ATIKAMEKSHENG ANISHNAWBEK

SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT

Final Report

Submitted by: First Nations Engineering Services Ltd.

FNESL Project No.: 38062

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EXECUTIVE SUMMARY

First Nations Engineering Services Ltd (FNESL) was retained by Atikameksheng Anishnawbek to complete a Solid Waste Management Plan (SWMP) and Landfill Assessment. FNESL retained Pinchin Environmental to complete an assessment of the existing landfill site and the abandoned waste site located approximately 2 km north of Lake Penache.

To determine the First Nation's waste disposal needs all background studies were reviewed and previous recommendations were taken into consideration. The existing landfill was assessed to determine is remaining usefulness. Pinchin created a Digital Terrain Model from a drone survey, collected and analyzed groundwater and surface water samples and provided historic waste deposit estimations at the existing landfill site and abandoned waste site. It was determined that the results of this assessment are not considered to be a significant environmental concern. Continued monitoring is recommended. Based on the topography and recommended slopes of the active site, there is a remaining capacity of 10,000m^3 remaining. A site closure plan for the active site is included in Pinchin's assessment. It is recommended no further waste disposal occur at the closed waste site.

FNESL completed 20 year population projections and a waste generation analysis. It was estimated a total volume of 80,472m^3 of waste would be generated by the community over the next 20 years. The total waste volume does not take into account the implementation of any diversion methods. Based on this estimation the existing landfill site would reach its capacity by 2022, without recycling. An analysis of potential diversion quantities is included in the report. The First Nation currently has a recycling program, however full participation is not practiced at this time. If full participation of the recycling program was practiced the existing landfill's capacity could potentially extend to 2024.

A number of alternatives to meet the community's 20 year waste disposal needs were analyzed and the following alternatives were determined to be possibly feasible:

	Alt 1: Do Nothing	Alternative 4: New Landfilling Site (with Diversion)	Alternative 5: New Landfilling Site (without diversion)	Alternative 6: Haul Off-Reserve to an Existing Landfill Site
Capital Cost	$1,114,289	$5,129,773	$4,119,759	$1,749,693
O & M	$70,204	$119,704	$70,204	$63,000
20 Yr LCC	$1,445,814	$7,079,246	$6,407,875	$4,488,593

These alternatives were presented to the community for input through community meetings and an online survey. A majority of respondents were in support of Alternative 6: Haul Off Reserve to an Existing Landfill Site. Alternatives were also scored on several criteria, including ease of maintenance, land requirements, environmental impacts, economic impacts and costs. Alternative 6 scored the highest based on this criteria.

The City of Greater Sudbury's Waste Management Department was consulted regarding the acceptance of Atikameksheng's solid waste, and are in support of the recommended alternative. The recommended alternative to Haul Off-Reserve to an Existing Landfill was further refined. The costs and efforts of the First Nation hauling the waste to CGS Landfill was compared to contracting out the services to a third party. These alternatives are summarized in the following table.

	Alt 6a: FN to Haul Waste	Alt 6b: Contractor to Haul Waste
Description	Recycling program is maintained, FN purchases and maintains their own bins and trucks. Waste and recycleables would be collected weekly from curbside and stored at the transfer station. FN would haul full waste bins to CGS Landfill site.	FN would still complete curbside pick up of waste and recycleables and store in bins at transfer station. A contractor would be retained to supply bins and collect when full. Contractor would haul waste to CGS Landfill. Fees for contractor include hauling and tipping fees.
Capital Cost	$2,673,429	$2,431,429
O&M	$114,937 - $127,277	$84,243 – $93,205
20 Year LCC	$4,837,694	$3,785,811
Advantages	Employment for FN members FN won't need to rely on an outside contractor	Costs are lower Less O&M effort required
Disadvantages	Costs are greater More O&M effort is required.	Public Works has continued responsibility for curbside pickup FN has no control over contractor fees

Based on this comparison it is recommended the First Nation contract out the services to haul the waste off the reserve. Capital costs of this alternative include the construction of a transfer station and the decommissioning of the existing landfill.

Decommissioning of Existing Landfill	$845,889
Transfer Station	$1,585,540
Total Capital Cost	**$2,431,429**

The following steps will need to take place and an estimated timeline/milestone is included:

2020-22	CGS to expand Environmental Compliance Application
2020-21	CGS and Atikameksheng to review and approve a Municipal Type Service Agreement, a template provided by ISC has been included in the Appendices.
2020	Begin funding applications for design and construction of landfill closure and new Waste Transfer Station.
2021	Upon funding approval, retain consultants for design and contract administration services through competitive bid process. A project manager will also be required.
2022	Construction works of existing landfill site closure and new Waste Transfer Station to be underway.
2022	Tender out contractor services to haul waste from New Transfer Station to CGS Landfill.
2023	New Waste Transfer Station fully operational.

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1.0 INTRODUCTION

First Nations Engineering Services Ltd. has been retained by Atikameksheng Anishnawbek to complete a Solid Waste Management Plan. The First Nation has identified the need to improve their existing waste management practices, plan for future waste disposal needs of the community and, address the condition of the existing landfill site. An assessment of the community's abandoned disposal site was also completed.

1.1 Project Background

Atikameksheng Anishnawbek is located approximately 20 km west of the City of Greater Sudbury (CGS) downtown core and just south of Regional Road 55, as seen in Figure 1: Location Plan. Atikameksheng has a current land base of 43,747 acres, as seen in Figure 2.0: Study Area. As of December 31, 2018 the First Nation has a total membership of 1,293 members and a total on reserve population of 475 people. The core developed area of the community is situated near Simon Lake. This area is serviced with a water distribution system, three phase hydro, telephone, natural gas and recycling services.

The remaining portion of the reserve contains eighteen lakes, surrounded by 8 other lakes and much of the land is covered with deciduous and coniferous forests. Along the shores of Lake Penage, there is 43.5 acres of land surrendered for the purposes of leasing for cottagers. The cottagers waste disposal requirements are not included in this study.

Atikameksheng Anishnawbek historically had a communal well system connected to residence via watermain. The First Nation now has communal water servicing with a potable water supply from CGS. The community still relies on individual septic systems for wastewater disposal. The community consists of approximately 138 homes. Atikameksheng owns and operates a community landfill site, community complex, health station and public works garage. The community also has a gas station, several convenience stores, and police building, as shown in Figure 3.0: Existing Community.

The community provides weekly garbage collection and transports solid waste to the existing landfill site 1.5 km south of the main community. At the landfill site, a large bin is provided where members can separate recyclables. Segregation for tires, metal, wood and hazardous waste are performed on site to reduce the loading on the landfill.

Blue box collection is provided by CGS services under a Municipal Transfer Service Agreement. Service provided is a single stream recycling program, all recyclables are collected in one receptacle, the recyclables are transferred to the CGS's sorting station for processing.

Composting collection is not provided to the community and several residents practice backyard composting. A communal composting area was presented to community members but concerns with attracting wildlife was identified.

1.2 Previous Reports

Waste Management Plan Study – Neegan Burnside(Oct. 2003)

Neegan Burnside completed a Waste Management Study for Atikameksheng Anishnawbek. The existing landfill was evaluated for existing lifespan remaining and ability to service the needs of the First Nation community. The existing site has been servicing the community since at least 1980 and was approaching the end of its lifecycle.

Population projections were completed for a 20 year study period using a growth rate of 1.5% and provided waste generation volumes utilizing the rate of 1.8 kg/person/day.

Summary of findings of the study are:

- The existing landfill site is reaching capacity and is located within an area unsuitable for landfilling for the next 20 years
- The existing site should be closed
- Initially, off-Reserve disposal options are extremely limited as surrounding municipalities indicated they are not approved or unwilling to accept 20 years of waste from the First Nation
- Incineration and other technology based waste disposal options were determined to be too costly for the community
- Community consultation indicated concerns with the environment and the existing landfill. The community also showed interest in recycling
- There are a number of candidate areas in the central portion of Reserve lands identified as potentially suitable for the establishment of a new landfill site
- A preliminary field screening program examined a number of sites identified by the First Nation from the candidate sites
- Three potential landfill sites were found to meet the requirements during the preliminary field screening program and a single site was identified as the preferred location for a new landfill

Recycling and waste diversion were recommended to continue to be developed and practised to reduce the volumes of waste landfilled.

Following the distribution and review of the Draft Report, continuing discussions with the CGS resulted in City Council approving a motion to accept municipal solid waste from the First Nation. Preliminary costing based on $72/tonne for tipping fees indicated this would be by far the most economical alternative and was the recommended alternative in the Final Report.

Environmental Management Action Plan – WESA BluMetric Company (2014)

Atikameksheng retained WESA to complete an Environmental Management Action Plan (EMAP). A draft copy was reviewed. An EMAP outlines a systematic approach to identifying environmental issues or concerns and identifies and prioritizes the required actions that are required to be taken to properly manage the environment. The plan provides an environmental description of the First Nation territory. The Atikameksheng Anishnawbek is part of the Site District 5 E-5 within the Ontario Shield Ecozone. The typical surface area of these regions is roughly 10% lakes and rivers as well as about 2.5% wetlands. The reserve is situated within the Sudbury Igneous Complex characterized by mineral-bearing ore bodies.

Expansions to the original community with the development of residential subdivision following an east-west ridge lying to the southwest of the Village. Along Junction Creek, the community is currently developing an industrial subdivision expanding in the northeast boundary of the community.

Near the southeastern boundaries of the reserve, a historical gold mine was located near Long Lake. There is a contaminated site resulting from the four tailings ponds from when the mine was operational. Near the southwestern portion of the community, another mineral rich deposit is located near Lake Panache.

Historically, the McCharles Lake Landfill Site had the potential of releasing contaminants to the surrounding areas. This site no longer accepts waste for disposal but acts as a transfer site for the City of Greater Sudbury.

As of November 2014, the community's existing landfill did not have a gate or security installed for the site. Proposals to restrict operational hours throughout the week as well as have an attendant present during operating hours have been presented to Chief and Council. This has since been addressed.

The community does not practice composting/green box collection. Curbside blue box collection is provided to the main community as well as band owned and operated weekly garbage collection. Household batteries can be brought to the administration office for disposal. Burning of any waste within reserve boundaries is strictly prohibited.

The community has committed to development of a Communications Strategy for waste diversion which includes activities such as development of a recycling calendar, quarterly Recycling Champion awards, annual recycling Lunch and Learn activities and an Annual General Meeting normally held by the community to report on community achievements for the year and plans for the future.

The intention of this plan was to have a suite of environmental laws developed for the First Nation, however no environmental laws have been enacted to date.

1.3 Study Objectives

- Assessment of the existing landfill site and the abandoned landfill site at Penage, along Blackwater Rd.
- Project a 20 year population and its waste generation
- Determine the remaining life of the existing landfill
- Alternatives / recommendations provided for:
    - Future operational plans for the landfill site including on-going health & safety, security, final capping, closure and long-term monitoring;
    - Possible need to close and cap the previous land fill sites,
    - Recycling options,
- Comparison Analysis between:
    - establishing new Transfer Station, and options for entering a Municipal Service Agreement, or
    - Direct Drive option for local pick-up by local Municipality.
- Funding needs and sources;

- Provide a final Waste Management Plan based on community consultations

2.0 LANDFILL ASSESSMENT

Solid waste is picked up at curbside once per week with a ¾ tonne pickup truck then transported to the landfill site located 1.5 km southeast of the main community. Existing landfill site location can be seen in Figure 4.0. Residents also have the option to personally drop off waste at the landfill site as required. Currently Atikameksheng Anishnawbek is disposing their solid waste at an existing landfill south of the community. Access is via gravel driveway off of Blackwater Rd. The site is equipped with disposal bins where waste is disposed of by the Public Works Department or residents. Once bins are full, Public Works will empty into the active fill area and periodically cover with granulars. When the site is not operational, the entrance gate is locked. There is currently no regulated water quality monitoring program. The community has concerns with the attraction of wildlife to the landfill site, increasing the chance for individuals to have an encounter with a wild animal.

Pinchin Environmental was retained to complete an assessment of the existing landfill site and the closed landfill site. The community's closed site can be seen in Figure 5.0. The assessment includes a hydrogeological assessment of the active landfill and the closed landfill sites. The sites were also assessed for historical volumes of waste currently on the site and estimated capacity remaining. Pinchin completed the following tasks:

- Well installation and repair program in order to establish an operable monitoring well network, while installation of new wells include soil sample collection
- Groundwater sampling and monitoring of the new and existing wells
- Collection of representative surface water samples form adjacent surface water features
- Created a Digital Terrain Model from a drone survey to complete an elevation survey and develop a conceptual closure plan for each site
- Provided a historic waste deposit estimation and provided estimated remaining capacity

The assessment considers the following standards, regulations and guidelines:

- Ontario Regulation 903: Wells, under Ontario Water Resources Act
- Ministry of the Environment, Conservation and Parks (MECP) "Landfill Standards: A guideline of the Regulatory and Approval Requirements for New or Expanding Landfilling Sites" dated January 2012
- MECP, "Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario" dated December 1996
- MECP, "Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act", dated April 15, 2011
- Ontario Regulation 153/04: Records of Site Condition – (Aquatic Protection Values (APV))
- Provincial Water Quality Objectives (PWQO) and Canadian Water Quality Guidelines (CWQG) criteria.
- Procedure B-7-1 "Determination of Contaminant Limits and Attenuation Zones"

The methodology of the assessment is detailed in Pinchin's report which can be found in the Appendices. The following is a summary of findings and recommendations:

Soil samples were tested for parameters and limits listed in Table 3 of MECP Standards. Concentrations of VOCs, metals and inorganics in the soil samples from the active and closed site met the applicable standards. It was also confirmed that neither of the sites are within environmentally sensitive areas, as defined within O.Reg 153/04.

