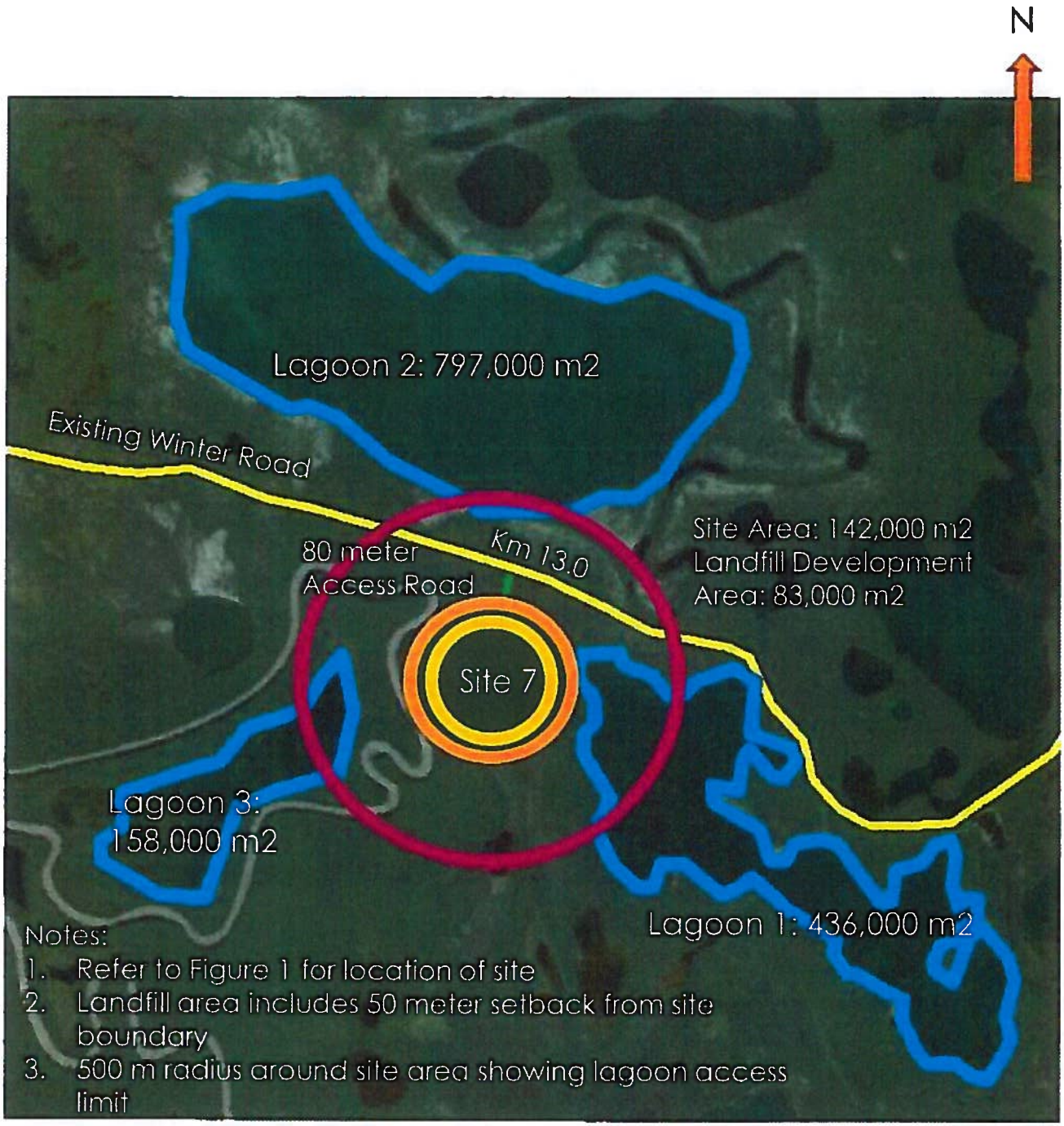
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 24. Wastewater Lagoon Ponds - Site 4
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

200 m
Scale

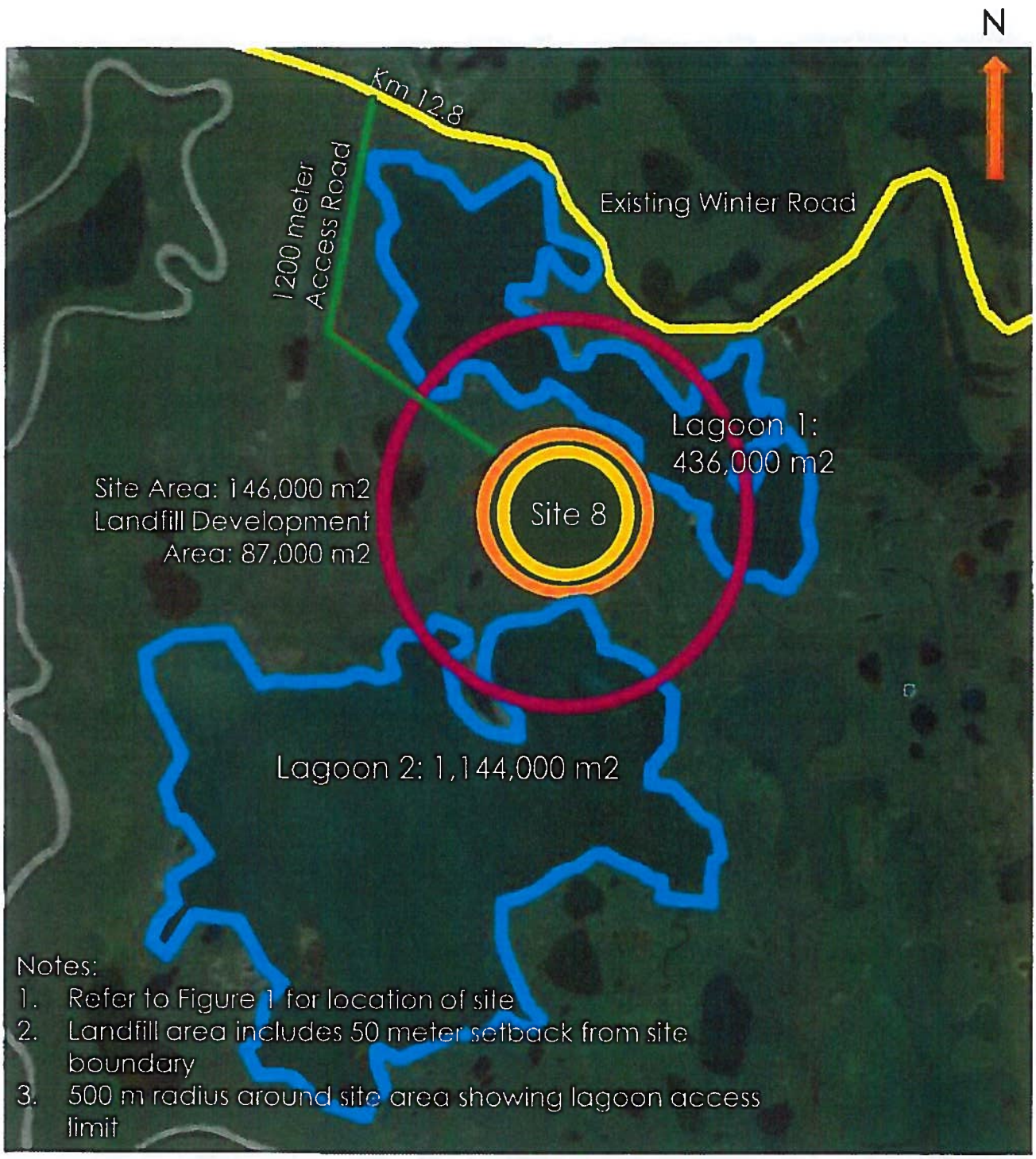
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 25. Wastewater Lagoon Ponds - Site 7
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

300 m
Scale

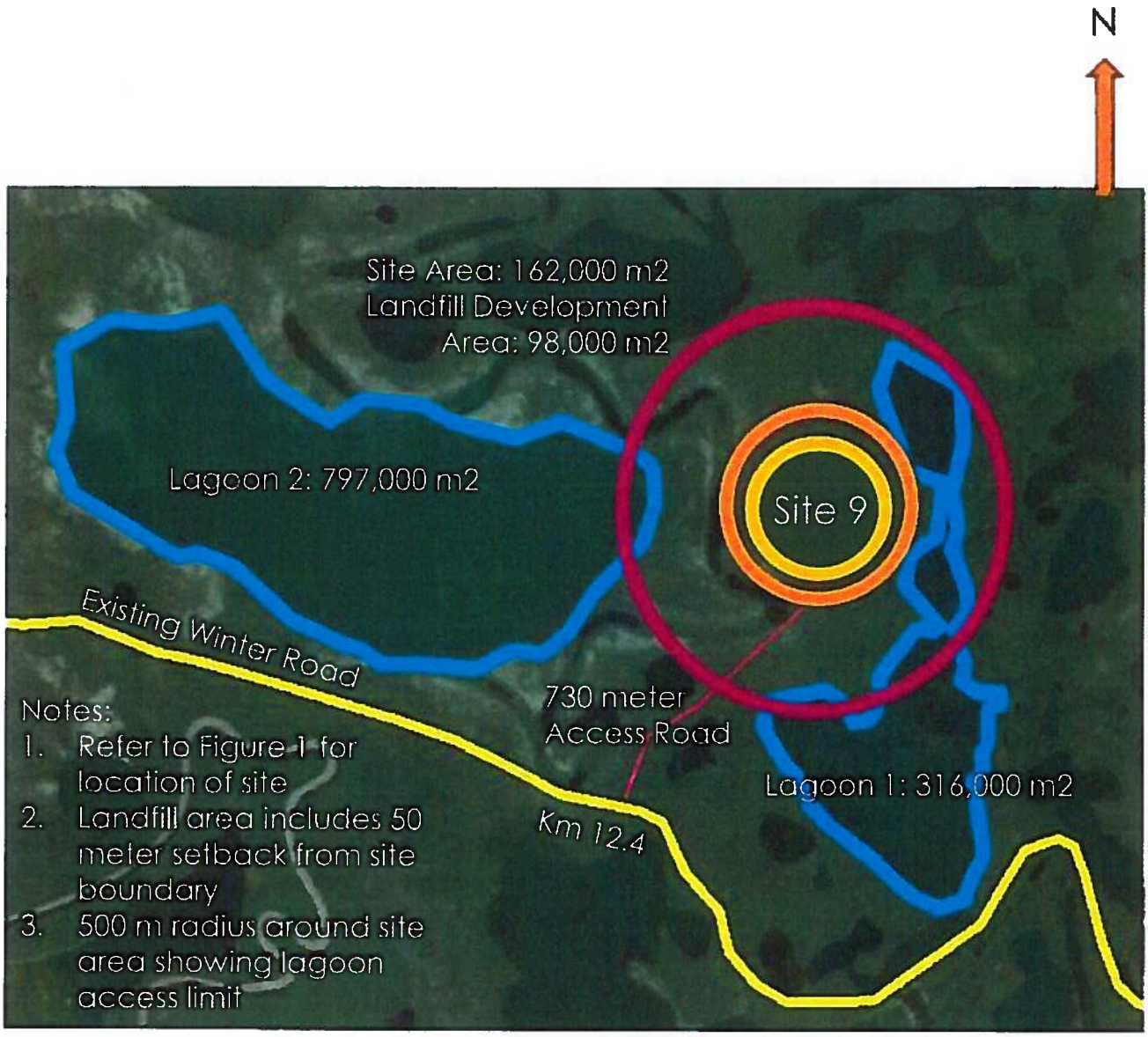
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 26. Wastewater Lagoon Ponds - Site 8
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

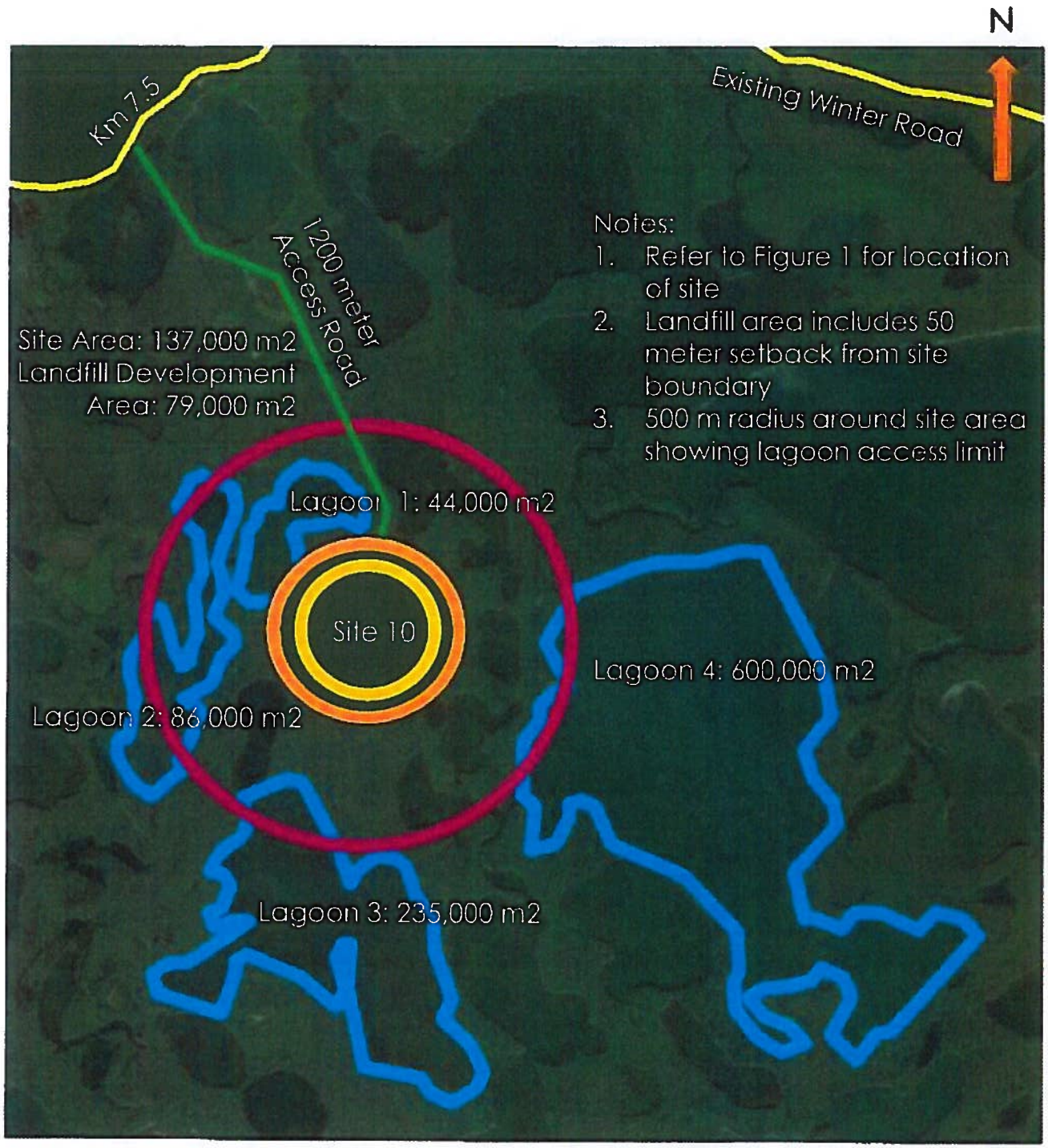
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 27. Wastewater Lagoon Ponds - Site 9
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

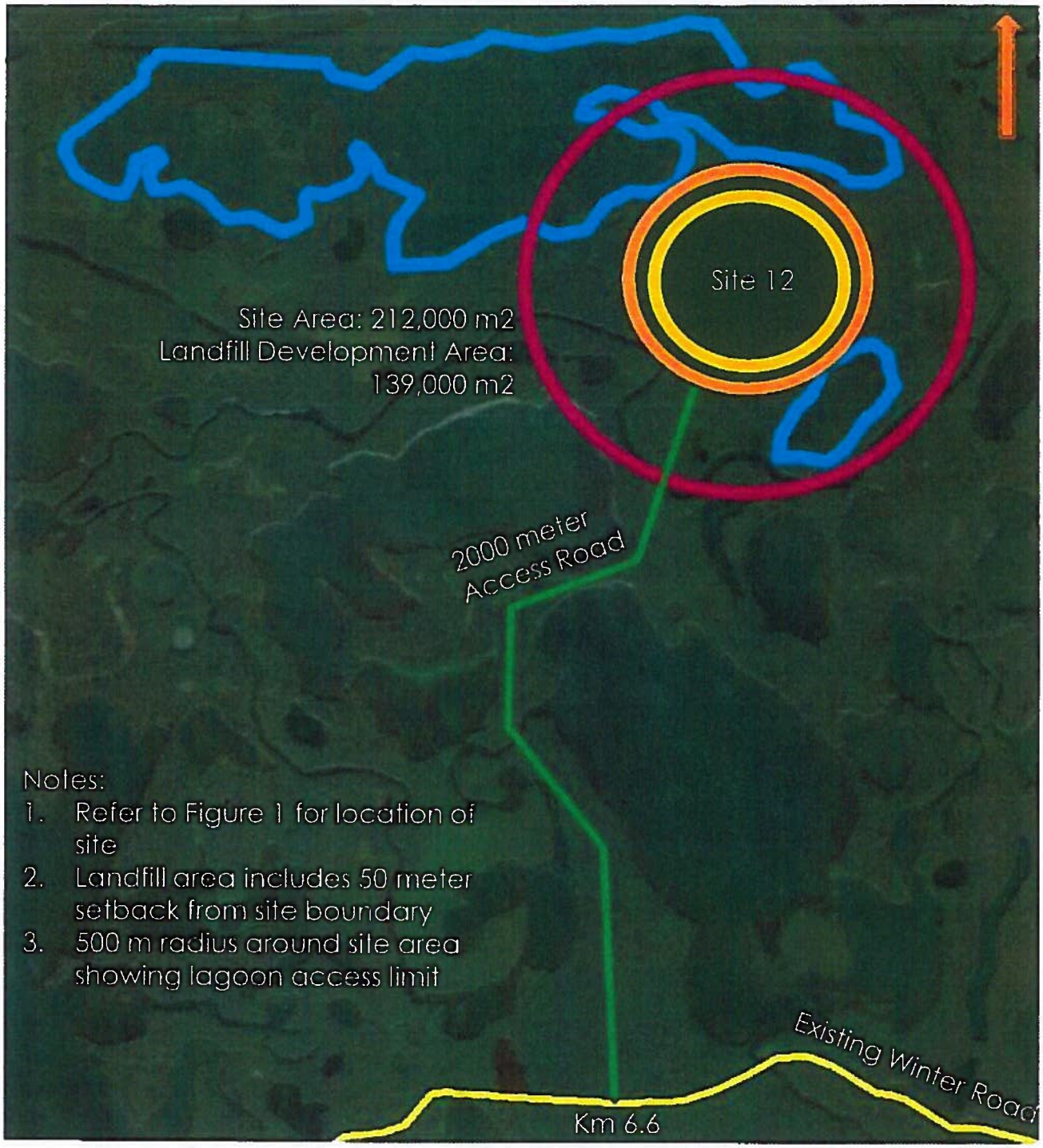
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 28. Wastewater Lagoon Ponds - Site 10
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