In regards, to Groundwater, a background on water quality was collected from Monitoring Well #1(MW1) at the active site and MW1 at the closed site. The active site has MW2, MW3 and MW4 which were sampled, tested and compared to groundwater quality results from MW1. It was determined that there were elevated levels of dissolved organic carbon (DOC) and manganese at each of the monitor wells on the active site, indicating that this exceedance is not landfill derived. Additional concentration exceedences of the ODWQS were observed fro depressed alkalinity at MW4 and total dissolved solids (TDS) at MW2. The results are not considered to be a significant environmental concern.

As for the closed site, MW1 and MW2 were observed to be dry. MW3, MW4 and MW5, which are located downgradient of the waste fill area were observed to have low concentrations of baseline landfill indicator parameters such as conductivity, alkalinity, chloride, calcium, sodium, potassium or nitrate. There were elevated concentrations of DOC at MW4 and manganese at MW3. These parameters were elevated at the active site as well, therefore it is inferred that these concentrations are naturally present in this area and therefore are not sourced from the landfill. The results here are not considered to be a significant environmental concern.

It is important to note, this is one sampling event and regular monitoring is recommended. Continued monitoring of these wells is recommended during the spring and fall for a minimum of three years, to quantify and establish a scientifically defensible database to base community decisions upon.

Surface water samples were collected at SW1, SW2 and SW3. SW1 is located upgradient of the active landfill site and SW2 and SW3 are located downgradient. All parameters analyzed at these locations met the regulatory standards, with the exception of phenols. These elevated concentrations are likely not attributed to impacts originating from the landfill, as this parameter has not been quantified in the groundwater samples and were also detected in the upgradient sampling location. Continued monitoring is recommended during the spring, summer and fall, for a minimum of three years. No surface water samples were collected at the closed site.

Waste volumes at each site were estimated based on the elevation survey. The active site is estimated to have a total volume of 54,750 m^3 buried. The closed site has approximately 2,100 m^3 buried. Based on the topography and recommended slopes of the active site, there is a capacity of 10,000 m^3 remaining here. It is recommended no further waste disposal occur at the closed site.

The assessment concludes with operation recommendations and a site closure plan for the active site. A post closure monitoring for the active and closed site is also discussed.

3.0 POPULATION PROJECTIONS

Planning for the community's future land use is based on the projected growth and demographics of Atikameksheng Anishnawbek First Nation. Historical statistical information was collected and analyzed to determine a realistic community growth rate.

This section outlines the source data, historical population analysis, determines a base population, recommends an average annual growth rate, and ultimately projects a population for the 20-year planning period. In addition, 50-year population projections were completed to ensure that the proposed land use plan and associated infrastructure will not hamper community growth beyond the 20-year planning period.

3.1 Data Sources and Collection

Historical population data from 1988 to 2018, as well as the latest Indian Registry, was obtained from Indigenous Services Canada (ISC). The historical population data was analyzed for trends in the Average Annual Growth Rate (AAGR). The Indian Registry contains demographic data for age, sex, membership, and on- and off-reserve residents.

It is noted that the data is extracted directly from ISC's Indian Registry System (IRS) and have not been updated for late reporting of births or deaths. It should also be noted that the residency codes are for First Nations' registrants and the above numbers should not be taken to represent the true on-reserve population for the following reasons:

- the data does not account for any non-registered individuals who may be living on-reserve
- the above numbers do not account for any members registered to other bands who may be living on reserve
- on reserve historical data includes counts pertaining to First Nation registrants residing on reserve or crown land belonging to other bands

The following section will adjust the base population to account for the above.

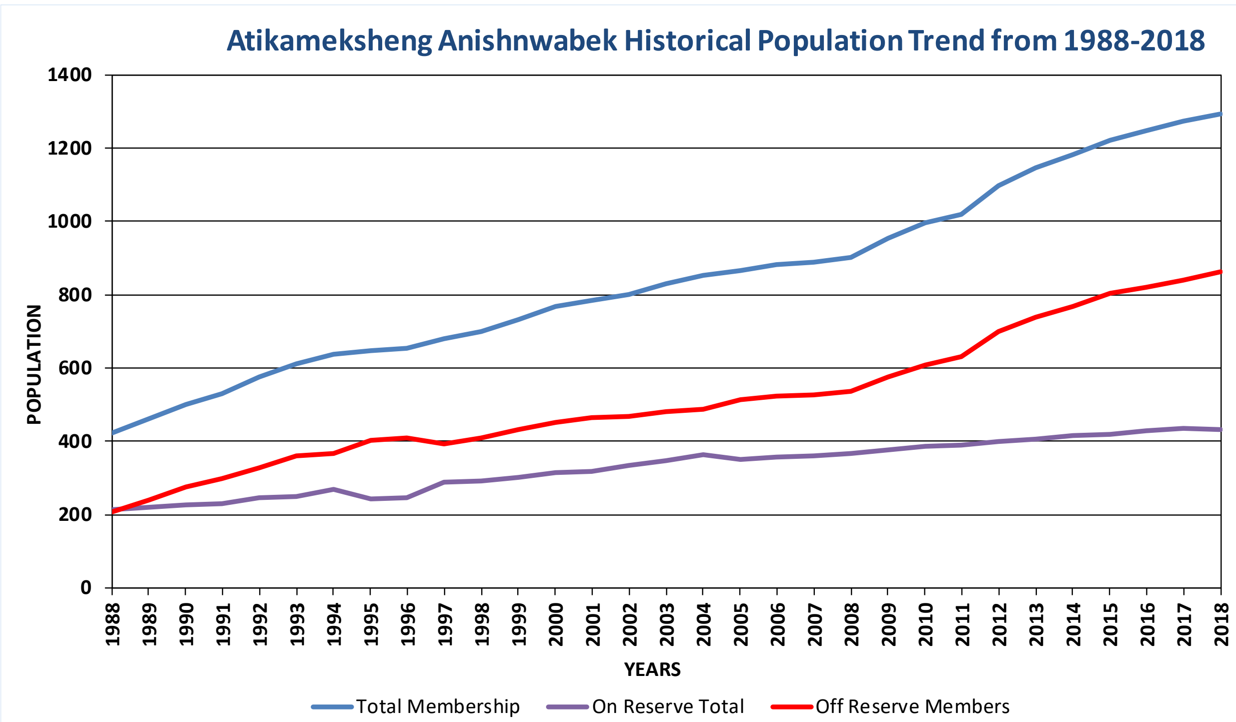
The data provided will used to examine the historical trends and determine an Average Annual Growth Rate (AAGR). The AAGR is calculated using the following formula:

$$AAGR\% = \left[\sqrt[n]{\left(\frac{P_f}{P_i}\right)} - 1\right] x100$$

Where, n = *number of years*
P_f = *population in the final year*
P_i = *population in the initial year*

3.2 Historical Population Data & Analysis

The historical population data from ISC was analyzed for trends in the Average Annual Growth Rate (AAGR). This analysis was completed for the on-reserve, off-reserve, and total population, however the projections that follow are for the on-reserve portion only. The historical data was available for most years beginning at 1988 and indicates that the total membership of Atikameksheng Anishnawbek grew from 423 in 1988 to 1293 in 2018. ISC data indicates that at the end of 2018, there are 431 members living on-reserve and 862 off-reserve, resulting in a combined total membership of 1293, as seen in the following graph.



The plotted data was examined for any significant trends, and one minor trend was found as indicated after 2010, where the slope increases. The increase in the off-reserve population can be attributed to Bill C-3. In December 2010, Bill C-3 received a Royal Assent which ensured that eligible grand-children of women who lost status as a result of marrying non-Indian men will become entitled to registration and receive status. Bill C-3 has been in effect since January 31st, 2011.

Even though the off-reserve population saw a slight increase in 2011, the on-reserve population appears to be relatively steady over the last 30 years.

Modified Demographics

Based on historical populations and previous experience, it has been shown that the total number of children in the 0-4 year cohort are not necessarily registered with the First Nation until a later cohort. The historical data was reviewed to compare the 5-9 year cohort population with the 0-4 year cohort five years earlier to determine the percentage of children on reserve who were registered with ISC between 0 and 4 years old. Percentage of Children Registered in the 0-4 Cohort

Table 1 Percentage of Children Registered in the 0-4 Cohort

Year	Cohort	Male	% not registered	Female	% not registered
2018	5-9 year old	18		18	
2014	0-4 year old	16	11%	11	39%
2017	5-9 year old	15		20	
2013	0-4 year old	15	0%	11	45%
2016	5-9 year old	15		17	
2012	0-4 year old	12	20%	13	24%
2015	5-9 year old	18		17	
2011	0-4 year old	9	50%	10	41%
2014	5-9 year old	16		18	
2010	0-4 year old	12	25%	11	39%
Average % not registered			21%		41%

The results show that on average, about one third of the total children were not registered in the 0-4 year old cohort. The 2018 0-4 cohort numbers can be adjusted to reflect this reality. Table 3 includes the estimated number of children not yet registered from the 0-4 cohort population for 2018.

Table 2 Adjusted 0-4 Year Old Cohort

Average % not registered:		31%	
Year	Cohort	Total Registered	Inflated Total
2018	0-4 year old	27	35

Therefore, a total of 8 children will be added to the 0-4 year old cohort.

Adjusted On-Reserve Population

The First Nation reports the number of non-members living on-reserve in June 2019 was 44. The 2016 Census reports that 30 non-members were living on the First Nation.

Table 3 Adjusted On-Reserve Population

Year	On-Reserve Non-Members	0-4 Year Old Cohort Addition	On-Reserve Members	On-Reserve Total
2018	44	8	431	483

Moving forward, since the ISC data was to the end of December 2018, the adjusted on-reserve population for 2019 will be 483. This number will provide the base population in the following population projections.

Historical AAGRs

The AAGR for the on-reserve and off-reserve populations were calculated for 2018 using the base years of 1988, 1998, and 2008, as shown in the following table. A summary of the historical AAGRs is presented below:

Table 4 Historical AAGRs

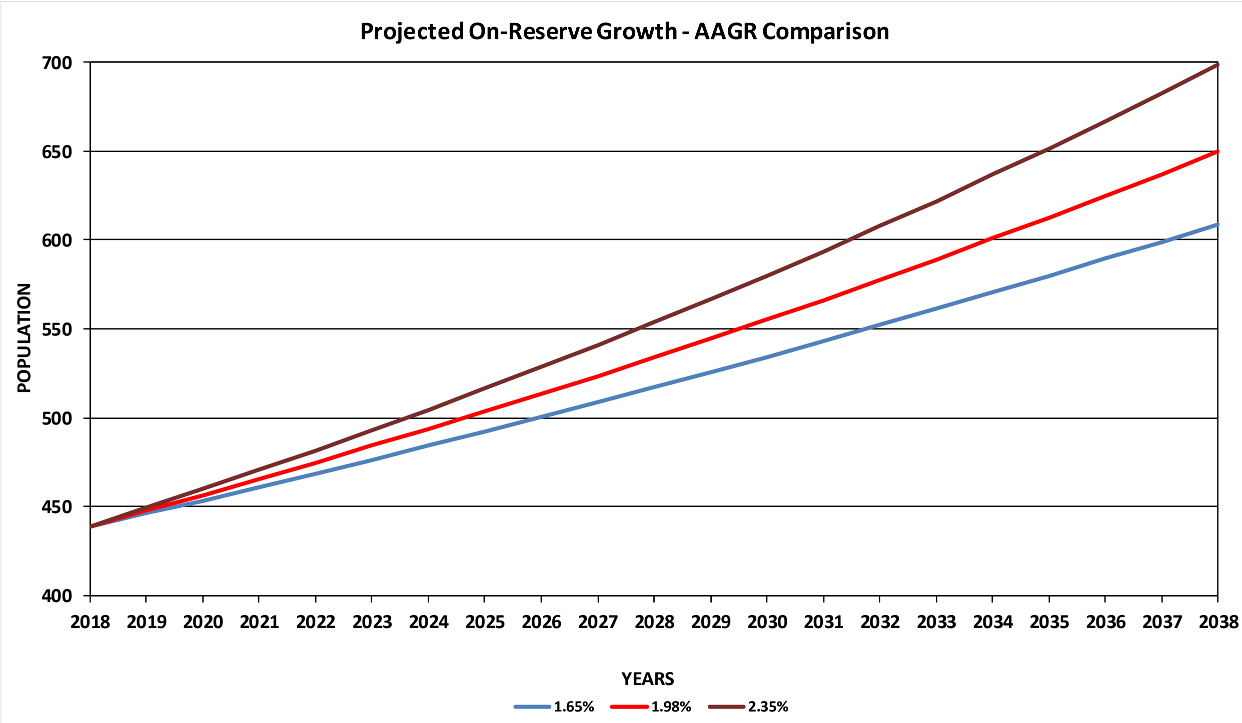
	Total Population	On-Reserve	Off-Reserve
AAGR Base Year 1988	3.79	2.35	4.89
AAGR Base Year 1998	3.12	1.98	3.80
AAGR Base Year 2008	3.66	1.65	4.85

As seen in Table 3, the AAGR for on-reserve members using the base year of 1988 for Atikameksheng Anishnawbek was 2.35, illustrating the last 30 years of growth. The base year of 1998 and 2008 illustrate positive growth rates of 1.98 and 1.65, respectively. The off-reserve and total membership growth rates have been included for comparison, and this study is only concerned with the on-reserve growth.