150 m
Scale

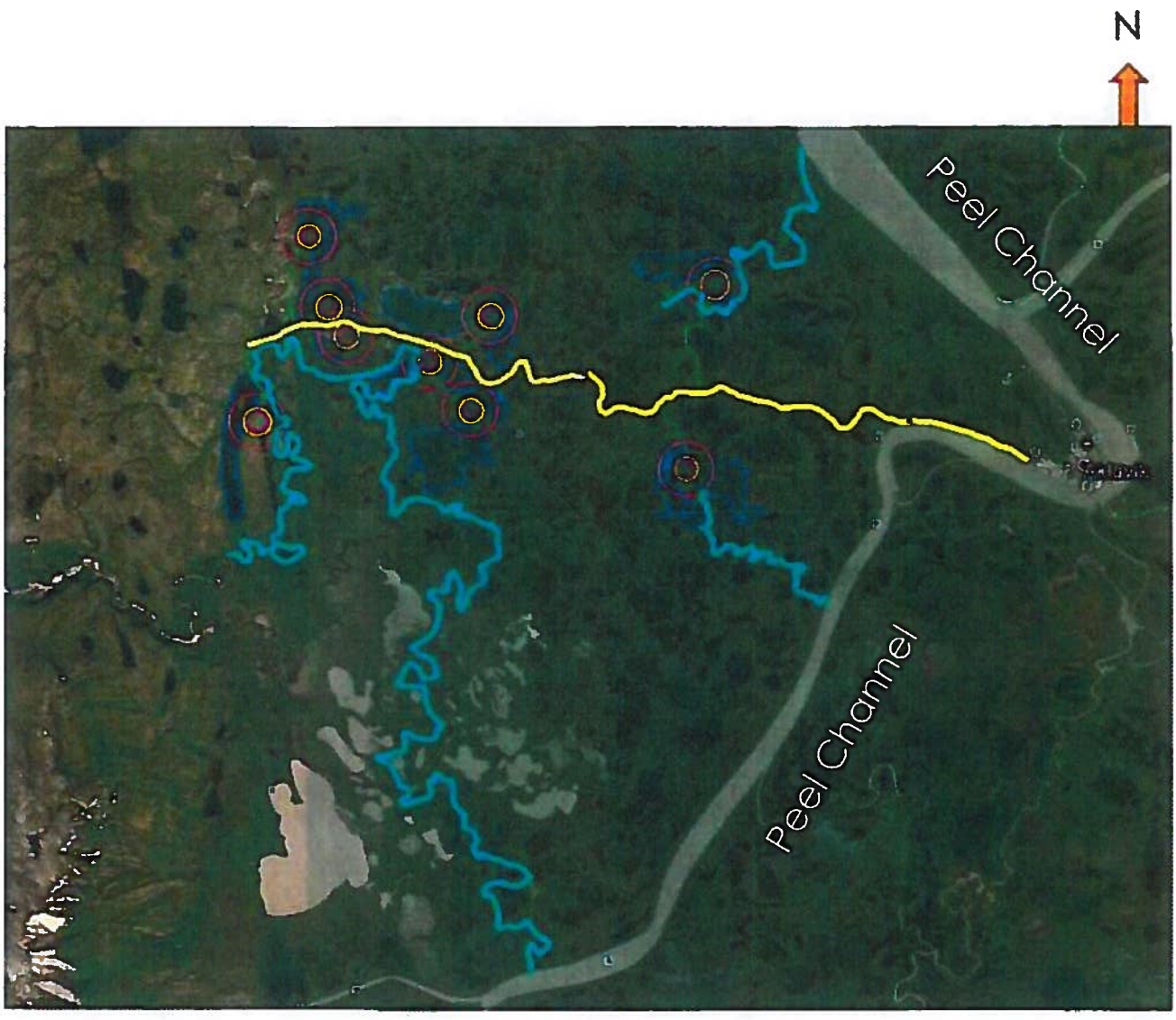
KAVIK-STANTEC



Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 29. Wastewater Lagoon Ponds - Site12
Prepared by Jamie Davignon, BASc, EIT, 2016 06 21

200 m
Scale

KAVIK-STANTEC



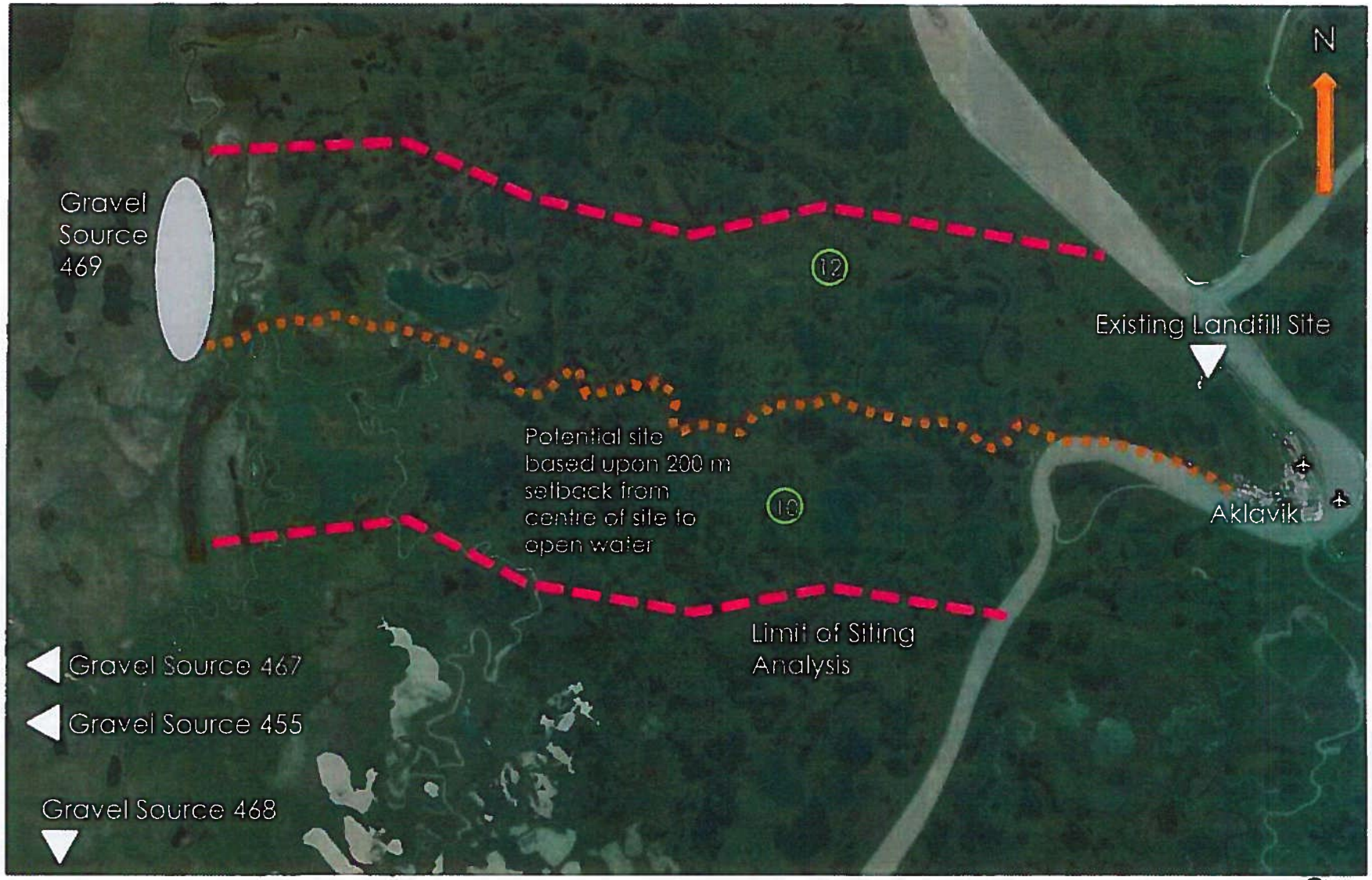
Notes:

1. Landfill area includes 50 meter setback from site boundary (pink circle)
2. 500 m radius around site area showing lagoon access limit (red circle)
3. Flow drainage path (light blue)
4. Lagoon (dark blue)

Hamlet of Aklavik, NWT
Landfill Siting Study
FIGURE 30. Wastewater Lagoon Discharge Path
Prepared by Jamie Davignon, BASc, EIT, 2016 06 30

1000 m
Scale

KAVIK-STANTEC



Hamlet of Aklavik, NWT Landfill Siting Study

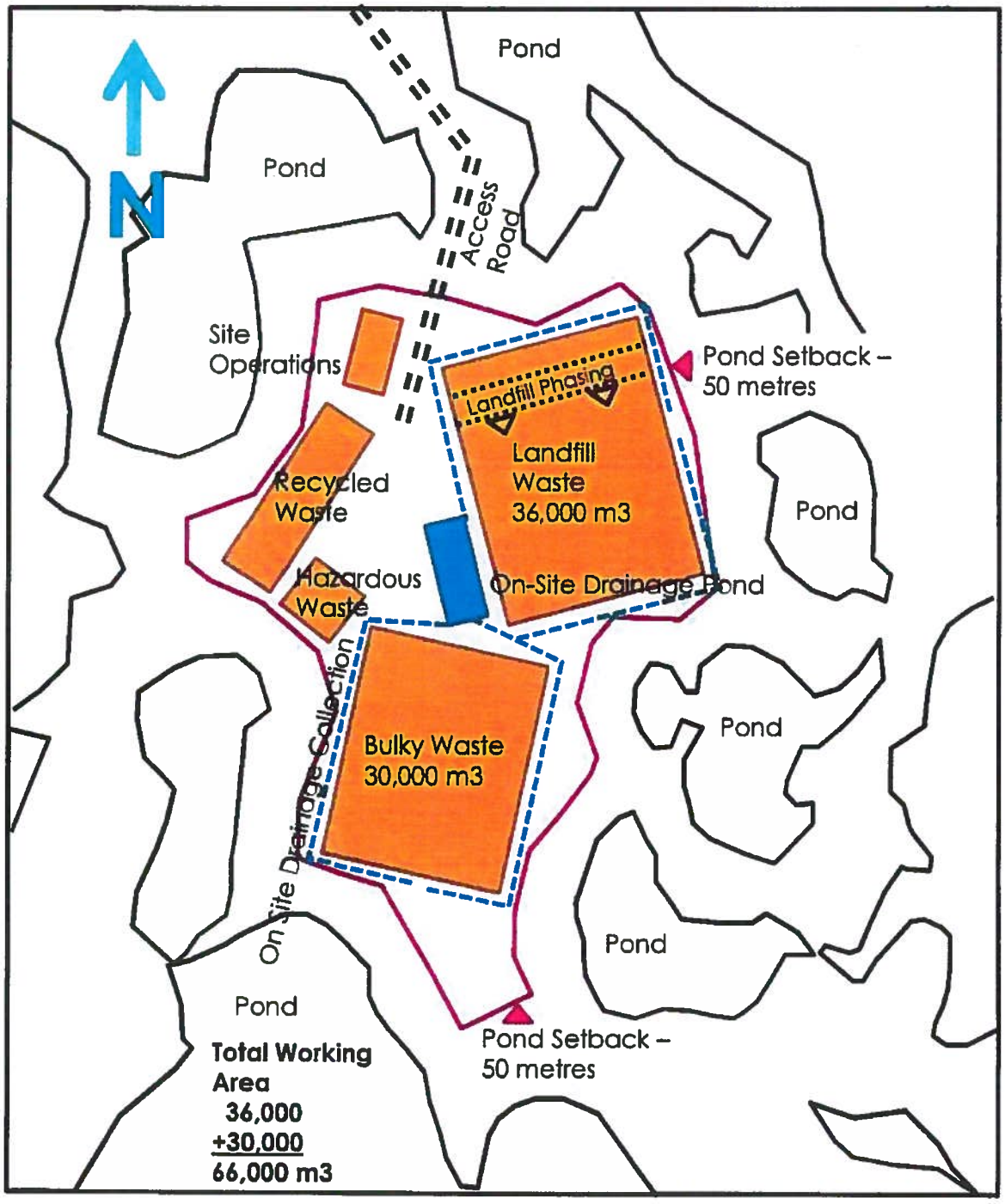
FIGURE 31. Recommended Waste Management Sites

Prepared by Jamie Davignon, BASc, EIT, 2016 07 07

2 km

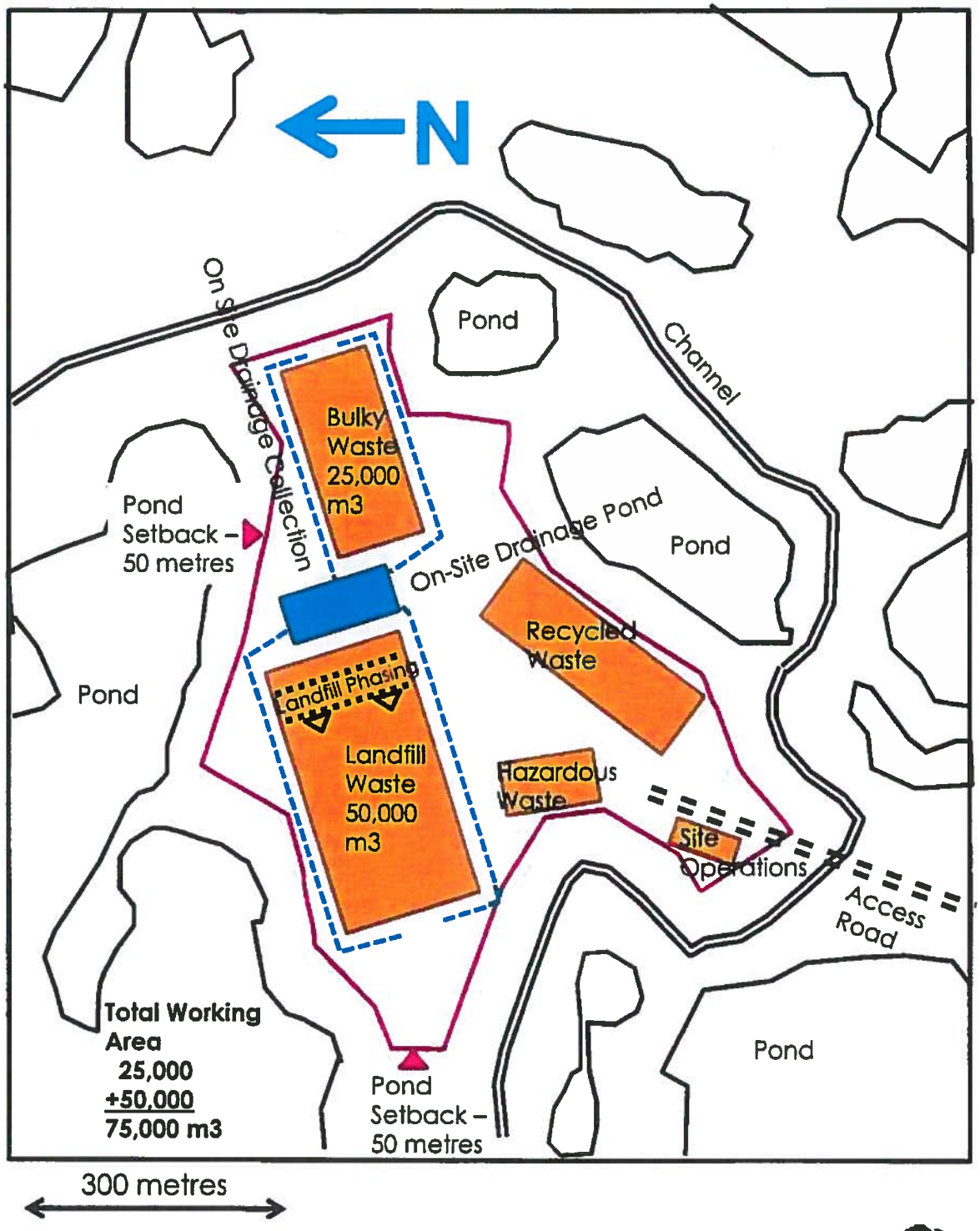
Scale

KAVIK-STANTEC



Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 32. SITE 10 DEVELOPMENT DETAILS
Prepared by Ken Johnson, RPP, P.Eng. 2016 05 20

KAVIK-STANTEC



Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 33. SITE 12 DEVELOPMENT DETAILS
Prepared by Ken Johnson, RPP, P.Eng. 2016 05 20

KAVIK-STANTEC

APPENDIX B Cost Summary

Table B-1 Cost Summary

Site	Primary Road	Secondary Road	Bulky Waste Area	Hazardous Waste Storage Cell	Honeybag & Carcass Cell	Burn Pit Cell	Recycled Waste Area	Landfilled Waste Area	Site Operating Structures
1	$16,568,490	$731,088	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
2	$15,662,570	$945,156	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
3	$14,917,310	$62,454	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
7	$13,017,640	$46,302	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
8	$12,840,930	$720,222	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
9	$12,453,110	$439,205	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
10	$7,478,640	$695,544	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000
12	$6,579,340	$1,197,120	$15,000	$106,966	$30,058	$30,093	$15,000	$20,000	$50,000

Site	On Site Drainage Management	Off Site Drainage Management	Perimeter Fence	Double Swing Gate	Site Signage	Sub-Total	Engineering/Provision (40%)	Total Capital Cost	O&M/yr (2% of CC)
1	$20,205	$84,555	$578,663	$26,218	$24,233	$18,300,569	$7,320,227	$25,620,796	$512,416
2	$20,205	$84,555	$476,460	$26,218	$24,233	$17,506,514	$7,002,606	$24,509,119	$490,182
3	$20,205	$84,555	$534,481	$26,218	$24,233	$15,936,573	$6,374,629	$22,311,202	$446,224
7	$20,205	$84,555	$503,195	$26,218	$24,233	$13,989,465	$5,595,786	$19,585,251	$391,705
8	$20,205	$84,555	$510,293	$26,218	$24,233	$14,493,773	$5,797,509	$20,291,282	$405,826
9	$20,205	$84,555	$538,130	$26,218	$24,233	$13,852,772	$5,541,109	$19,393,881	$387,878
10	$20,205	$84,555	$495,526	$26,218	$24,233	$9,092,038	$3,636,815	$12,728,853	$254,577
12	$20,205	$84,555	$615,093	$26,218	$24,233	$8,813,881	$3,525,552	$12,339,433	$246,789

Table B-2 Costing Examples

Description	Estimated Quantity	Unit	Unit Price	Total
Lagoon Retention Berm	200	l.m.	$ 990.48	$ 198,095.53
Retention Berm and Access Road	125	l.m.	$ 691.46	$ 86,432.37
Lagoon Submerged Berm	60	l.m.	$ 555.31	$ 33,318.61
Isolation Berm (Lagoon and Metal Dump)	240	l.m.	$ 938.35	$ 225,204.64
Run-off Diversion Berms (3)	280	l.m.	$ 460.64	$ 128,978.57
Wetland Diversion Berm (2)	170	l.m.	$ 993.33	$ 168,865.34
Wetland Open Water Section Trench	66	l.m.	$ 153.12	$ 10,105.63
Wetland Flow Control Berm	30	l.m.	$ 780.29	$ 23,408.59
Run-off Diversion Channel East of Sewage Lagoon	83	l.m.	$ 40.14	$ 3,331.63
Run-off Diversion Channel North of Sewage Lagoon	83	l.m.	$ 40.14	$ 3,331.63
Run-off Diversion Channel North West of Sewage Lagoon	285	l.m.	$ 25.72	$ 7,329.60
Truck Discharge Structure Supply & Installation*	1	l.s.		$ 24,592.35
Lagoon Spillway (including rip-rap apron, geotextile base)	1	l.s.		$ 67,402.75
Sludge Drying Pad	1	l.s.		$ 32,253.72
Extend Existing Access Road	270	l.m.	$ 365.94	$ 98,802.64
Truck Turnaround (12 m radius)	1	l.s.		$ 44,661.34
Hazardous Waste Storage Area	1	l.s.		$ 106,966.06
Excavating Crush & Bury Trenches (72.3 m x 20 m)**	1	l.s.		$ 70,620.31
Crushing & Burying Scrap Metal Waste	1	l.s.		$ 250,339.43
Adding crushed granular base for equipment storage area***	1	l.s.		$ 14,057.07
Landfill Site Berm	295	l.s.		$ 19,097.06
Hazardous Waste Cell ****	95	l.s.		$ 80,828.77
Honeybag & Carcass Cell (including berm and excavation)	115	l.s.		$ 30,058.37
Burn Pit Cell (including Berm and Excavation)	115	l.s.		$ 30,092.53
Runoff Detention Pond	1	l.s.		$ 12,869.80
Drain Ditches	675	l.m.	$ 169.11	$ 114,150.52
Chain Link Fence (2.0 m high) Supply & Installation	515	l.m.	$ 375.76	$ 193,517.56
Double Swing Gate Supply & Installation	1	l.s.		$ 26,217.72
Lagoon and Landfill Signage & Installation	21	u.p.	$ 21.00	$ 24,223.15
Access Road	180	l.m.	$ 372.19	$ 66,993.67
Truck Turn-around/Access to MSW Cells (12 m radius)	1	l.s.		$ 34,041.90
Truck Turn-around /Access to Hazardous waste, honeybag cell (approx 250 m2)	1	l.s.		$ 30,770.05

* includes Nestable CSP, Styrofoam Insulation Bump Post, Wheel Stopper, granular fill, Rip-Rap and Geotextile

** including Excavation, HDPE Liner, and sand cover

***approx 785 m2

****including Berm, Excavation, HDPE Liner, and sand cover

sq.m = square meter

l.m. = linear meter

u.p. = price per unit

l.s. = lump sum

APPENDIX C Population Project and Waste Generation

Table C-1 Population Projection and Waste Generation

Year	Planning Year	Population	Annual Volume (m^3)	Total Volume (m^3)	Total Compacted Volume (m^3)
1	2015	668	3955	3955	1318
2	2016	660	4000	7954	2651
3	2017	662	4045	11999	4000
4	2018	663	4091	16090	5363
5	2019	664	4138	20228	6743
6	2020	666	4185	24413	8138
7	2021	667	4233	28646	9549
8	2022	668	4281	32927	10976
9	2023	670	4330	37257	12419
10	2024	671	4380	41637	13879
11	2025	672	4430	46068	15356
12	2026	673	4481	50549	16850
13	2027	675	4533	55081	18360
14	2028	676	4585	59666	19889
15	2029	677	4638	64304	21435
16	2030	679	4691	68995	22998
17	2031	680	4745	73740	24580
18	2032	681	4800	78541	26180
19	2033	682	4856	83396	27799
20	2034	684	4912	88309	29436
21	2035	685	4969	93278	31093
22	2036	686	5027	98305	32768
23	2037	687	5085	103390	34463
24	2038	689	5145	108535	36178
25	2039	690	5205	113739	37913
26	2040	691	5265	119005	39668
27	2041	693	5327	124332	41444
28	2042	694	5389	129721	43240
29	2043	695	5452	135173	45058
30	2044	696	5516	140690	46897
31	2045	698	5581	146271	48757
32	2046	699	5647	151918	50639
33	2047	700	5713	157631	52544
34	2048	702	5781	163412	54471
35	2049	703	5849	169260	56420
36	2050	704	5918	175178	58393
37	2051	705	5988	181166	60389
38	2052	707	6059	187225	62408
39	2053	708	6131	193356	64452
40	2054	709	6204	199560	66520