The 2001 Atikameksheng Anishnawbek Waste Management Study prepared by Neegan-Burnside used a growth rate of 1.5%. Using this rate, with a base population of 333 in 2001, would calculate an on-reserve population of 435 for 2019. This is lower than the actual on-reserve population of 475. This study used historical on-reserve population from 1990 to 2001 to determine a growth rate of 1.5%. Since that time significant development has occurred within the community, such as more commercial developments and the construction of a residential subdivision. It is reasonable to conclude that continuing to use a growth rate of 1.5% would no longer be representative of the on-reserve population.

AAGR Analysis

The following graph compares the historical growth rates displayed in Table 4, On-Reserve population. The 20-year populations respectively are 670, 715 and 769; also the 50-year populations are 1095, 1287 and 1543, respectively for the corresponding growth rates.



Recommended AAGR

The increased local economic growth and the service improvements within the Atikameksheng Anishnawbek are expected to maintain a positive community growth rate. Atikameksheng's proximity to the Greater City of Sudbury provides the community members with amenities and job opportunities, creating an opportunity for members to reach out for other opportunities while still maintaining a home residence on First Nation lands. On-Reserve membership has shown a continuous growth rate. It is recommended that the AAGR of 1.98% be used to project the 20-year population, since it is based on the past 20 years. This growth rate is higher than the previous 1.5% that was used which fell short. The growth rate of 1.65% is slightly higher, however this value is only based on the past 10 years of data. The recommended AAGR of 1.98% would provide a reliable estimate of the on-reserve growth.

3.3 Population Projections

To ensure population projection accuracy, on-reserve population was adjusted to capture membership of the children population not yet registered with ISC. A total of 8 additional members was added to the 2018 population. Data was provided by Atikameksheng Anishnawbek for non-member residence within the community, this population value was added to the community population as well. Based on an AAGR of 1.98%, the projected population of Atikameksheng Anishnawbek was calculated. The resulting 20 and 50 year on-reserve populations can be seen in the following table.

Table 5 Projected On-Reserve Population

	Baseline	5th Year	10th Year	15th Year	20th Year	50th Year
Year:	2019	2024	2029	2034	2039	2068
Population:	483	533	588	648	715	1262

4.0 SOLID WASTE GENERATION

4.1 Waste Generation Rate Analysis

Atikameksheng Anishnawbek First Nation calculated a generation rate of 1.81 kg/cap/d, in their 2003 Waste Management Plan. A waste survey and data was collected during the *Sudbury Area First Nation Recycling Program Implementation Evaluation* study (May, 2012) prepared by Robins Environmental was also reviewed. Ontario First Nation's Solid Waste Management Strategy Planning Manual (1997) uses a generic generation rate of 1.67 kg/cap/d. AANDC's *Community Solid Waste* (2002) document states that the average Canadian produces 1.50 kg/cap/d, while the average First Nation member produces slightly less. Statistics Canada's Waste Management Industry Survey: Business and Government Sectors (2010), states that the average Canadian produces 2.0 kg/cap/d and Ontarian produces 1.92 kg/cap/d.

These generation rates include non-hazardous waste, residential and non-residential waste which have been disposed of at public and private disposal facilities. The waste generation rates to be considered are summarized below:

Source	Generation Rate		Year
Ontario First Nations	1.67	kg/cap/day	1997
AANDC	1.50	kg/cap/day	2002
Atikameksheng Anishnawbek First Nation	1.81	kg/cap/day	2003
Statistics Canada - Canada	2.00	kg/cap/day	2010
Statistics Canada - Ontario	1.92	kg/cap/day	2010

Statistics Canada showed a higher generation rate than the rate provided by Ontario First Nations. Statistics Canada rates include rural and urban districts, and urban areas have more commercial and institutional waste contributors. This will result in the First Nation's waste generation rates to be lower than the rates for Canada and Ontario.

Since Atikameksheng Anishnawbek has known data on the community's waste generation rate, 1.81 kg/cap/day will be used for the purposes of this report.

4.2 Projected Waste Volumes

It is recommended that a waste management plan consider a plan for at least 5 years and a longer term ranging to 20 years. The volume of waste generated is calculated based on an assumed density. AANDC's technical Community Solid Waste states that waste density could range from 50 to 150 kg/m^3 without compaction. It is assumed that waste is slightly compacted and a conservative value of 100 kg/m^3 will be applied to Atikameksheng's generated waste. The projected volume of waste generated was calculated using the following formula:

$$Volume\ \left(m^3/_{yr}\right) = Population\ \times \frac{Generation\ Rate\ (kg/yr/cap)}{Waste\ Density\ (kg/m^3)}$$

An accumulation of waste produced each year was considered and is summarized in the following table: Projected Volume of Waste Accumulated

Table 6 Projected Volume of Waste Accumulated

Year	Volume (m^3)	Year	Volume (m^3)	Year	Volume (m^3)	Year	Volume (m^3)
2020	3,318.6	2025	20,923.3	2030	40,341.4	2035	61,759.5
2021	6,702.8	2026	24,656.2	2031	44,458.7	2036	66,300.9
2022	10,154.1	2027	28,462.9	2032	48,657.5	2037	70,932.2
2023	13,673.7	2028	32,345.0	2033	52,939.5	2038	75,655.2
2024	17,263.0	2029	36,304.0	2034	57,306.2	2039	80,471.7

The above projections do not consider the application of any waste diversion methods (this is the "worst-case" scenario). Therefore, any implementation or continuation of diversion methods will extend the useful life of a landfill site.

4.3 Estimated Area Required

Based on the above projected waste generation, the amount of area required to accommodate this waste has been estimated. This was calculated assuming that waste will be allowed to build up to a height of 3 meters and a 100-meter buffer was applied around the waste as per the MECP's Landfill Standards Guideline stating that a buffer zone be located between the waste fill area and the site boundaries. The areas below do not account for any diversion efforts. Atikameksheng Anishnawbek currently provides weekly blue box pickup service for the community.

Table 7 Estimated Landfill Area Requirements

Year	Total Area (m^2)	Total Area (Acres)	Year	Total Area (m^2)	Total Area (Acres)
2020	54,409.9	13.4	2030	99,831.8	24.7
2021	61,141.5	15.1	2031	103,513.8	25.6
2022	66,655.9	16.5	2032	107,161.0	26.5
2023	71,562.8	17.7	2033	110,782.5	27.4
2024	76,097.2	18.8	2034	114,386.2	28.3
2025	80,379.7	19.9	2035	117,978.5	29.2
2026	84,481.6	20.9	2036	121,564.9	30.0
2027	88,449.4	21.9	2037	125,150.5	30.9
2028	92,315.6	22.8	2038	128,739.6	31.8
2029	96,103.8	23.7	2039	132,335.9	32.7

4.4 Waste Composition

Volume and Type of Waste Generated

The projected amount of waste was determined in a previous section. This section determined the projected volume of waste to be accumulated over the next 20 years. It was projected that the total accumulated volume of waste would be 80,471m^3 by the year 2038. These waste projections included non-hazardous waste, residential and non-residential waste. Preliminary calculations determined that an area of 132,336 m^2 or 32.7 acres would be required, which was based on minimal site information. This estimate requires that the waste fill area will reach a height of 3 m and it assumes there is a 100 m buffer around the waste site.

As reported in the previous section, the existing landfill accepts household waste, construction and demolition materials, electronics, appliances, furniture and tires. There are no records on the proportion of each type of waste. Therefore, a typical waste composition will be used to project the amount of different types of wastes to be accepted by the landfill. These projected volumes of different types of waste will assist in determining an appropriate waste management plan.

Two methods of estimating waste composition have been used as there have been minimal reports or waste audits performed in First Nation communities in recent years on the waste compositions.

Ontario First Nations Report

A waste composition was developed in a Solid Waste Management Strategy Planning Manual (1997) prepared for Ontario First Nations. A sample weight of 2.5 kg is separated into waste categories (Organic, Fibres, Containers, etc). A weight for each category is determined. This composition is used for estimating waste in the whole community during the 20-year waste generation period, which includes residential, business, institutional and commercial/industrial sectors.

Table 8 Types of Waste Generated

Total 20 Year Waste Generation			80,472	m^3
Waste Item		**Weight (kg)**	**Percentage**	**Projections (m^3)**
Organics	Vegetable	0.075	3.0%	2,414
	Processed Foods	0.12	4.8%	3,863
	Meat/Parts	0.06	2.4%	1,931
	Other Organic	0.045	1.8%	1,448
	Total Organic	**0.3**	**12.0%**	**9,657**
Fibres	News/Flyers	0.24	9.6%	7,725
	White	0.24	9.6%	7,725
	Other Fibre	0.55	22.0%	17,704
	Total Fibre	**1.03**	**41.2%**	**33,154**
Containers	Steel	0.075	3.0%	2,414
	Aluminum	0.015	0.6%	483
	Wood	0.06	2.4%	1,931
	Plastic	0.09	3.6%	2,897
	Other	0.015	0.6%	483
	Total Containers	**0.255**	**10.2%**	**8,208**
Other Household Goods	Plastic Film	0.03	1.2%	966
	Foil	0.015	0.6%	483
	Diapers	0.06	2.4%	1,931
	Paper Towels	0.015	0.6%	483
	Other	0.03	1.2%	966
	Total other households	**0.15**	**6.0%**	**4,828**
Miscellaneous Bulk	Clothing	0.03	1.2%	966
	Automobiles	0.27	10.8%	8,691
	Snowmobiles	0.105	4.2%	3,380
	Appliances	0.045	1.8%	1,448
	Furniture	0.03	1.2%	966
	Tires	0.015	0.6%	483
	Building Materials	0.09	3.6%	2,897
	Other	0.075	3.0%	2,414
	Total Miscallaneous	**0.66**	**26.4%**	**21,245**
HH Hazardous Waste	Batteries	0.015	0.6%	483
	Paint	0.03	1.2%	966
	Cleaners	0.015	0.6%	483
	Other	0.045	1.8%	1,448
	Total HHW	**0.105**	**4.2%**	**3,380**
Total weight		**2.5**	100.0%	80,472

Based on the waste composition estimated using the Solid Waste Management Strategy Planning Manual, the following items could potentially be diverted from the waste fill area over the next 20 years. The volumes are summarized in the following table:

Table 9 Potential Waste Diversion Volumes

Waste Items	Volume (m^3)
Organics	9,657
Recyclables (fibre, cardboard, plastic, metal, etc.)	39,431
Automobiles	8,691
Snowmobiles	3,380
Appliances	1,448
Furniture	966
Tires	483
Building Materials	2,897
Household Hazardous Waste	3,380
Maximum Potential Volume of Waste to be Diverted:	70,332
Percentage of Diverted Waste:	87%

**Estimates assume 100% community participation*

The above estimation indicated that there is a potential to divert up to a maximum of 87% of generated waste from landfilling. Achieving this entire diversion rate would be overly optimistic as it would require 100% participation rate, but it would significantly reduce the required fill area. The existing landfill operation has managed to divert several of the items in the above table, such as building materials, tires, furniture, appliances, automobiles and snowmobiles.

MECP Residential Waste Composition

Another commonly used estimate is based on the 2004 MECP Residential Waste Composition. This guideline has been used in other Ontario First Nation Technical Services estimates for waste compositions on the First Nation communities.

Residential waste is divided into the following categories shown in the table. The estimated 20-year volumes of waste generated according to each category have also been shown:

Table 10 MECP Waste Composition

Type	**Composition**	**Volume (m^3)**
Paper	24%	19,313
Food	25%	20,118
Other	26%	20,923
Plastic	4%	3,219
Aluminum	1%	805
Ferrous	2%	1,609
Glass	5%	4,024
Yard	13%	10,461
Total	**100%**	**80,472**

Based on the MECP Residential Waste Composition figures, it is estimated that 34% of the material (paper, plastic, aluminum, glass) can be recycled, while 38% of the material (food and yard waste) can be composted. The 2% ferrous or metal components (including cars etc.) can be salvaged from the scrap. The "Other" 26% would include hazardous wastes, electronics, furniture, etc. Programs can be introduced to encourage members to continue reducing their waste output. These reduction levels should also be more achievable.

4.5 Diversion Programs

The Minister of the Environment, Conservation and Parks website, provides information on how waste is managed in the province. The site reports the policies, rules and regulations that guide Ontario's resource recovery and waste reduction which include:

- Resource Recovery and Circular Economy Act (RRCEA), 2016
- Waste Diversion Transition Act (WDTA), 2016
- Environmental Protection Act (EPA)
- Environmental Assessment Act (EAA)
- Nutrient Management Act (NMA)
- Food and Organic Waste Policy Statement (FOWP)

The Environmental Protection Act addresses waste collection, disposal and environmental approvals, including:

- Landfill design standards under Reg. 232

- Standards for disposal sites, the management, tracking and disposal of hazardous and liquid industrial waste under Reg. 347
- Requirements for landfill gas collection under Reg. 217
- Requirements for municipal Blue Box programs under O. Reg. 101/94
- Requirements for IC&I sector to reduce waste and recover resource under '3Rs' regulations: O. Reg. 102/94, O. Reg. 103/94 and O. Reg. 104/94
- Requirements for producers of pharmaceuticals and sharps to establish free collection locations across Ontario for pharmaceuticals and sharps they no longer need under Reg. 298/12
- Ontario Compost Quality Standards under Reg. 347 and Guidelines for the Production of Compost

First Nations are not obligated to comply with provincial waste management regulations. In the absence of federal regulations, it is recommended that First Nations in Ontario adopt, where possible and practical, provincial regulations, standards, or guidelines.

The Ontario government first introduced policies and programs directed at waste diversion during the late 1980's and early 1990's. Diversion targets, announced by MECP in 1989, called for diversions of at least 25% of Ontario's solid waste from disposal facilities by 1992, and at least 50% by the year 2000. The Waste Reduction Action Plan introduced by MECP in February 1991, included regulatory measures; financial and technical support; public education; and the development of markets for recyclable materials, to promote waste diversion.