APPENDIX D Life Cycle Evaluation Table

Year	Daily ($)	Weekly ($)	Monthly ($)	Yearly ($)	Total ($)	PVF	Current ($)
1	$319.93	$ 150	$ 5,850	$ 12,400	$173,581	0.95	$ 165,315
2	$322.67	$ 150	$ 5,850	$ 10,400	$172,294	0.91	$ 156,276
3	$325.48	$ 150	$ 5,850	$ 10,400	$173,024	0.86	$ 149,465
4	$328.35	$ 150	$ 5,850	$ 10,400	$173,772	0.82	$ 142,962
5	$331.30	$ 150	$ 5,850	$ 10,400	$174,537	0.78	$ 136,754
6	$334.31	$ 150	$ 5,850	$ 10,400	$175,321	0.75	$ 130,827
7	$337.40	$ 150	$ 5,850	$ 10,400	$176,123	0.71	$ 125,168
8	$340.56	$ 150	$ 5,850	$ 10,400	$176,945	0.68	$ 119,764
9	$343.80	$ 150	$ 5,850	$ 10,400	$177,787	0.64	$ 114,603
10	$347.11	$ 150	$ 5,850	$ 110,400	$278,649	0.61	$ 171,067
11	$350.51	$ 150	$ 5,850	$ 10,400	$179,532	0.58	$ 104,969
12	$353.99	$ 150	$ 5,850	$ 10,400	$180,437	0.56	$ 100,474
13	$357.55	$ 150	$ 5,850	$ 10,400	$181,363	0.53	$ 96,181
14	$361.20	$ 150	$ 5,850	$ 10,400	$182,312	0.51	$ 92,080
15	$364.94	$ 150	$ 5,850	$ 10,400	$183,284	0.48	$ 88,163
16	$368.77	$ 150	$ 5,850	$ 10,400	$184,279	0.46	$ 84,420
17	$372.69	$ 150	$ 5,850	$ 10,400	$185,299	0.44	$ 80,845
18	$376.71	$ 150	$ 5,850	$ 10,400	$186,343	0.42	$ 77,430
19	$380.82	$ 150	$ 5,850	$ 10,400	$187,414	0.40	$ 74,166
20	$385.04	$ 150	$ 5,850	$ 110,400	$288,510	0.38	$ 108,736
21	$389.36	$ 150	$ 5,850	$ 10,400	$189,633	0.36	$ 68,067
22	$393.79	$ 150	$ 5,850	$ 10,400	$190,784	0.34	$ 65,220
23	$398.32	$ 150	$ 5,850	$ 10,400	$191 963	0.33	$ 62,498
24	$402.97	$ 150	$ 5,850	$ 10,400	$193,171	0.31	$ 59,896
25	$407.73	$ 150	$ 5,850	$ 10,400	$194,409	0.30	$ 57,410
26	$412.61	$ 150	$ 5,850	$ 10,400	$195,678	0.28	$ 55,033
27	$417.61	$ 150	$ 5,850	$ 10,400	$196,978	0.27	$ 52,760
28	$422.73	$ 150	$ 5,850	$ 10,400	$198,310	0.26	$ 50,587
29	$427.98	$ 150	$ 5,850	$ 10,400	$199,675	0.24	$ 48,510
30	$433.36	$ 150	$ 5,850	$ 110,400	$301,073	0.23	$ 69,662
31	$438.87	$ 150	$ 5,850	$ 10,400	$202,507	0.22	$ 44,624
32	$444.52	$ 150	$ 5,850	$ 10,400	$203,976	0.21	$ 42,808
33	$450.32	$ 150	$ 5,850	$ 10,400	$205,482	0.20	$ 41,070
34	$456.25	$ 150	$ 5,850	$ 10,400	$207,026	0.19	$ 39,408
35	$462.34	$ 150	$ 5,850	$ 10,400	$208,608	0.18	$ 37,819
36	$468.58	$ 150	$ 5,850	$ 10,400	$210,230	0.17	$ 36,298
37	$474.97	$ 150	$ 5,850	$ 10,400	$211,892	0.16	$ 34,843
38	$481.52	$ 150	$ 5,850	$ 10,400	$213,596	0.16	$ 33,450
39	$488.24	$ 150	$ 5,850	$ 10,400	$215,343	0.15	$ 32,118
40	$495.13	$ 150	$ 5,850	$ 10,400	$217,134	0.14	$ 30,843
					Total Life Cycle		**$3,282,588**

APPENDIX E Aklavik Solid Waste Management Review

KAVIK-STANTEC INC.
Box 2320
Inuvik, NT, Canada X0E 0T0
Tel: (867) 777-4548
Fax: (867) 777-4925

November 9, 2016
File No.: 144902298

Fred Behrens, SAO
Hamlet of Aklavik
Aklavik, NT

Attention: **Fred Behrens, Senior Administrative Officer**

Dear Fred:

Reference: Aklavik Solid Waste Management Review

Introduction

In follow up to the solid waste facility siting study prepared for the Hamlet of Aklavik, at the request of the Hamlet, Kavik-Stantec has completed a solid waste facility management review of the existing facility. The overall scope of work for this management review included: travel to Aklavik for inspections and discussions; reconnaissance site measurements and photographs of the landfill site for the purposes of determining the site limits; review and analysis of site operating conditions, and preparation of a letter report on the operation and maintenance of the facility with specific consideration of the ways to optimize the site operation to gain an additional operating horizon for the facility. This horizon will provide additional time for the identification and development of a new solid waste management site for the community.

Background

The Hamlet of Aklavik operates a municipal solid waste area, and a bulky / construction waste area approximately 2 kilometers' northeast of the community (See Figure 1). The facility is configured into two general operating areas (See Figure 2 and Figure 3): a bulky waste area to the northeast, and a municipal waste operating area to the southwest. An area of the municipal waste operating area has been covered and revegetated. Adjacent to the municipal solid waste area is an area for limited waste diversion.

The Hamlet has been advised that this site may be at the end of its operating life, and therefore the Hamlet must advance the development of a new site. In response to this advice, a waste management siting study report was completed by Kavik-Stantec (November 2016), which provided a siting analysis for a new landfill area. The study investigated a total of 15 potential sites, and screened these sites down to 2 recommended sites for further investigation. A site visit was completed as part of the siting study, and Kavik-Stantec suggested that redevelopment of the existing site could provide an additional operating horizon for the facility.

Aklavik Solid Waste Management Review

Solid Waste Operation and Maintenance Improvements

Municipal Waste Area

The municipal waste area (See Figure 2 and Figure 3) is approximately 4600 m², and currently operates as a large single cell for municipal solid waste disposal. Smaller cells within the area have been used in the past as evident with several internal perimeter berms. The current operating configuration does not accommodate efficient waste compaction, fire protection and animal attraction control by periodic waste covering, and allows for blowing debris to easily occur.

An improvement in the operation of the municipal solid waste area is presented in Figure 4. This operating concept presents multiple cells which are filled sequentially. The configuration has included a site drainage management system, and waste diversion stations and storage.

In the operation of this configuration, cells may be created and sequentially filled (See Figures 5 and 6). The cells may be created by the construction of perimeter berms spaced 10 to 15 meters apart, and 1 to 1.5 meters high. The management of a single waste cell consists of a sequence of activities. The main activity is associated with the active waste disposal area, which should be kept to a minimum size with both the garbage truck dumping and the resident dumping. The active area should be periodically consolidated compacted with heavy machinery. Following the compaction of the waste, intermediate cover should be added and compacted. Once the complete sequence of cells has been filled, a new operating layer of the facility may be developed (See Figure 7).

The area adjacent to the municipal waste area may be organized to accommodate waste diversion with a series of turnouts and drop off areas. Associated with the turnouts and drop off areas, signage should be added to instruct and direct the waste disposal.

On site drainage management has been incorporated into the redevelopment concept to improve the facility operation with the current regulatory expectations for runoff management.

Bulky / Construction Waste Area

The bulky / construction waste area (See Figure 2) has generally been developed in a satisfactory manner with the dumping of bulky and construction wastes and the periodic consolidation of the waste with a caterpillar tractor. This area is filling up and consideration should be made for the redevelopment of future phases of a bulky / construction waste area. A potential development scenario for future phases is the consolidation and covering of the bulky / construction waste and creation of new working areas on top and adjacent to the current working area.

Solid Waste Operation and Maintenance Practices

The general operation and maintenance practices at the solid waste areas in Aklavik should be defined in a comprehensive operation and maintenance plan, which would provide considerably more detail than the information in this letter report.

The solid waste operation and maintenance plan would include details on waste diversion, household hazardous waste management, compaction and waste covering, site access and road maintenance, performance monitoring and record keeping, and fencing and signage.

Aklavik Solid Waste Management Review

Landfill Capacity

The Hamlet has been advised that this site may be at the end of its operating life, and therefore the Hamlet must advance the development of a new site. However, the site may be redeveloped to gain an additional operating horizon. The operating area presented in Figure 4, is approximately 6500 m^2, which corresponds to a potential volume of 6500 m^3 of solid waste placed at a depth of 1 meter. Based upon the anticipated waste generation for a 40-year horizon, this may provide an additional 5 years of capacity, with a range of 4 to 6 years.

Building up a second layer of solid waste in this area to a 1-meter depth may provide may provide another 5 years of capacity, with a range of 4 to 6 years. Overall, the site redevelopment may provide an additional 8 to 12 years of capacity at the existing site. In addition, a future expansion area identified on Figure 4, would provide further operating capacity for the site.