The 3R's (Reduction, Reuse, and Recycling) Regulations, introduced by MECP 1994, under the Environmental Protection Act, consisted of four regulations including:

- Recycling and Composting of Municipal Waste (O. Reg. 101/94)
- Waste Audits and Waste Reduction Work Plans (O. Reg. 102/94)
- Industrial, Commercial, and Institutional Sources Separation Programs (O. Reg. 103/94)
- Packaging Audit and Packaging Reduction Work Plans (O. Reg. 104/94)

O. Reg. 101/94 requires every municipality with a population of 5,000 or greater to operate a Blue Box recycling program which accepts five mandatory materials, plus two other materials which may be selected from a schedule. Mandatory materials established by the regulation include aluminum containers, glass containers, newsprint, polyethylene terephthalate (PET) plastic bottles and steel containers. The regulation also includes requirements for the establishment of a yard waste composing system.

Waste Diversion Act

Although regulations expanded the Blue Box programs to municipalities throughout Ontario, funding of the program became a significant concern, as revenues from recycled materials failed to offset cost of operations and Municipal programs became dependent upon subsidies provided by the Provincial Government. Despite review of the problem and proposals to resolve the issue, throughout the 1990's, the funding shortfall issue remained contentious throughout the 1990's, between the Association of Municipalities of Ontario, Ministry of the Energy, Conservation and Parks, and industry associations. A Memorandum of Understanding signed in 2000, between industry associations, Association of Municipalities of Ontario, Recycling Council of Ontario, and MECP to work cooperatively to achieve sustainable municipal recycling, eventually led to the development of the Waste Diversion Act.

The Waste Diversion Act, 2002 was developed to provide for the development, implementation, and operation of waste diversion programs, and promote the reduction, reuse and recycling of waste, within Ontario. The Waste Diversion Act, 2002 effectively shifted responsibility from MECP to industry for management of products & packaging that enter the waste stream; developing, implementing & operating diversion programs; and initiatives required to achieve performance goals (i.e. marketing, R&D, education). The Waste Diversion Act, 2002 also switched burden of funding of diversion programs to industry and consumers, through Industry Funded Organization, and consumer fee.

In 2004, Ontario put a paper which increased the Waste Diversion Goal to 60%. Many communities have successfully increased their waste diversion from 28% to 63% in five years. In recent years, some municipalities have even created "Zero Waste" goals.

On November 30, 2016 the Waste-Free Ontario Act, 2016 (WFOA) was proclaimed. The Resource Recovery and Circular Economy Act, 2016 (RRCEA) and the Waste Diversion Transition Act, 2016 (WDTA) have been enacted by the WFOA. The RRCEA and the WDTA replace the Waste Diversion Act. Under the Act there is a new organization – Resource Productivity and Recovery Authority (RPRA). This Authority is a regulatory body that is playing a critical role in supporting the transition towards a circular economy and a waste-free Ontario. The Authority replaces Waste Diversion Ontario and will oversee new and existing programs.

Waste Diversion Ontario (WDO), which is being replaced by RPRA, was a non-crown corporation created under the Waste Diversion Act to work co-operatively with an Industry Funding Organizations to develop a waste diversion plan for designated waste. RPRA is now responsible for conducting public consultation on matters referred to by the Minister of the Environment, Conservation and Parks.

WDO has been designated responsibility for Blue Box Wastes, Used Tires, Municipal Hazardous or Special Waste (MHSW) and Waste Electrical and Electronic Equipment (WEEE), diversion programs. The Used Tire Program was developed by Waste Diversion Ontario, Ontario Tire Stewardship, and the Industry Funded Organization to provide convenient opportunities for individual consumers and businesses to direct passenger and commercial tires for re-use, retreading, and recycling programs.

As of January 1, 2019, the Ontario Tire Stewardship is no longer responsible for managing tire recycling. Resource Productivity & Recovery Authority (RPRA) will be overseeing the tire program.

The Ontario Electronic Stewardship (OES) is the Industry Funding Organization (IFO) for the Waste Electrical and Electronic Equipment Program Plan. The program provides for 44 different products as eligible for diversion from landfill through a network of recycling and reuse partners who have met specific standards under the program and are monitored on a regular basis. As of 2019 this program has begun winding up, RPRA is currently completing consultations for this process. Recycle My Electronics website reports the nearest drop off location for Atikameksheng Anishnawbek is in City of Greater Sudbury at their 120 McCharles Lake Road, the Walden Transfer Station landfill.

As of August 15, 2019, MECP issued direction to RPRA and Stewardship Ontario to begin to transition the management of Ontario's Blue Box Program to producers of plastic and other packaging. The will enable the transition of materials collected under the program to individual producer responsibility under the RRCEA, 2016. Under the Waste Diversion Transition Act, 2016, RPRA is responsible for overseeing the orderly wind up of current waste diversion programs and the industry funding organizations responsible for managing those programs. During the transition, Stewardship Ontario will continue to operate the Blue Box Program without disruption.

4.6 Estimated Diversion Potential

To extend the service life of the landfill site, it is recommended that diversion plan be incorporated into the overall waste management plan. Recycling programs are extensive throughout Ontario and there are many variations on the same theme of recovering useful materials from waste prior to its disposal.

Recycling

The Blue Bin program is often used in other cities in Ontario. Waste producers leave their recyclable wastes at the curbside in blue containers provided by the recycling company or municipality. All residential customers will generally use one or more blue boxes (0.1 m^3 capacity), while commercial/institutional/industrial customers prefer larger blue bins with a minimum capacity of $0.5m^3$. The recyclables are sometimes separated by the producer and sometimes by the collector at the pick-up point and shipped to a sorting and processing plant. The level of sorting required at that point is dependent upon the efficiency of the producer and the collection system. However, some degree of sorting is required before the product is prepared for re-sale, usually by compacting and baling.

There are many variations of this basic system in practice throughout Ontario depending upon the available types of collection vehicles, the equipment available at the processing plant and the types of products to be recycled.

Currently the recycling program for the Atikameksheng Anishnawbek is provided by the City of Greater Sudbury under a Municipal Transfer Service Agreement with a single stream collection system.

FNESL recommends that Atikameksheng Anishnawbek First Nation continue to encourage community members to participate in removing their waste including diverting the waste correctly by recycling, composting, scrap metal etc. Continued community education will provide members about the benefits of the program and incentives that could be put into place. Additional programs can also be put in place at community areas to learn about the benefits of waste reduction. The least complicated recycling method for smaller communities and their members is usually through a single stream process. In a single stream process, all recyclables can be collected together without previous sorting and delivered to a recycling facility. The sorting of the different recycling materials will occur internally at these facilities.

Based on the MECP Waste Composition, by diverting the recyclables from the current landfill site would result in the following maximum space saving over the 20-year planning period. The maximum 20-year estimated volume of recyclable is 27,361 m^3 and includes items such as paper, plastic, aluminum and glass:

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
*Diversion with Recycling only	53,111	11.1	27.4

Recycled Items: Paper, Plastic, Aluminum and Glass
**Based on a 100% participation*

Composting

Composting is the aerobic or anaerobic decomposition of organic wastes which is accomplished naturally by soil organisms. In time the compost product can be used as a natural soil but may be subject to chemical conditioning depending upon the initial waste product used. There is currently no communal composting of organics (whether meats or plant-based) at Atikameksheng Anishnawbek First Nation.

Statistic Canada 2011 identified that approximately 61% of Canadian homes compost regularly. It is estimated that approximately 45% households reported composting their food waste and up to 68% of households reported composting their yard waste. This will represent a potentially significant reduction in waste to be disposed of at the current landfill site. There are generally two types of composting presently available: backyard composting and centralized community composting, which is discussed in the following sections.

Based on the MECP Waste Composition in Table 18, if Atikameksheng Anishnawbek community members begin to participate in a compost or green bin/bag program, items diverted from the landfill would result in the following maximum space saving over the 20 year planning period. The maximum 20 year estimated volume of compostable materials is 30,580 m^3 and includes items food and yard waste.

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with Composting only	49,892	10.8	26.7
*Diversion from Recycling & Composting	22,532	8.2	20.3

Composted Items: Food and Yard waste
**Based on a 100% participation*

However, it has been found that acceptance of these concepts are still growing, so a more conservative estimate of 45% participation rate is anticipated for recycling and compositing.

Alternative 1: Backyard Composting

Many residents in Ontario practice backyard composting for household wastes. These typically are free standing plastic bins designed for suitable airflow with a capacity of +/-0.3m^3 to provide aerobic composting. The composters are designed to accept household food and vegetable wastes together with garden wastes and produce a soil which is suitable for residential lot use.

A typical backyard composter retails in the range from $70 to $500 and there are numerous manufacturers. All models come with operational instructions and their success is solely dependent on the will of the user.

Alternative 2: Centralized Composting

Many municipalities and regions are utilizing centralized composting plants for their green bag and yard waste collections. There are a number of processes based upon both the aerobic and anaerobic decomposition principles. The simplest process uses windrows (mounds) of waste which are periodically turned over/tilled to introduce air/oxygen and encourage the aerobic decomposition. Other more sophisticated mechanical plants used compressed air, heat recovery and methane recovery and result in a speedier anaerobic composting process in a more confined space and are this better suited to an urban environment.

These larger community systems are more efficient than backyard composters but must have a market for the compost and energy produced. Because the wastes used are also often from commercial/industrial/institutional sources they are not always consistent, and the chemical quality of the compost produced must be carefully monitored and suitable for sale. CGS collects and processes compostable waste. Rather than considering their own centralized composting, it is recommended that Atikameksheng consider diverting their compostable waste to CGS waste facilities.

Scrap Metals

Waste items such as automobiles, snowmobiles and appliances can take up significant amounts of space in a landfill, especially if it is uncompacted. The existing landfill has a designated area for these items that is separate from the general waste. These items are generally sold for scrap.

The prices for scrap metal constantly fluctuates with market prices. However, the price of a scrap car can be $225/ton (updated 2018 -11-28). Some of these cost recoveries can be used to help offset the cost of the programs.

The MECP Residential Waste Composition estimates that approximately 2% of household waste is ferrous (such as metals), while the OFN's Solid Waste Management Strategy Planning Manual uses a much higher estimate, up to 21%. This includes ferrous materials such as steel and aluminum containers, foil, automobiles, snowmobiles, appliances, etc. There is no actual waste composition for Atikameksheng Anishnawbek, therefore it will be assumed that 8% of the community's waste will be made up of scrap metal waste. This estimation was also used in a neighboring First Nation community. The assumed 8% works out to 6,438 m^3 of scrap metal over the 20 year period. Based on this calculation, including scrap metal diversion from the landfill would result in the following maximum space saving over the 20 year planning period.

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with Scrap Metal only	74,034	12.8	31.5
*Diversion from Recycling, Composting & Scrap Metal	16,094	7.5	18.4

Scrap Metal Items: steel and aluminum containers, foil, automobiles, snowmobiles, appliances, etc.
**Based on a 100% participation*

Electronic Waste

This category is one of the fastest growing categories as electronics become more affordable and readily available. According to the Statistics Canada, electronic waste such as "consumer electronics- including TVs and other video equipment, computers, assorted peripherals, audio equipment, and phones – has increased by 645% from 2006 to 2014 and comprises approximately 1-2% of the total municipal solid waste stream, as tracked in the Municipal Solid Waste Characterization Report".

Electronics are complex and made up of a wide variety of material constituents, including heavy metals such as lead, nickel, cadmium, and mercury. These types of metals can pose risks to human health (workers and communities) and the environment. Hence, proper care is required in its end of life management to avoid leaching of material such as heavy metals from landfills, etc.

Studies have shown that disposing electronics in a properly managed municipal solid waste landfills does not threaten human health and the environment. However, government organization (like the USEPA and MECP) strongly supports and recommends keeping used electronics out of landfills, to recover materials and reduce the environmental impacts and energy demands from mining and manufacturing.

The Ontario Electronic Stewardship has set up electronic recycling programs where used electronics can be dropped off or the community itself can be collection site. There are two types of collection sites: permanent and events. Permanent sites are opened regularly for drop-offs while Event sites are occasional. The Ontario Electronic Stewardship provides the community with a bin and offers free pick-up and incentives for electronics recycling. The closest drop-off location for electronic waste for Atikameksheng Anishnawbek residents is at the Walden Small Vehicle Transfer site, located at the McCharles Lake Road location off of Old Highway 17 West.

It should be noted that OES Program has submitted a Wind-Up Plan to RPRA which was approved on August 16, 2019. The end date of the program is December 31, 2020 and until then OES will continue to provide safe, secure recycling. Further details about the program can be found on the Ontario Electronic Stewardship website.

Based on the USEPA estimate for electronic waste, a 2% estimate will be used to show electronic waste diversion from the landfill. This estimate is equivalent to approximately 1,610 m^3 of waste and would result in the following maximum space saving over the 20 year planning period.

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with Electronic Waste only	78,862	13.1	32.4
*Diversion from Recycling, Composting, Scrap Metal & Electronic Waste	14,485	7.3	17.9

Scrap Metal Items: steel and aluminum containers, foil, automobiles, snowmobiles, appliances, etc.
**Based on a 100% participation*

Tires

Ontario Tire Stewardship operated the Used Tire Program that diverted vehicular tires from landfills to be reused and recycled. This program ended on December 31, 2018 and on January 1, 2019 used tires moved to the new individual producer responsibility framework. The RPRA lists the closest registered tire collector is Walden Transfer Station, located in the City of Greater Sudbury, approximately 25km away from Atikameksheng.

Based on the Solid Waste Management Strategy Planning Manual, a 0.6% estimate for tires diversion would result in 483 m^3 of waste diverted from the landfill, as shown in the following table. The maximum space saving over the 20 year planning period is shown as follows:

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with Tires only	79,989	13.2	32.6
*Diversion from Recycling, Composting, Scrap Metal, Electronic Waste & Tires	14,002	7.2	17.8

**Based on a 100% participation*

Construction and Demolition Waste

It is understood that present construction and demolition materials (CDM) are set aside for salvaging. There are no recycling programs for this type of material, thus material that is salvaged is kept from landfill and the cost associated with dealing this material at its end of life use.

Based the Solid Waste Management Strategy Planning Manual, a 3.6% estimate for building materials diversion would result in 2,897 m^3 of waste diverted from the landfill, as shown in Table 5.3. The maximum space saving over the 20 year planning period is shown as follows:

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with CDM only	77,575	13.0	32.2
*Diversion from Recycling, Composting, Scrap Metal, Electronic Waste, Tires & Building Materials	11,105	6.8	16.8

**Based on a 100% participation*

Hazardous Household Wastes

Ontario's hazardous waste program (Orange Drop – also referred to as Municipal Hazardous or Special Waste (MHSW) is part of the Stewardship Ontario program. The organization was set up to discharge businesses extended producer responsibility obligations under the Waste Diversion Act (2002). Under this program, the MHSW's accepted include:

- Paints, coatings and their containers
- Solvents and their containers
- Single-use dry cell batteries
- Pressurized containers
- Lawn fertilizers, pesticides and their containers
- Antifreeze and its containers
- Empty lubrication oil containers – 30L or less
- Oil filters

Currently the closest location for hazardous waste near Atikameksheng Anishnawbek Community is at the Household Hazardous Waste Depot, located in the City of Greater Sudbury, approximately 10km away. As other diversion programs, the MHSW program will transition to individual producer responsibility under the RRCEA 2016. The operation of the MHSW program for all designated materials except single use batteries will cease on June 30, 2021.

	Total Accumulated Waste Volume (m^3)	Landfill Area (3m Height)	
		Hectares	Acres
No Diversion	80,472	13.2	32.7
Diversion with Household Hazardous Wastes(HHW) only	77,092	13.0	32.1
*Diversion from Recycling, Composting, Scrap Metal, Electronic Waste, Tires, CDM & HHW	7,725	6.3	15.5

**Based on a 100% participation*

In summary the total amount of waste that could potentially be diverted is listed below:

Types of Diversion	**Volume Diverted (m3)**
Recycling	27,360
Composting	30,579
Scrap Metals	6,438
Electronic Waste	1,609
Tires	483
Construction & Demolition Materials	2,897
Hazardous Household Wastes	3,380
Total	72,746

5.0 WASTE MANAGEMENT OPTIONS

The waste management plan should include the projected amount of waste generated, diversion plans for waste, plans for collection and transportation of waste and plans for disposal, treatment and storage of wastes. This section shall examine several alternatives for each component of the plan and recommend an overall management plan.

The following sections examine options to meet the community's future waste needs. Based on previous study recommendations, it was determined that a majority of the community preferred the existing landfill site be closed and waste be hauled off-reserve. If it is determined that if the First Nation will need to develop a new landfill site on-reserve a total land area of 32.4 acres would need to be planned for. A future landfill site was identified within the Neegan Burnside 2003 study, and can be seen in Figure 6.

5.1 Waste Transportation & Collection Operations

Alternative 1: Individual Disposal

This option would be a continuation of the existing disposal method. The landfill or transfer station would require convenient access to the site for community members. Members would be responsible for ensuring their household waste reaches the landfilling site. They would also bear the cost of transporting their waste to the disposal site. The advantages and disadvantages of this system are shown below:

Advantages	Disadvantages
• More freedom for residents to dispose of their waste. • Reduces operational costs and efforts on Public Works Department	• May be difficult for some residents to reach landfill site • Dumping of waste in non-designated areas may occur.

Alternative 2: Collection Services are made Mandatory

This option would greatly limit the user's access to the site. Residents would have their household waste and recyclables collected on a weekly basis. Recyclables are currently collected by a private contractor and transported to CGS recycling facility. The First Nation Public Works Department collects other household wastes on a weekly basis and transports to the existing landfill site.

It is understood the operation and maintenance budget is limited for the community. Therefore, to offset the expense of this operation it may be necessary to charge community members a pick up fee. For the Public Works Dept to continue to implement this option a collection truck will need to be purchased and additional employees will be required. The advantages and disadvantages of this system are shown below:

Advantages	Disadvantages
• Convenient for residents • Job opportunities • Trained collectors will determine if recyclables contain any contaminants	• Residents may not approve of being charged fee • A higher capital cost/operation and maintenance cost • Administration office will have to collect user fees

Via Contract out Services

This option would involve the First Nation to hire a contractor to provide waste collection services. Therefore, the Public Works Department would not need to purchase a collection truck or hire new staff. The administration office would collect the user fees for the service which would be used to pay the contractor. The advantages and disadvantages of this system are shown below:

Advantages	Disadvantages
• The public works department would not have to worry about increased operation and maintenance • Convenient for residents • Potential business for members	• Community members may not approve of an additional user fee • No new jobs for members

5.2 Waste Diversion & Disposal Alternatives

Waste Diversion

The extent to which diversion system can be implemented can vary. For example, some variables could include:

1. Collection of recyclables, sorting, baling and shipping to market (full recycling operation).
2. Collection of separated blue box contents and sale to recycling centre.
3. Collection of blue box combined recycling products and sale to sorting and recycling centre.
4. Collection of compostable waste (compostable bag) and processing of compost on-reserve.
5. Collection of compostable waste and shipping to regional composting plant.

The main advantages of many of these options would primarily be job creation in the community. However, many of these options require initial work to find buyers for recycled materials and capital investments. Fortunately, Atikameksheng's neighbouring municipality, CGS already has a well-organized diversion program.

Atikameksheng has already been diligently practicing a waste diversion program, consisting of the Blue Box program. An expansion of waste diversion to follow what the CGS currently implements would be as follows:

- **Blue Box** – cardboard, all paper, glass, cartons, plastic (#1,2,4,5 and 6), plastic bags, aluminum, empty paint cans, aerosol cans and egg cartons.
- **Green Cart** – paper coffee cups, paper bags, tissue paper, paper towels, paper takeout containers, all food waste
- **Leaf and Yard** – garden plants, straw, garden trimmings, grass clippings, branches
- **Household Hazardous Waste Depot** – batteries, fluorescent lights, syringes, propane/helium tanks, unused/expired medications
- **Garbage** – a one bag limit is currently being practiced.

Community Recycling/Composting

The most complicated part of the waste diversion program will be setting up the recycling and composting program and ensuring that members comply with protocols needed to make the program work.

The Green (wet or organics) cart – Blue (recyclable) box system is commonly used in many municipalities. Consumers essentially split their household wastes into two categories. All wet decomposable wastes such as food waste and vegetable matter goes in a compostable bag, while the blue box gets all of the dry and mostly recyclable wastes. This system therefore requires a much more complex processing plant where all wastes produced are taken for further sorting.

Green and blue boxes cost between $20.00 and $25.00, respectively, depending on the retailer, although discounts are given for bulk purchases. It is estimated that an average family would require one green box and two blue boxes. The cost for these boxes can be the responsibility of the residents and alternatives to these boxes can also be made available, or they can use their own containers and boxes instead of the standard green and blue boxes.

Community members would take their green bags to the community designated compost location and their blue boxes to the recycling drop off locations. Or if a communal collection system was used, then the blue and green/compostable bags or boxes would be separated according to their colour codes. The distinct bags/box colours would be needed if a communal collection system is implemented.

Information available from the Waste Diversion Ontario in March 2012 indicates the average net cost per tonne of recyclable waste is $302.92 for all Ontario municipalities reporting. 15 First Nations reporting within the Waste Diversion Ontario database indicate an average net cost per tonne of recyclable waste of $1,448.32. The net cost for operation of a recycling program within the First Nations range from a low of $26.88 to high of $5,669.39 per marketed tonne. This may be due to a number of factors including economies of scale (lower populations), elevated costs associated with rural collection, lower rates of participation in recycling programs, and lower rates of waste diversion, within First Nation communities.

The Waste Diversion Ontario's Annual report of 2006 indicates that residents of Ontario were recycling or composting 38% of their waste. It is assumed, at minimum that Atikameksheng will continue to implement their Blue Box program and that 38% of their waste will be diverted. Therefore, the following table provides a summary of waste volume accumulated each year, potential volume of recyclables and total landfill capacity required to dispose of waste.

Table 11 Required Landfill Capacity

Year	Volume (m3)	Recycleables (38%)	Landfill Volume (m3)
2020	3,318.6	1261.0	2,057.5
2021	6,702.8	2547.1	4,155.7
2022	10,154.1	3858.5	6,295.5
2023	13,673.7	5196.0	8,477.7
2024	17,263.0	6559.9	10,703.0
2025	20,923.3	7950.9	12,972.5
2026	24,656.2	9369.3	15,286.8
2027	28,462.9	10815.9	17,647.0
2028	32,345.0	12291.1	20,053.9
2029	36,304.0	13795.5	22,508.5
2030	40,341.4	15329.7	25,011.7
2031	44,458.7	16894.3	27,564.4
2032	48,657.5	18489.9	30,167.7
2033	52,939.5	20117.0	32,822.5
2034	57,306.2	21776.4	35,529.9
2035	61,759.5	23468.6	38,290.9
2036	66,300.9	25194.3	41,106.5
2037	70,932.2	26954.2	43,977.9
2038	75,655.2	28749.0	46,906.2
2039	80,471.7	30579.2	49,892.4

Based on Pinchin's assessment the existing landfill site has a remaining capacity of 10,000 m^3. The above table shows this capacity being reached by 2024. This gives the First Nation time to implement a sustainable and long term solution. The following alternative analysis will consider this limitation.

5.3 Waste Disposal Alternative

The following section will examine only a couple of the various possible different waste management scenarios and alternatives, along with their associated cost estimates.

Alternative 1: Do Nothing

The “Do Nothing” approach entails the continuation of landfill operations as currently practiced, without making any changes. The waste from the community, would continue to be disposed of at the existing Landfill Site. Pinchin’s assessment does recommend a regular monitoring program be implemented to include sampling in the spring and fall annually. This alternative also includes a closure plan to be implemented by 2024, since the site will have reached its capacity. There is no benefit to this alternative and should not be considered any further.

A Class D Cost Estimate for the “Do Nothing” alternative is shown in the appendix with summary listed as follows:

Item	Amount
Capital Cost	$180,000
Annual Operation & Maintenance	$101,282
20 Year Life Cycle Cost	$1,445,814

Advantages	Disadvantages
• The First Nation has greater control over their waste management and costs, including their recycling program • Maintain jobs within the community	• Does not meet 20 year needs • Long term environmental liability

Alternative 2: Thermal Technology (Waste Incineration)

Thermal technology, more commonly known as incineration, incinerates waste at high temperatures, which converts the waste into ash, flue gas, and heat. The process of incineration occurs in an environment with excess air and requires little to no additional fuel source (i.e. Natural gas) once combustion has commenced. As waste incineration involves the burning of raw waste materials, some handling is required for pre-processing, to remove recyclables from the waste stream, as well as the removal of recyclables metals from the process ash. This requires a storage/sorting/pre-processing yard in association with the actual incinerator site.

As for the process ash, it is mostly composed of inorganic materials and usually deposited as lumps at the base of the system or as particulates within the gases. As a result, the exhaust gases typically pass through a monitored air filtering system. Under normal operating conditions, they are discharged to the environment in accordance with specific guidelines (the air emissions from these plants meet the requirements of MECP Guideline A-7).

As for the sizing of the incinerator, a great amount of detailed information including data on the waste composition and characteristics is required to engineer the facility properly. Poor design can cause unstable combustion conditions and potentially (temporarily) increased air emissions. The sizing of a furnace to match the quantity and characteristics of waste fed to the incinerator is of utmost importance. It determines if the temperatures required for a complete and clean combustion are achieved and maintained. This emphasizes the importance of the waste pre-processing mentioned above to ensure a reasonable steady waste stream with the required minimum characteristics and combustible components.

Typically, this alternative involves a small landfilling component as residues from the incineration process are mostly disposed of at a landfill. The thermal incineration of the waste has potential to divert approximately 70% to 75% of the materials that would otherwise be landfilled, if the metals are recovered from ash. Furthermore, if the ash has desirable toxic chemical leaching potential (TCLP) results, it can be marketed as a recycled granular construction aggregate, which further reduces the amount of materials going to the landfill. Due to the encapsulation of the waste materials (i.e. within a controlled environment) incineration can be located within population centers and built up areas, thus reducing waste transportation and associated costs. The high temperatures of the incineration have the potential to destroy clinical and hazardous wastes, as well as eliminating methane gas emissions from the waste management process.

As stated above, incineration reduces the amount of waste significantly, yet a landfill is still required for disposal of the by-products, if a suitable market is not found. In Ontario, there is currently one operating incinerator facility, in the Region of Peel, which has been in operation since 1992 and operates at approximately 130,000 tonnes per year.

Currently, waste generation volumes for the community is estimated at an average of 2071 m^3/year. Assuming an average waste density of 690 kg/m^3, this equates to approximately 1429 tonnes of waste per year, this does not include recyclables. It is anticipated that as waste diversion numbers increase the waste generation rate will stabilize to offset the expected population growth. As discussed above, a constant waste stream is required to make this alternative feasible. A minimum of 100 tonnes per day is required for a two stage incineration. With the above yearly waste generation rate estimates, the Community generates only about 4 tonnes per day. Incineration therefore works well if large amounts of waste are to be processed, particularly since there is an inverse relationship between volume and operational costs of these facilities (i.e. cost/ton is higher for small facilities). Based on the current waste generation volumes for the community, additional waste would need to be imported to make this alternative feasible.