Closure

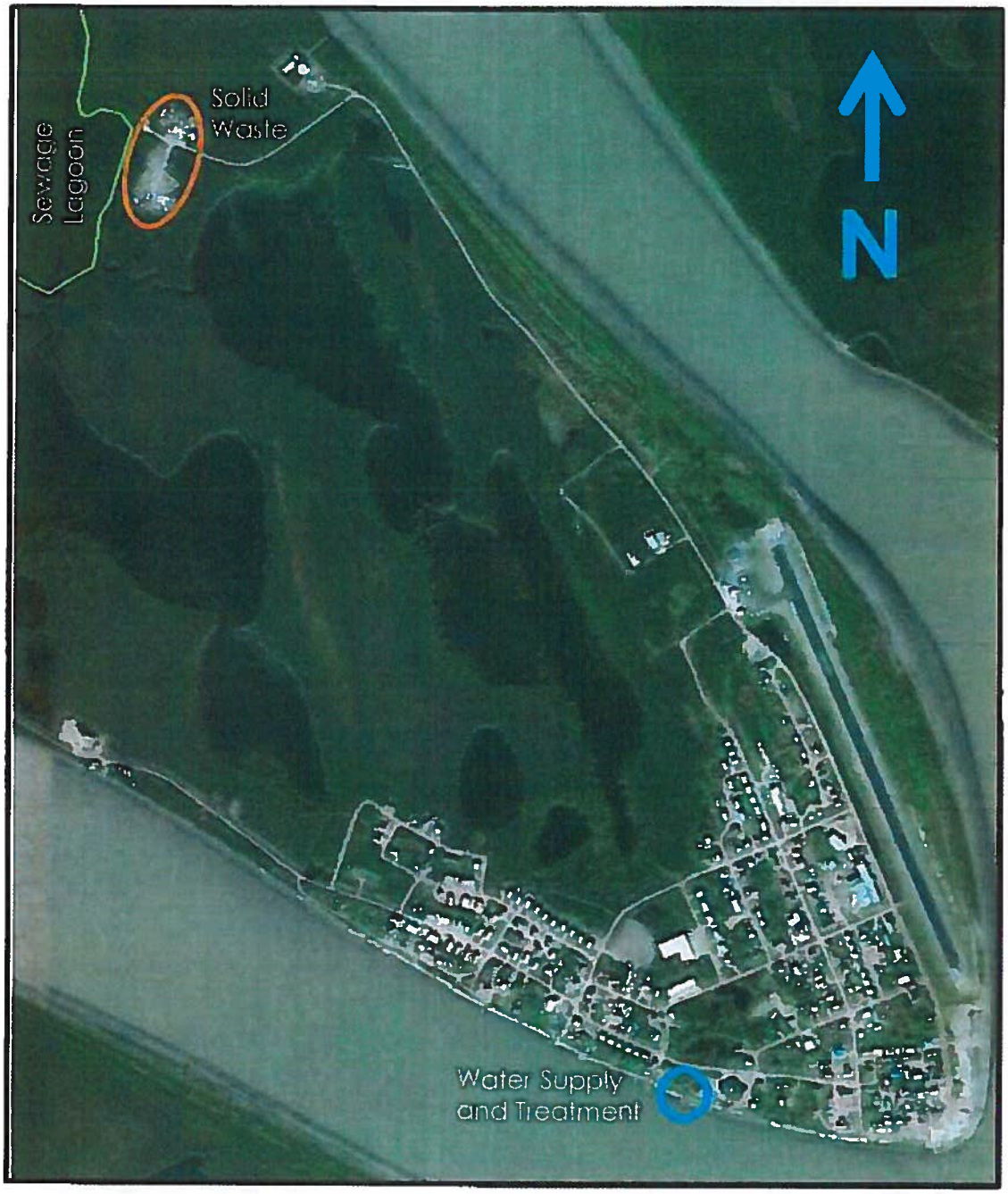
The outline information is this letter report will provide a basis for redeveloping the existing landfill site, and advancing operation and maintenance improvements to solid waste management in Aklavik. Engineering of the improvements associated with this conceptual plan should be completed, including a detailed topographic survey, and the design of the development sequence to provide a complete basis for redevelopment. A comprehensive operation and maintenance plan should also be advanced to provide documentation of the appropriate operation and maintenance activities at the redeveloped site.

Sincerely,

KAVIK-STANTEC INC.

Ken Johnson, M.A.Sc., RPP, P. Eng.
Senior Environmental Engineer
Tel: (780) 969-1022
Ken.Johnson2@stantec.com

Arlen Foster, P. Eng.
Civil Engineer
Tel: (867) 920-2882
arlen.foster@stantec.com

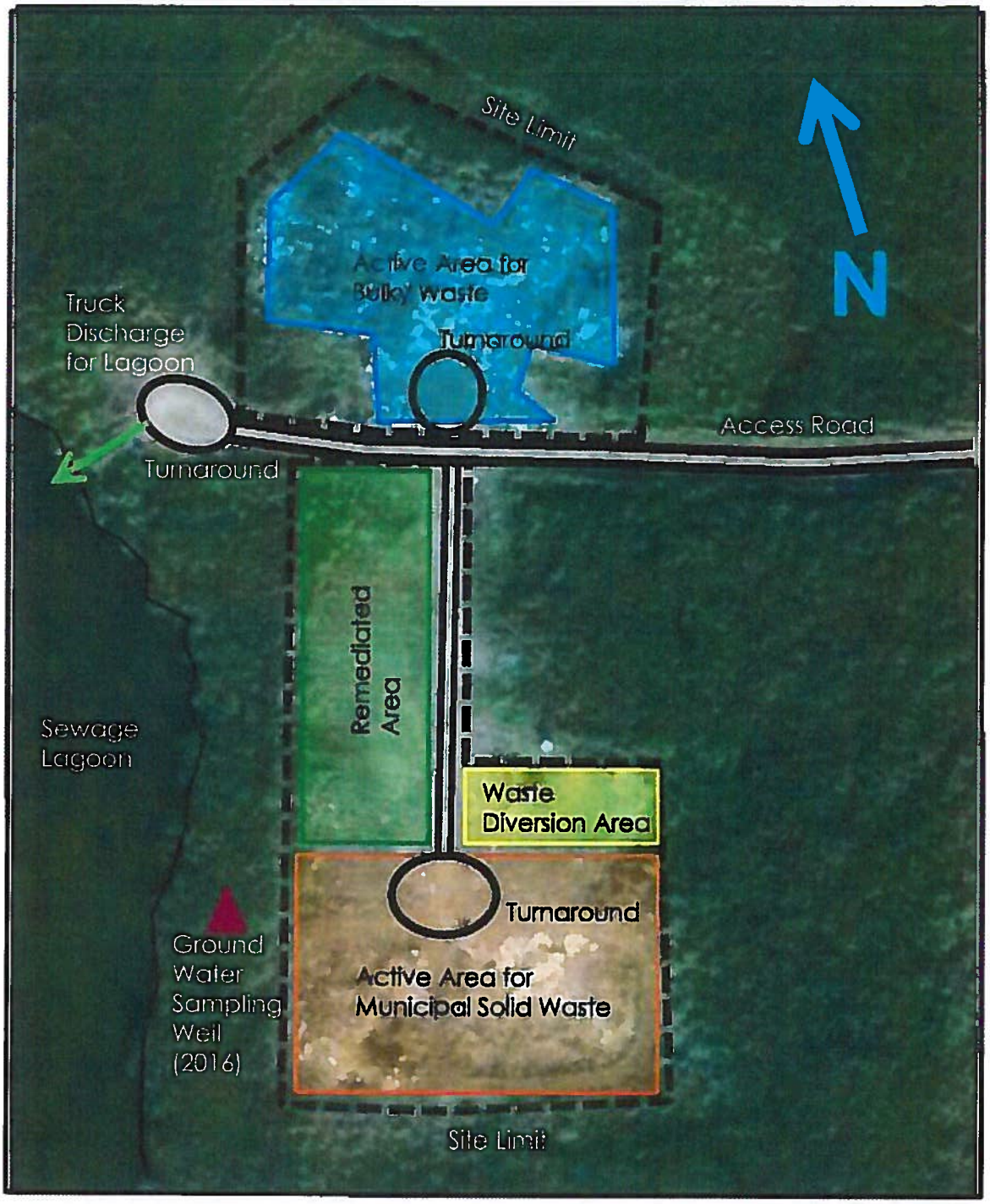


Scale

300 metres

Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 1. FACILITY LOCATION
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC

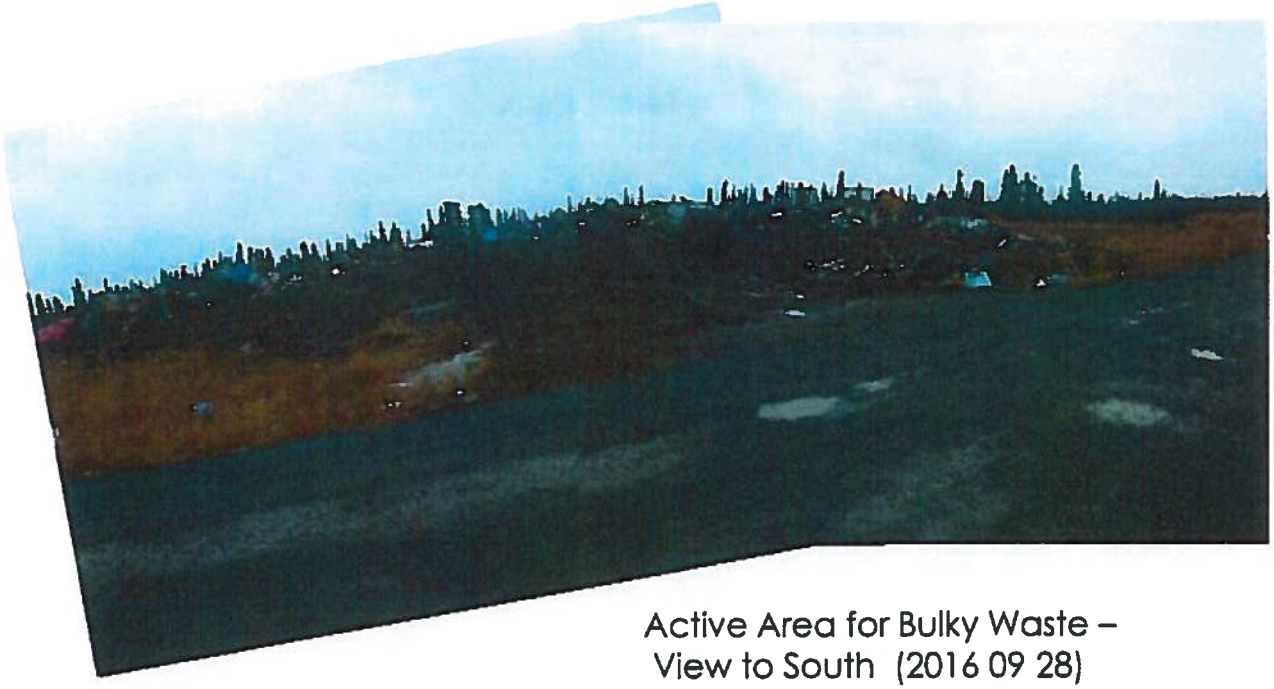


50 metres

Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 2. EXISTING SITE OPERATION
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC

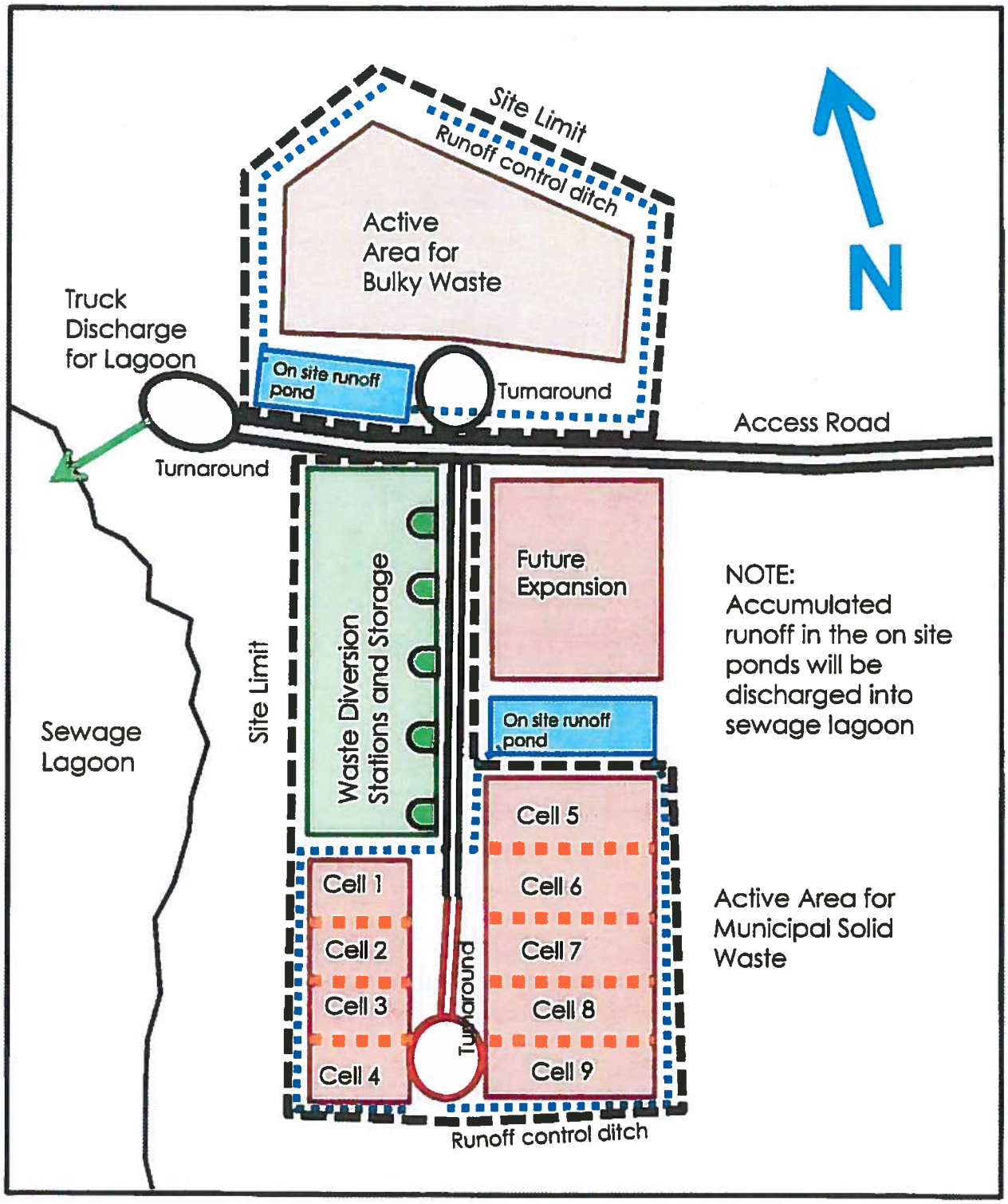
Active Area for Municipal Solid Waste – View to South (2016 09 28)



Active Area for Bulky Waste –
View to South (2016 09 28)

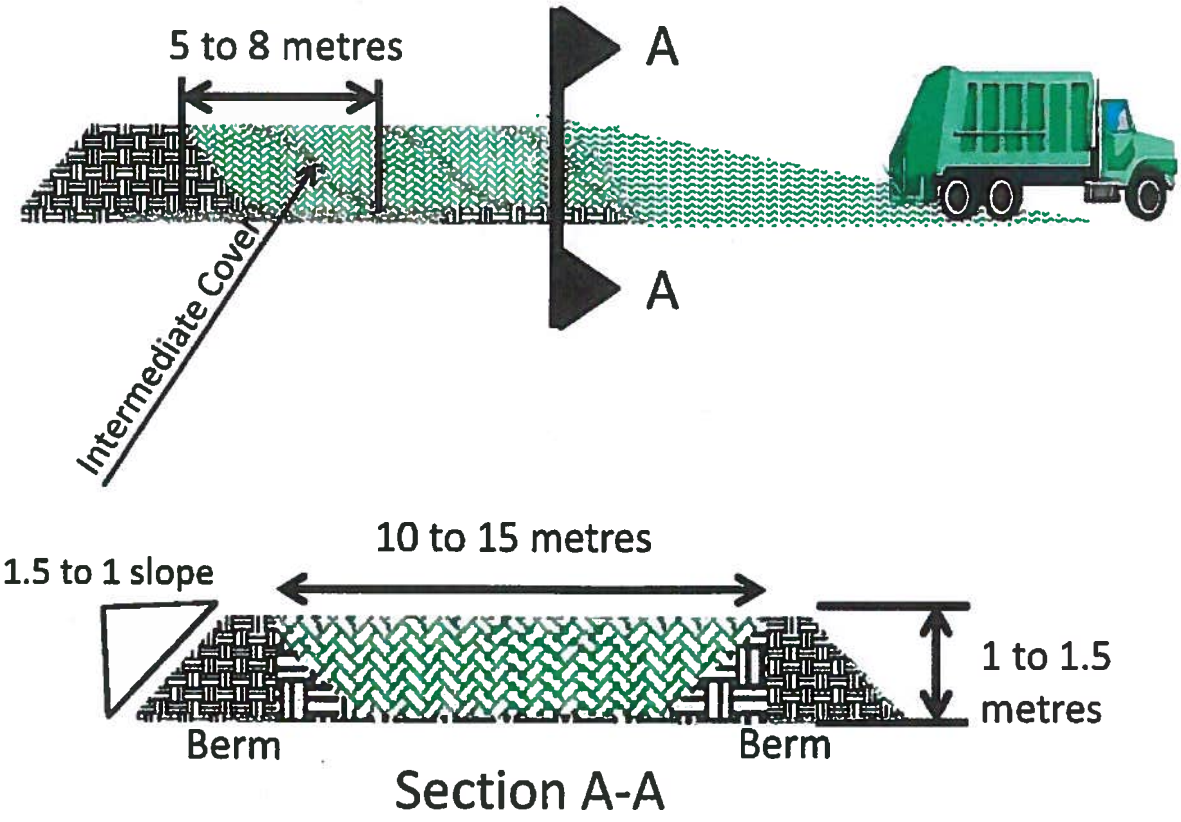
Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 3. EXISTING SITE PHOTOGRAPHS
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC



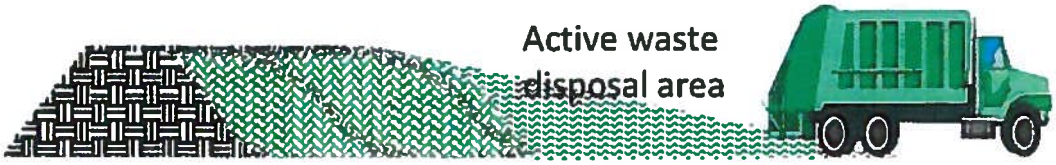
Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 4. EXISTING SITE IMPROVEMENTS
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC

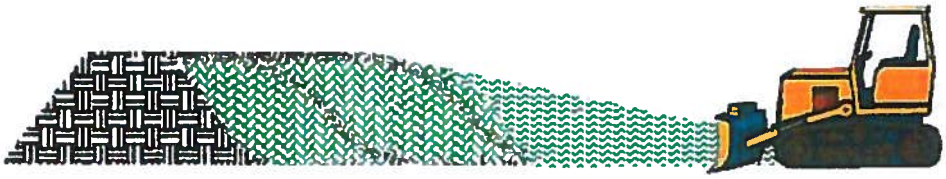


Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 5. WASTE CELL CONFIGURATION
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 06

KAVIK-STANTEC



Working area in cell



Consolidation of waste in working area

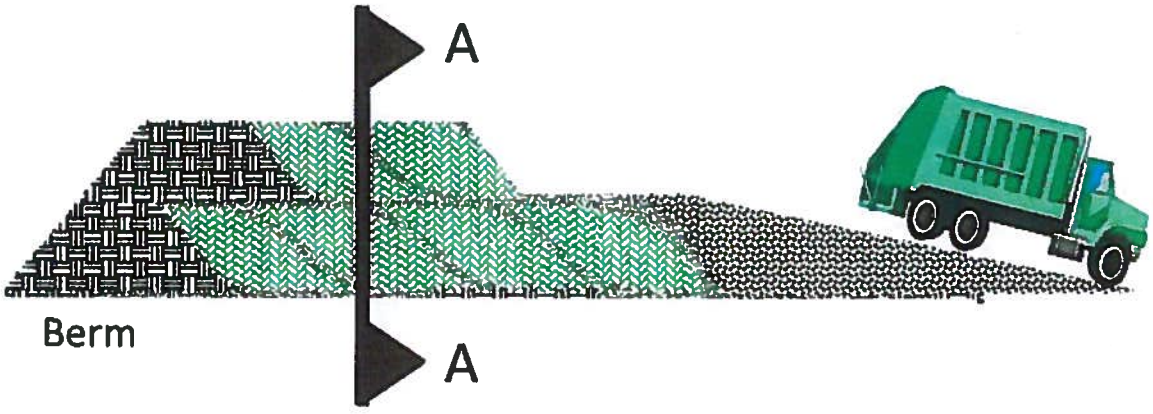
Compaction of consolidated waste

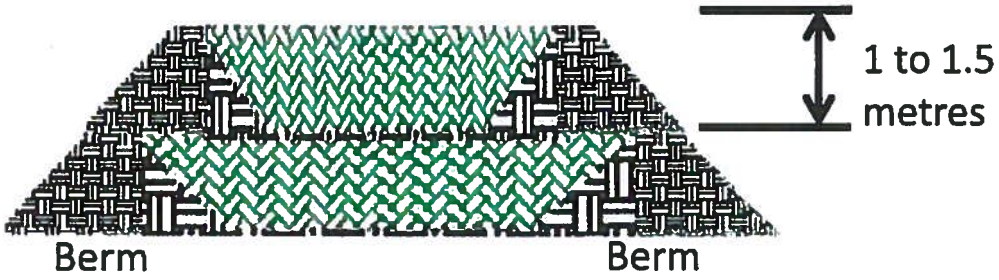
Addition of intermediate cover

Compaction of intermediate cover

Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 6. WASTE CELL MANAGEMENT
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC





Section A-A

Hamlet of Aklavik, NT
Solid Waste Planning Study
FIGURE 7. WASTE CELL EXPANSION
Prepared by Ken Johnson, RPP, P.Eng. 2016 11 07

KAVIK-STANTEC

Appendix D

Aklavik Solid Waste Site Improvements

Aklavik Solid Waste Site Improvements

Assumptions

Aklavik needs to build capacity to dispose of solid waste.