As large-scale operations generally have several incinerators to supply the demand for the large volume of waste, the low waste generation rates for the community are generally too low to support multiple incinerators. As a result, consideration would have to be taken into account for the storage of waste materials during maintenance periods of the equipment.

Alternative 3: Waste to Energy

There are numerous approaches to dispose of waste and, at the same time, obtain energy from the waste management process. This is typically associated with waste streams high in organic content. It is included as an Alternative, as it potentially offers an economically attractive approach for managing the waste in combination with the utilization of its value as an energy source.

The waste-to-energy process is similar to the waste incineration process. The process begins with the delivery of waste within an enclosed reception area. The waste is placed within storage pits, where it is fed into large hoppers that feed the boilers. Within the boiler structures, an inclined reciprocating, metal grate slowly disperses the waste through a combustion (thermal) process, with temperatures typically exceeding 2000 degrees Fahrenheit (^{0}F), resulting in complete combustion. The high pressure steam created from the combustion is collected within the boiler, which is then transferred to a turbine generator, thus creating electricity. Like the incinerator process, the subsequent gases are passed through multiple filtration systems and the air released is cleaned to meet regulatory guidelines. In order to achieve the proper combustion of the materials, air is drawn in from the receiving area, which causes negative pressures, significantly reducing the escape of odors and dust to the natural environment.

Upon completion of the process, recyclables materials such as scrap metals, are removed from the ash residue and recycled, reducing the overall waste by approximately 90%. The by-product of the incineration of the waste, being energy, can be viable source of revenue for the plant, as the power can potentially be sold back to the grid and use to provide power to numerous homes. As there is an increasing need for alternatives for landfilling, waste to energy has been considered a renewable resource because there will always be fuel available to run the plant. In some cases, it has been proposed that materials that have previously been landfill be mined out and used within the plants.

As with the previously discussed incinerators, capital and operating costs for these types of facilities are extremely high, even after considering potential revenues from energy. Furthermore, with increased diversion at the source of the waste (i.e. 3R's – reduce, reuse, recycle), the quality and quantity of the feed is reduced, which could potentially decrease the heating value within the boilers, which pose challenges in the proper operation of the system.

As per the discussion pertaining to the incinerators, a constant waste stream of significant size is required to support the waste to energy alternative. The high capital and operation costs of both the incinerator and the energy generation system would not be offset with the minimal amount of materials that would be processed through the facility. In order to feasibly operate a process of this nature, the community would have to act as a hub for northern Ontario, accepting waste from multiple municipalities or consider the mining of waste from existing landfills, to support a sufficient waste feed for the plant.

Alternative 4: New Landfilling Site (with diversion)

Landfilling is the most established approach to waste management in Ontario and possibly worldwide. Landfilling involves the organized disposal of waste within an engineered facility that has been certified to accept various types of waste from a specified region. Typically, waste is placed within a specific footprint or cell and covered with materials (i.e. sand) on a daily basis to prevent windblown waste. As all landfills are engineered and permitted for a specific capacity, once a cell or the landfill has reached that capacity, they are capped with an impermeable materials and vegetative growth is reintroduced to the surface. At this point, future landfilling for the community could involve the development of a new landfill site. The previous Waste Management Plan did identify a preferred future site which is located approximately 10 km from the community area, as shown in Figure 6. The site identified is approximately 43 Hectares (106 acres). Based on the estimated total area required of 32.7 acres, this entire site would not be required.

As landfills are operated under strict regulatory guidelines and control, a properly managed landfill will monitor the levels of impacts to the groundwater, as well as the amounts of gas and leachate being generated. Concentrations are compared to specific criteria and if there are signs of impacts migrating off-site, a variety of techniques is available to prevent further off-site contamination.

With recent development of methane gas collection systems, the production of energy for these gases are in existence at a commercial scale throughout Canada and could contribute a revenue potential for a landfill.

With respect to the Thermal Treatment and Energy from Waste Alternative discussed above, they too require some degree of landfilling to manage the residual wastes. There are no facilities to date that can eliminate waste completely. As a result, the landfilling alternatives has been included as it would, as a minimum, be required in association with the alternatives involving incineration. Also, landfilling would represent a continuation of the management of the community's waste as is currently successfully practiced.

Although there is an interest in a recycling and composting program, it is difficult to accurately predict and estimate the quantity of waste that will be diverted from the community. This alternative also includes the construction of a new landfill and along with some waste diversion. As estimated in the previous waste diversion sections, it has been assumed that 38% of waste will be diverted. Assuming a 38% diversion a total landfill area of 10.8 Hectares (26.7 acres) would be required. This includes the 100 m buffer and assumes a height of 3 m.

The two phase construction planning of the landfill will allow the community to reassess the need for landfill expansion if the waste diversion programs are going well.

A natural attenuation landfill has been assumed to be adequate for the potential landfill site, rather than an engineered landfill. If an engineered landfill is required, then the costs of the landfill options will increase. The advantages and disadvantages of this option are listed as follows

Advantages	**Disadvantages**
• The First Nation has greater control over their waste management and costs, including their recycling program • An allocated site within the community for waste and increased accessibility to the site • Maintain jobs within the community	• An additional operation and maintenance cost to Atikameksheng Anishnawbek FN • Long term environmental liability • Requires a large area of land

A Class D Cost Estimate for a new landfill is shown in the appendix with summary listed as follows:

Item	Amount
Capital Cost	$3,922,699
Annual Operation & Maintenance	$101,282 to $119,704
20 Year Life Cycle Cost	$7,079,246

Alternative 5: New Landfilling Site (without diversion)

This alternative is similar to alternative 4 however, this alternative assumes that minimal to zero recycling or waste diversion is occurring within the community and there is a suitable site found on the reserve where a new landfill site could be developed. The landfill will require an estimated 15.5 hectares (32.7 acres) of land within the community. It has been assumed that a natural attenuation landfill is sufficiently adequate for the potential landfill site, rather than an engineered landfill.

The community is also known to have a shortage of usage land, as a large majority of the land has shallow soil cover. A new landfill sized for the 20 year waste volume will take up a significant amount of area, and rehabilitating these types of land will take many years. There would an opportunity for costs saving using this land as a landfill. The advantages and disadvantages of this option are listed as follows:

Advantages	Disadvantages
• The First Nation has greater control over their waste management and costs • An allocated site with in the community for waste and increased accessibility • Maintain jobs within the community	• An additional operation and maintenance cost to Atikameksheng Anishnawbek FN • Long term environmental liability • Requires a large area of land

A Class D Cost Estimate for a new landfill is shown in the appendix with summary listed as follows:

Item	Amount
Capital Cost	$4,119,759
Annual Operation & Maintenance	$70,204
20 Year Life Cycle Cost	$6,407,875

Alternative 2-5b: Waste Import

Waste import involves the transportation of waste from a neighboring municipality to the community where it would be managed together with the community's own waste. For a small community, such as Atikameksheng, to develop and operate certain waste management facilities (e.g. a waste incinerator) is often economically not feasible. This is typically due to low waste generation rates and rather small overall waste volumes. It is therefore considered reasonable that, when evaluating alternatives managing its own waste the community examines waste imports in order to take advantage of additional revenue streams from processing fees (e.g. tipping fees) and economy of scale considerations. The additional funds that such a program could provide would contribute to covering the cost for the development and operation of a new management facility. In an ideal situation, the revenues from the waste import would not only make the waste management infrastructure economically viable but also potentially provide the community with a net income. If any of the previous alternatives are considered further, then this option could be considered.

Alternative 6: Haul Off-Reserve to an Existing Landfill Site

This involves the export of waste into another jurisdiction outside of the community. In this scenario, the waste would be disposed of or otherwise processed in a facility, located outside of the community but licensed to receive and manage the various types of waste generated by the community. The community would ensure long-term acceptance of its waste in a contractual agreement with the facility's owner. This Alternative has been included as it has the potential to address the need for additional waste management capacity without the community owning/operating a new facility or continuing as owner/operator of its existing landfill.

It can be assumed that it is not feasible for the roadside waste collection trucks to transport the waste to an outside source. As such, this scenario also entails the development of a waste transfer station within the community. At the transfer station the waste would be temporarily stored and the loaded onto large transport vehicles to be taken to the final disposal site. The site in which the waste is disposed of or otherwise processed would need to be licensed to receive the waste from the community and would need to meet all applicable environmental standards that are imposed by the local governing bodies. With a long-term contractual agreement between the two parties, such scenario could potentially address the community's need for additional waste management capacity.

Atikameksheng has had previous discussions with the City of Greater Sudbury. CGS has confirmed that there is capacity. The process would take 1-2 years before implementing. As mentioned the existing site has a remaining capacity of approximately 10,000m^3, which would be reached by 2025 if recycling practices continue.

A Class D Cost Estimate for an off-reserve disposal site with contracted transport services is shown in the appendix with summary listed as follows:

Item	Amount
Capital Cost	$1,749,693
Annual Operation & Maintenance	$57,200 to $63,000
20 Year Life Cycle Cost	$4,488,593

6.0 RECOMMENDED WASTE MANAGEMENT PLAN

Alternative Comparison

The waste disposal alternatives were examined to determine the most suitable method of disposal for the community. The strengths, weaknesses and economic feasibility of each system will be compared and analyzed with respect to each of a set of evaluation criteria including:

- Environmental Considerations (i.e. destruction of habitat, air emissions, groundwater pollution);
- Socio/Cultural Considerations (i.e. land use conflicts, number of facilities required);
- Economic Considerations (i.e. construction, operating and transportation costs, Site approval, legal risk);
- Technical Considerations (i.e. complexity of technology, addressing of the current problem, technical risk, additional studies required); and
- Municipal Policy Considerations (i.e. compliance with draft WMMP, potential to support waste diversion efforts, municipal preferences).

The following table summarizes an analysis of each of the alternatives being considered.

	Alt 1: Do Nothing	Alternative 4: New Landfilling Site (with Diversion)	Alternative 5: New Landfilling Site (without diversion)	Alternative 6: Haul Off-Reserve to an Existing Landfill Site
Capital Cost	$1,114,289	$5,129,773	$4,119,759	$1,749,693
O & M	$70,204	$119,704	$70,204	$63,000
20 Yr LCC	$1,445,814	$7,079,246	$6,407,875	$4,488,593
Administration Concerns	FN has full oversight of operations, maintanence and monitoring of landfill site.	Similar to existing system. Diversion requires more coordination.	Similar to existing, however no MTA for recycling is required.	Public Works to maintain new Waste Transfer Site. Contracted company responsible to haul waste to CGS site. MTA will need to be renewed on a regular basis.
Ease of Maintenance	Work required for covering and cleanliness of site and diversion areas. An attendent is onsite during hours of operation and PW brings equipment to site to maintain site.	Work required for covering and cleanliness of site and diversion areas.	Work required for covering and cleanliness. Similar to existing.	Attendant to ensure recycleables are separated appropriately is recommended. Least amount of work.
Land Area for Future Expansion	Capacity of current landfill site will be reached by 2024.	Depending on the amount diverted, can be similar to Alt 5. (27 acres)	Require the most land. (33 acres)	20 year land requirements are minimal (< 5.0 acres).
Community Acceptance	Not favourable.	Previous waste management study showed support for this alternative, however more recent study no support was displayed.	Not favourable. The recycling program is well received within the community.	Community consultation revealed 100% support of this alternative.
Long Term Environmental Liability	Community is responsible for closure and future monitoring programs.	Community would be responsible for annual monitoring of new site and closed site. Proper closure plan will be required for existing and future site.	Community would be responsible for annual monitoring of new site and closed site. Proper closure plan will be required for existing and future site.	FN would only be responsible for the annual monitoring of the closed landfill site.
Economic Impact	FN is currently off-setting costs for waste O&M through other programs or own source revenue.	Federal funding for waste management on-reserve is approximately $9,600 annually.	Federal funding for waste management on-reserve is approximately $9,600 annually.	Federal funding for waste transfer stations on-reserve is 100% hauling costs covered and 80% tipping fees covered.
First Nation Self Reliance	Site will reach capacity within the next 5 years and FN would reviewing their options again.	FN will need to allocate more O&M funds to ensure site is properly operated.	FN will need to allocate more O&M funds to ensure site is properly operated.	Least amount of work.

The following evaluation matrix has been completed as well to score each alternative. The above criteria was weighted on a scale of 1 to 10, with 10 being the most important. Weighting is based on results from the community questionnaire and feedback from community meetings. Each alternative was provided a score from 1 to 10 based on how they compared to each other and how it met that specific criteria. Based on the scoring, Alternative 6 received the highest score, making it the recommended alternative. As mentioned earlier, further discussions and formal agreements will need to be negotiated with the City of Greater Sudbury. This analysis is intended to provide the First Nation with a direction to focus the next stage of implementation.

Criteria	Wt	Alt 1	Alt. 4	Alt 5	Alt 6	Alt 1	Alt 4	Alt 5	Alt 6
Capital Cost	10	10	5	6	8	100	50	60	80
O&M Costs	10	10	7	8	9	100	70	80	90
20 Year LCC	10	10	6	7	9	100	60	70	90
Ease of Maintenance	7	8	7	8	9	56	49	56	63
Land Requirements	10	6	6	5	8	60	60	50	80
Community Acceptance	9	1	1	1	10	9	9	9	90
Environmental Impact	7	4	6	6	9	28	42	42	63
Economic Impact	8	4	7	8	10	32	56	64	80
First Nation Self Reliance	10	5	9	8	10	50	90	80	100
					Total	**535**	**486**	**511**	**736**

7.0 RECOMMENDATIONS, IMPLEMENTATION AND PHASING

Based on the analysis and community support it is recommended the community proceed with implementing Alternative 6. Atikameksheng Anishnawbek and City of Greater Sudbury completed preliminary discussions and are prepared to proceed with the next steps. Based on input from CGS, Alternative 6 was refined and further cost analysis was complete to determine whether a contractor would be retained or whether the First Nation would transport their own waste.