There is a planning study for a new disposal site but it is not considered feasible at this time due to financial constraints to constructing a road.

The current solid waste site (on the southern side of the road) can be utilized with careful management and following the mounding method (i.e. build a cell on top of an existing disposal cell).

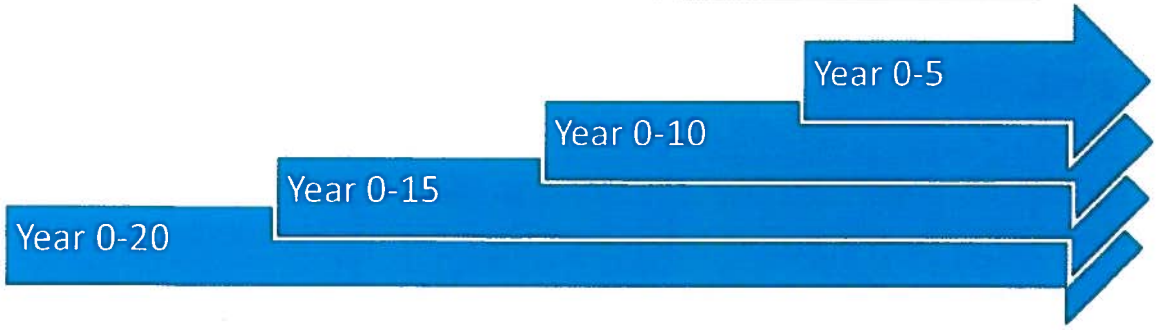
Removing vehicles, appliances, and heating oil tanks from the North side of the road is a work in progress.

Estimated Volume of Waste Generated in a 20 Year Period

Solid waste volume calculations for the Hamlet of Aklavik are made with the following assumptions.

- An average per capita volume of solid waste is 0.017 m3/person/day.
- A compaction ratio of 3:1.
- A slow population growth rate.
- A daily/intermediate cover ratio of 5:1 (solid waste : cover material).

Estimated Volume of Airspace Required for Solid Waste Over 20 Years	
Elapsed Years	**Volume (m3)**
0-5	7,500
0-10	16,000
0-15	26,500
0-20	36,000



Area of Land Suitable for Mounding Solid Waste at the Current Site

The current site appears to have nearly extended laterally as much as possible. It is constrained by water on three sides and a road to the North. It may be possible to clear some tree's to the South and

Northeast in order to develop a footprint of approximately 16,000 square meters. The dimensions of this footprint are approximately 175 m x 95 m. This is outlined in Figure 1.

Three advantages to continuing to use the current site are as follows:

I. The area is already disturbed and contains solid waste, thereby preventing the disturbance of another site.
II. The preexisting solid waste has raised the elevation of the site in relation to it's immediate surroundings. A new site would likely require considerable amount of fill as a base layer as the surrounding area is quite low.
III. It is more cost effective to use the current disposal site then to construct a road and a new disposal site.

Figure 1: GNWT ATLAS image with a proposed landfill footprint of Est. 95 m x 175m

Available Airspace and Volume of Berms

One important objective of managing a solid waste site is to maximize the use of available airspace to dispose of solid waste.

Volume of Airspace = Asset = Place to dispose solid waste

The available airspace can be maximized by placing solid waste in a sequential pattern that minimizes roads, and berms. A simple fill sequencing plan using the mounding method is outlined in **Figure 2** and **Appendix 1** where solid waste is placed in rectangular strips in sequence from the back (South) towards the front (North) over an estimated 20 year period.

Based on the outside dimensions of 175m x 90m the volume of berms required to enclose the perimeter and place solid waste is calculated with the following assumptions.

- Lift One: Berm Height = 2 m
- Lift Two: Berm Height = 1.5m
- 3:1 slopes on the inside and outside of berms

These berms would contain airspace of approximately **38,000 cubic meters**.

The volume of granular required to construct the berms is approximately **10,800 cubic metres**.

Final cover of the solid waste site is estimated to require approximately **7,700 cubic metres.**

The berms for a 20 year lifespan for the solid waste site could be constructed in phases as described in the table below.

Phase	North & South	East	West	Length of Berm	Volume of Granular
Year 0-5	95	40	40	175	3500
Years 5-10		45	45	90	1800
Years 10-15		50	50	100	2000
Years 15-20	95	40	40	175	3500
Sub Total: Amount for Length of berms				**540**	**10800**
Amount of Granular Required for Intermediate Cover					**6,000**
Amount of Granular Require for Closure					**7,700**
Total Estimated Amount of Granular for 20 Year Life					**24,500**

Draft Budget for Phase I Years 0-5

It may not be feasible to complete the construction of a 20 year solid waste site in one project however the berms can be built in phases as the edge of the active face of the solid waste site continues to advance from South → North.

This draft budget outlines what would be required to clear the space and develop the plans for a 20 year site and include enough budget to construct the Southern segment of the solid waste site.

Description	cubic metres	Cost
Design Drawings		$ 50,000
Project Management		$ 25,000
Site Elevation Survey and Engineered drawings		$ 35,000
Site Grading (2 pieces, $250/hr., 10 days)		$ 40,000
Mobile Litter Fence x 4[1]		$ 40,000
Granular at $110 per cubic meter	3700	$ 410,000
Total		**$ 600,000**

Figure 2: Illustration of the Mounding Method outlined in the MACA Solid Waste Guide

3.8 MOUNDING TO PROVIDE ADDITIONAL LIFE

With any of the recommended methods, additional life can be added to a site by mounding as shown in Figure 3-4. Slopes should be maintained for safe operation of equipment, prevent erosion, and minimize costs for cover material. Geotextile fabrics will promote slope stability.

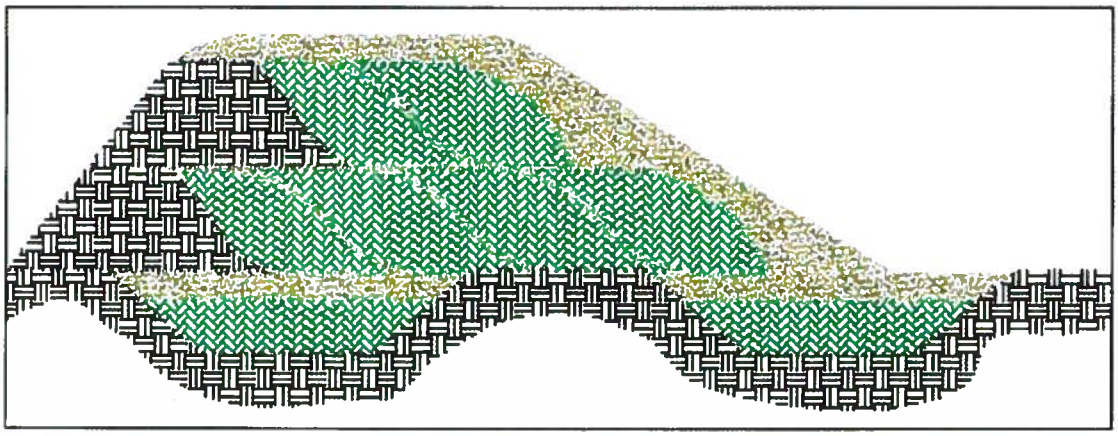


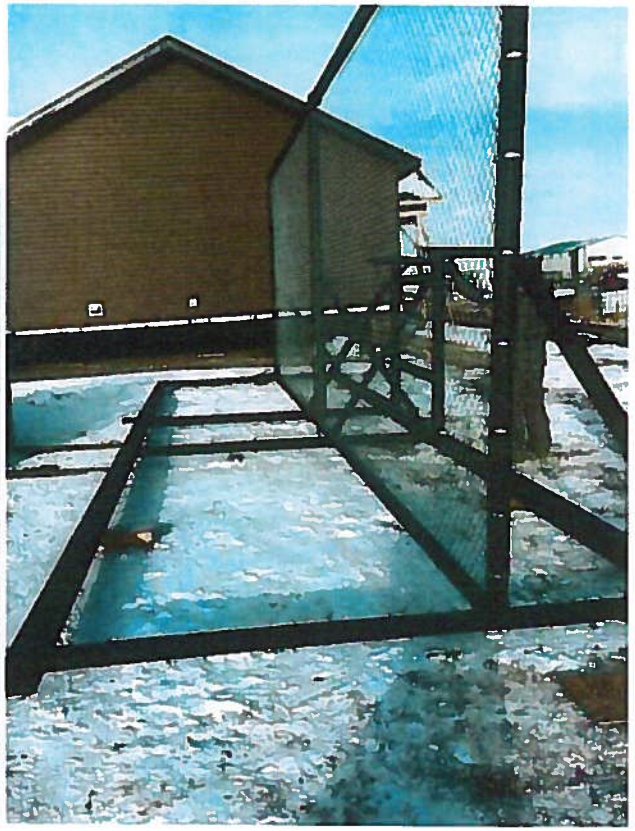
Figure 3-4 Mounding Concept

[1] Examples displayed in the Appendix

Appendix 1 : Simplified Fill Sequencing plan for the Solid Waste Site.

Appendix 1 : Simplified Fill Sequencing plan for the Solid Waste Site.

THE BULL LITTER FENCE WITH CANOPY



Supplier	website	fence			price	Number	Cost	Transpor-tation	Total
		length feet	height feet	weight lb.					
Metta Technologies	http://www.mettatechnologies.com/	24	15		$5,180	4	$20,720	$19,548	$ 40,268
Wind & Sun Protection Inc.	http://www.windandsunprotection.com/	30	9	2800	$5,300	4	$21,200	$15,000	$ 36,200