Alternative 6: Haul Off-Reserve to an Existing Landfill was further analyzed. CGS confirmed that waste accepted from Atikameksheng would need to be brought to the Kingsway Landfill. The analysis assumed the First Nation would purchase their own roll off bins and a roll off bin truck to transport the bins to CGS Landfill themselves. Cost estimates have been obtained to contract out the hauling portion of the waste management. The following table summarizes the 2 alternatives to haul the community's waste off-reserve.

	Alt 6a: FN to Haul Waste	**Alt 6b: Contractor to Haul Waste**
Description	Recycling program is maintained, FN purchases and maintains their own bins and trucks. Waste and recycleables would be collected weekly from curbside and stored at the transfer station. FN would haul full waste bins to CGS Landfill site.	FN would still complete curbside pick up of waste and recycleables and store in bins at transfer station. A contractor would be retained to supply bins and collect when full. Contractor would haul waste to CGS Landfill. Fees for contractor include hauling and tipping fees.
Capital Cost	$2,673,429	$2,431,429
O&M	$114,937 - $127,277	$84,243 – $93,205
20 Year LCC	$4,837,694	$3,785,811
Advantages	Employment for FN members FN won't need to rely on an outside contractor	Costs are lower Less O&M effort required
Disadvantages	Costs are greater More O&M effort is required.	Public Works has continued responsibility for curbside pickup FN has no control over contractor fees

Details on the above cost estimates can be found in Appendix VI. Based on the cost analysis at this time, it is recommended the First Nation proceed with retaining an outside contractor to haul waste to CGS Landfill site.

One of the major steps consists of completing a Municipal Type Service Agreement (MTSA). An MTSA, is an agreement between a First Nation and a federal department, provincial ministry, municipal government, private contractor, individual or organization. Typically, the agreement involves the First Nation paying a fee in exchange for receiving third party services, such as delivery of treated drinking water, solid waste disposal and/or fire protection. In this case a new MTSA will need to be developed between CGS and Atikameksheng for Solid Waste Disposal services. It is understood, the two parties already have agreements for drinking water and fire protection services.

Indigenous Services Canada (ISC) has provided a recommended MTSA template to work from. It should be noted that ISC is not a party to the agreement, however the department does provide funding support to assist the First Nation to cover the fees. ISC funding will only apply to Band-member residences and Band owned buildings. ISC funding does not support MTSA services provided to businesses on reserve. Atikameksheng will need to work out fees with Commercial waste producers on reserve, who will likely utilize the new Waste Transfer Station.

The following steps will need to take place and an estimated timeline/milestone is included:

2020-22	CGS to expand Environmental Compliance Application
2020-21	CGS and Atikameksheng to review and approve a Municipal Type Service Agreement, a template provided by ISC has been included in the Appendices.
2020	Begin funding applications for design and construction of landfill closure and new Waste Transfer Station.
2021	Upon funding approval, retain consultants for design and contract administration services through competitive bid process. A project manager will also be required.
2022	Construction works of existing landfill site closure and new Waste Transfer Station to be underway.
2022	Tender out contractor services to haul waste from New Transfer Station to CGS Landfill.
2023	New Waste Transfer Station fully operational.

Respectfully submitted,

First Nations Engineering Services Ltd.

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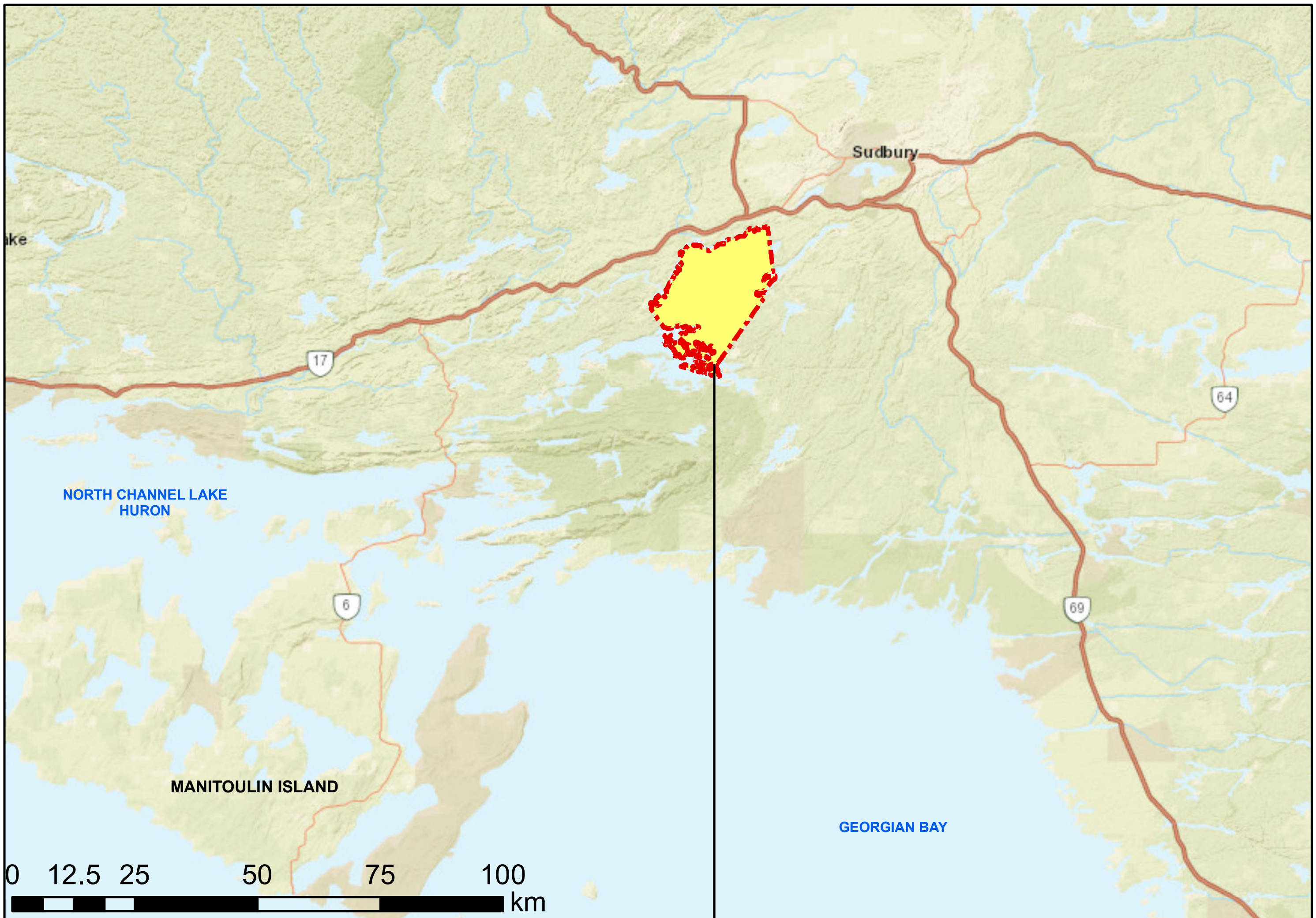
Appendix I Figures



Legend

Atikameksheng Anishnawbek First Nation

Date: 2020-04-07	Title:	LOCATION PLAN
Revision: 1		
Drawn By: MB Checked By: JH	Project No: 38062	Figure: 1.0
	Project: Solid Waste Management Study	
N	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION	

Source: Basemap- Google Imagery

LEGEND

Atikameksheng Anishnawbek First Nation

Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylinda, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/
FME_5644441C_1552572175354_5536.zip

Date: 2020-04-07	Title: Study Area	
Revision: 1		
Drawn By: MB Checked By: JH	Project No: 38062	Figure: 2.0
N	Project: Solid Waste Management Study	FIRST NATIONS ENGINEERING SERVICES LTD.
	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION	

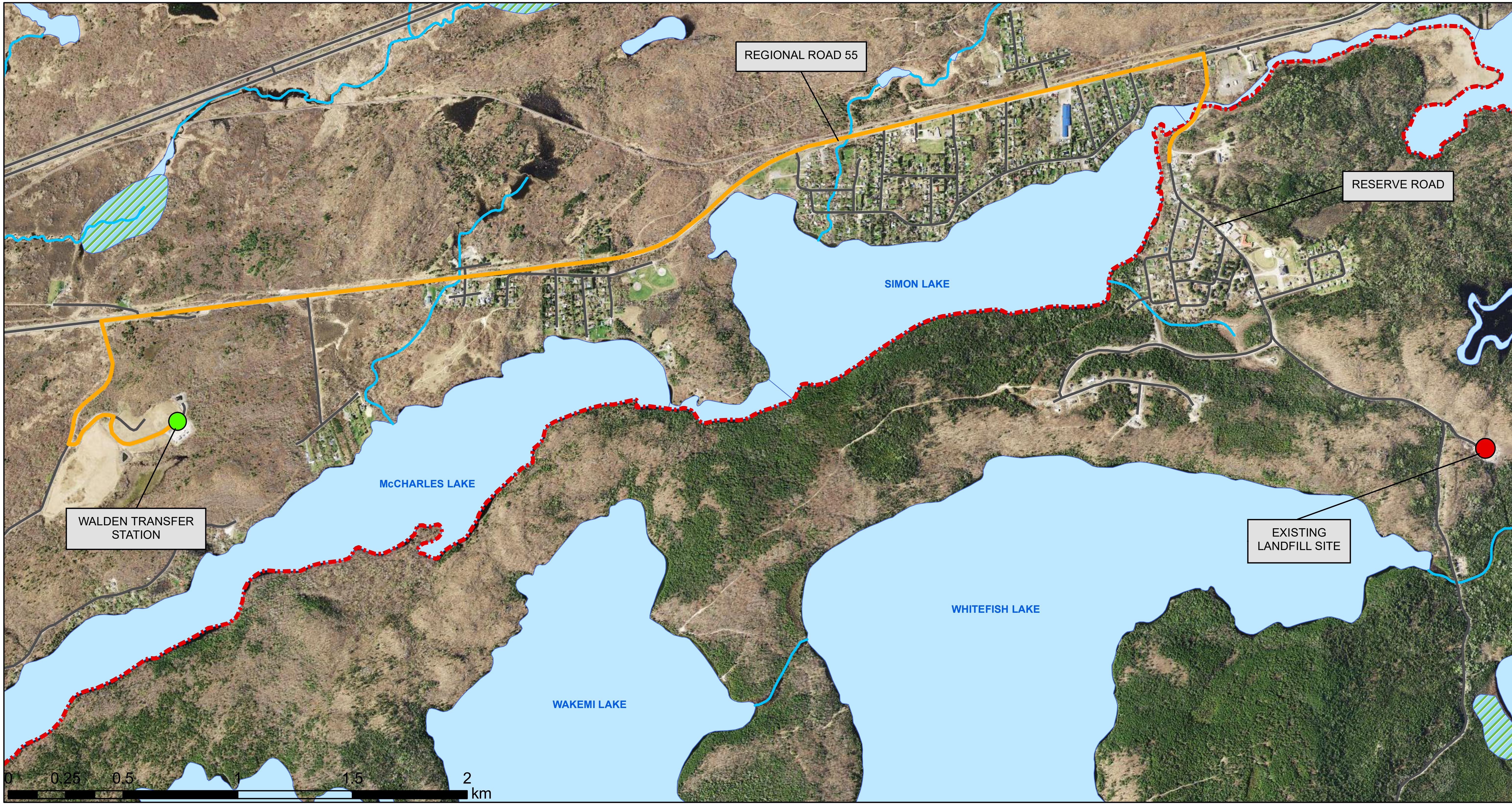
LEGEND

- Atikameksheng Anishnawbek First Nation
- Waterbody
- Watercourse
- Roads

Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylinda, OpenStreetMap contributors and the GIS User Community. https://webservices.maps.canada.ca/fmedatadownload/results/ FME_5644441C_1552572175354_5536.zip

Date: 2020-04-08	Title: EXISTING COMMUNITY
Revision: 1	
Drawn By: MB Checked By: JH	Project No: 38062 — Figure: 3.0
N	Project: Solid Waste Management Study
	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

FIRST NATIONS ENGINEERING SERVICES LTD.



LEGEND

- Atikameksheng Anishnawbek First Nation
- Watercourse
- Waterbody
- Wetlands
- Roads
- Route to Municipal Landfill Site

Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylinda, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/
FME_5644441C_1552572175354_5536.zip

Date: 2020-04-24	Title: Existing Landfill Area	
Revision: 1		
Drawn By: MB Checked By: JH	Project No: 38062	Figure: 4.0
N	Project: Solid Waste Management Study	
	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION	

LEGEND

Atikameksheng Anishnawbek First Nation

Waterbody

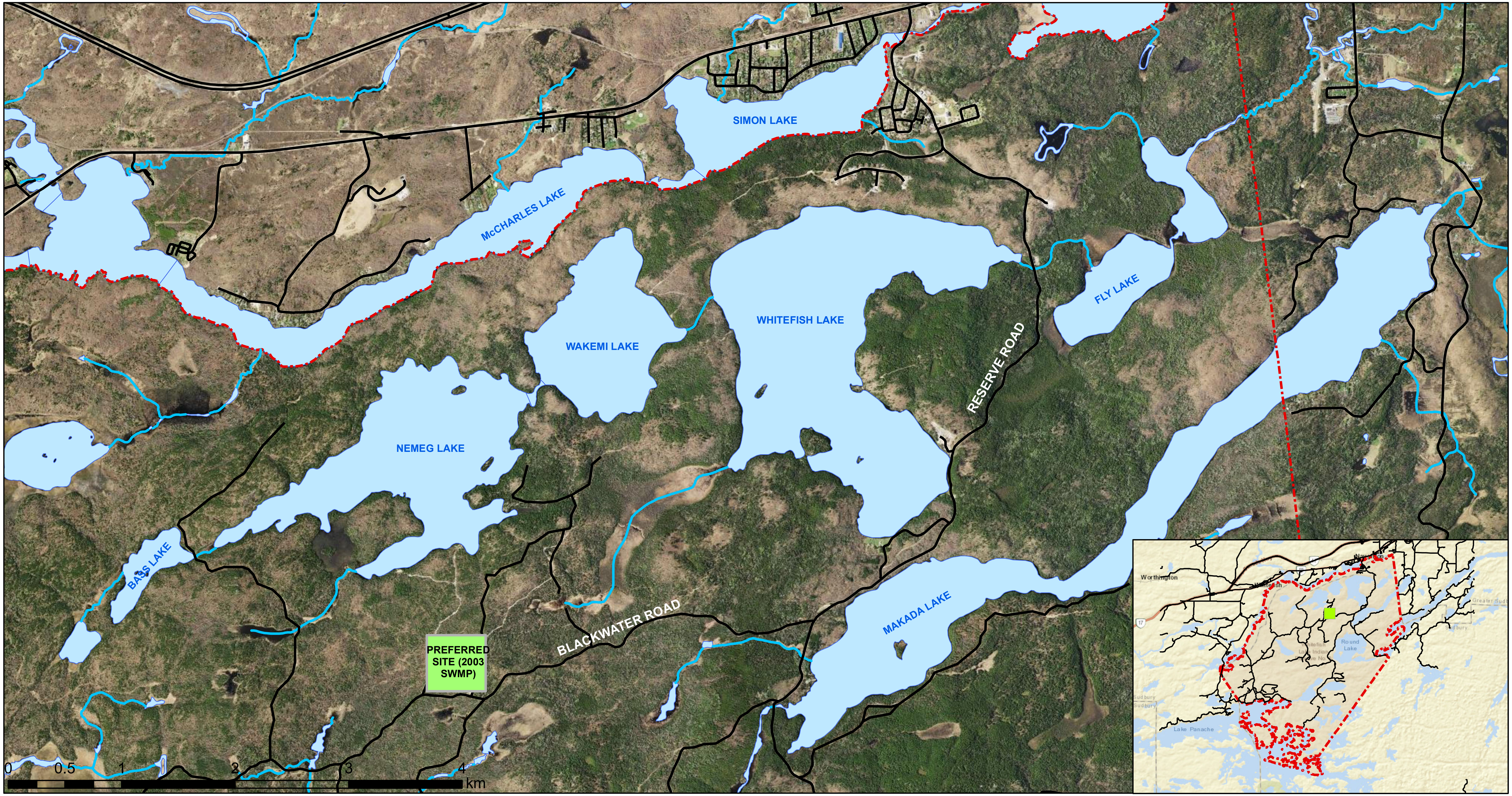
Watercourse

Roads

Closed Landfill Site

Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylinda, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/
FME_5644441C_1552572175354_5536.zip

Date: 2020-04-24	Title: CLOSED LANDFILL AREA	
Revision: 1		
Drawn By: MB Checked By: JH	Project No: 38062	Figure: 5.0
N	Project: Solid Waste Management Study	
	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION	



LEGEND

Atikameksheng Anishnawbek First Nation

Watercourse

Preferred Site 2003 SWMP

Roads

Waterbody

Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylinda, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/FME_5644441C_1552572175354_5536.zip

Date: 2020-04-24	Title: POTENTIAL FUTURE LANDFILL SITE
Revision: 1	
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	Project: Solid Waste Management Study
N	Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

FIRST NATIONS ENGINEERING SERVICES LTD.

Appendix II Pinchin Assessment

FINAL

Landfill Assessment

Atikameksheng Anishnawbek First Nation Waste Disposal Sites
Naughton, Ontario

Prepared for:

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January 22, 2020

Pinchin File: 224078

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1.0 INTRODUCTION

Pinchin Ltd. (Pinchin) was retained by First Nation Engineering Services Ltd. (FNESL) to complete a Landfill Assessment study to support FNESL with specific components of a more comprehensive Solid Waste Management System Planning Study for the Atikameksheng Anishnawbek. The Atikameksheng Anishnawbek First Nation (AAFN), which is located in northern Ontario, is approximately 19 kilometres (km) west of the City of Greater Sudbury, Ontario. The AAFN is situated south of Old Highway 17 and is approximately 43,747 acres, with a total population of 1,220 members.

This Landfill Assessment includes a hydrogeological assessment of the active landfill and the closed landfill sites. The active landfill site is located off Reserve Road, approximately 1.6 km southeast of the AAFN Community. The closed landfill site is located on Blackwater Road, adjacent to Lake Penage and approximately 17 km southwest of the AAFN Community. A location map of the active and closed landfill sites is included as Figure 1 and Figure 2, respectively (All Figures are provided in Appendix I).

1.1 Background

The active landfill site is located at Universal Transverse Mercator (UTM) NAD83, Zone 17T, Easting 487, 385 m, Northing 5,137, 298 m. The closed landfill site is located at Universal Transverse Mercator (UTM) NAD83, Zone 17T, Easting 475, 671 m, Northing 5,127, 015 m. Landfill coordinates were obtained using a Global Positioning System and are accurate within +/- 5 m.

Site inspections by Pinchin field personnel indicate that the AAFN active landfill site currently accepts solid non-hazardous waste and is utilized by residents in the area.

1.2 Scope of Work

The scope of work completed by Pinchin, as outlined in the Pinchin proposal entitled *"Landfill Assessment in Support of a Waste Management System Planning Study for Atikameksheng Anishnawbek"*, dated May 15, 2018 included the following as part of the Landfill Assessment:

Aquifer Instrumentation

Pinchin completed a well installation and repair program in order to establish an operable monitoring well network for both the active and closed landfill sites. The purpose of this aquifer instrumentation was to assess potential groundwater contaminant migration pathways that may result in landfill derived leachate effects on the adjacent receptors.

The scope of work for the aquifer instrumentation program is described below:

- Pinchin retained the services of a well driller, licensed in accordance with Ontario Regulation 903 (O.Reg. 903), to install one monitoring well to a maximum depth of 6.1 m at the active landfill site and three monitoring wells to a maximum depth of 7.62 m at the closed landfill site. Two of the existing monitoring wells at the active landfill site and one of the existing monitoring wells at the closed landfill site were repaired and put back into service;
- Pinchin supervised the borehole drilling and installation of the monitoring wells;
- Pinchin submitted representative soil samples to an accredited analytical laboratory to confirm the current soil conditions; and
- Pinchin documented the soil stratigraphy and waste characteristics within each monitoring well and provided detailed borehole logs to be included in the final report.

Groundwater Characterization

As discussed above, the potential for landfill derived leachate impacts to the groundwater aquifer need to be assessed to confirm or deny the presence of a groundwater plume originating from the landfill sites. Pinchin completed this aspect of the study by sampling and monitoring the new wells installed as part of this project, as well as the existing monitoring wells located at the sites.

The scope of work for the groundwater characterization program is described below:

- Pinchin monitored and sampled the four monitoring wells (MW1, MW2, MW3 and MW4) at the active landfill site and the five monitoring wells (MW1, MW2, MW3, MW4 and MW5) at the closed landfill site; and
- All groundwater samples, as well as quality assurance and control duplicates, were submitted to an accredited analytical laboratory for the analysis of the comprehensive list of landfill parameters as identified in Column 1 of Schedule 5 of the Ministry of the Environment, Conservation and Parks (MECP) "*Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites"* dated January 2012 (MECP Landfill Standards Guideline).

Surface Water Characterization

Similar to the characterization of the groundwater pathways, an assessment of the groundwater discharge zones (i.e., the adjacent surface water features) was required to evaluate the effects of the potential landfill derived leachate plume on the surface water receptors at the active landfill site.

Pinchin collected representative surface water samples from the adjacent surface water features at four monitoring locations (SW1, SW2, SW3 and SW4). These samples, as well as a quality assurance and control duplicate, were submitted to an accredited analytical laboratory for the analysis of the comprehensive list of landfill parameters as provided in Column 3 of Schedule 5 of the MECP Landfill Standards Guideline.

Landfill Closure and Capping Design

The Digital Terrain Model (DTM) created from the drone survey as part of this study was utilized in support of creating a conceptual closure plan for the waste disposal Site based on best management practices and the current MECP standards and guidelines. These design standards will serve to provide guidance with respect to suitable waste sloping and final contours, final cover and capping systems and preferred material specifications, in order to minimize the long-term environmental impacts of the landfill Site.

2.0 METHODOLOGY

The investigation methodology was conducted in general accordance with the MECP document entitled *"Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario"* dated December 1996 (*MECP Sampling Guideline*), the Association of Professional Geoscientists of Ontario document entitled *"Guidance for Environmental Site Assessments under Ontario Regulation 153/04 (as amended)"*, dated April 2011 (*APGO Guideline*) and Pinchin's standard operating procedures (SOPs).

2.1 Aquifer Instrumentation Program

Pinchin mobilized to the active site on July 5th, 2019 and to the closed site on July 8th and 9th, 2019 to initiate the aquifer instrumentation program (monitoring well installation and repairs). Based on the location of the waste deposits, Pinchin identified a need for new monitoring wells at various locations around the sites, in the upgradient, downgradient and cross gradient areas. Pinchin retained a licensed well drilling sub-contractor (Marathon Drilling) to conduct the borehole drilling and sampling of the overburden soil deposits, the subsequent monitoring well construction and installation, and the repairs to the existing monitoring wells.

The borehole drilling program was conducted utilizing a track-mounted CME-55 drilling unit complete with steel hollow split-spoon sampling equipment or hand augers. One borehole (MW1) was drilled at the active landfill site and a series of three boreholes (MW1, MW3 and MW4) were drilled at the closed landfill site. The boreholes were drilled and sampled until a maximum completion depth of 7.62 m (25 ft.), through the surficial and substrate soils, until the groundwater table was encountered. The boreholes were located to maintain a safe distance from underground services, as well as any overhead hydro lines, and to achieve the best possible coverage of the areas of concern. Locations of the boreholes/monitoring wells are provided in Figures 3 and 4 for the active and closed landfill sites, respectively. The borehole drilling supervision and sample collection was carried out by qualified technical staff from our Sudbury, Ontario office.

Boreholes were advanced at the approved locations on-site, using standard soils augering drilling techniques by the licensed drilling sub-contractor. The soil profile was recorded on preliminary field logs, with observations of any evidence of soil contamination (staining or olfactory evidence) being recorded.

Monitoring wells were installed in each of the borehole locations, in order to allow for the collection of representative groundwater samples, as well as to establish the hydraulic gradient within the aquifer. The monitoring wells were instrumented with 5.08 centimeter (cm), schedule 40 PVC casing with a 3 m long section of machine-slotted, #10 slot PVC well screen. The screened section was backfilled with clean sand and completed with a bentonite seal to surface and the appropriate style of stickup protective casing, in accordance with O.Reg. 903. The geographical coordinates of the borehole monitoring wells were captured using hand-held GPS instrument. The locations of the newly installed monitoring wells are presented on Figures 3 and 4. Borehole logs including the encountered soil stratigraphy and the monitoring well construction details are provided in Appendix II. The location details for each monitoring well are provided in Table 1 and Table 2 for the active and closed landfill sites, respectively (all tables are provided in Appendix III).

All monitoring wells were installed in accordance with O. Reg. 903. In keeping with O. Reg. 903, a copy of the well record was sent to the MECP and a copy given to the owner. The owner will be responsible for the upkeep of the monitoring wells and/or their decommissioning, should they be deemed unnecessary at a later date.

2.2 Soil Sampling

Concurrent with the aquifer instrumentation program, overburden soil samples were collected from each of the boreholes. At the active site, soil samples were taken at 0.61 m intervals at MW1, throughout the full depth of the borehole. At the closed site, soil samples were taken at 0.61 m intervals at MW1 and 1.22 m intervals at MW3 and MW4, throughout the full depth of the boreholes. Upon completion, the bagged soil samples were returned to our Sudbury office for review by the project hydrogeologist (as a quality control measure). Two representative soil samples collected from each borehole were then then submitted for laboratory analysis of VOCs, metals, inorganics and pH analysis. The results of the pH analysis were used to confirm the Site Condition Standards applicable to the Site as provided in the MECP document entitled “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act”, dated April 15, 2011 (MECP Standards). Only one soil sample from MW3 and from MW4 at the closed site were sent for laboratory analysis.

2.3 Elevation Survey

Concurrent with the aquifer instrumentation program, Pinchin completed a relative elevation survey of the newly installed and existing groundwater monitoring wells on July 9th, 2019 at the closed site and July 16th, 2019 at the active site, using a Stonex S900A GNSS RTK system. A known municipal benchmark was used to determine the elevation of the top of the monitoring well casings and the ground surface at each well location. These elevation measurements represent absolute geodetic elevation using the latest HT2.0 geoid. A summary of the elevation data is presented in Tables 1 and 2 for the active and closed sites, respectively.

2.4 Groundwater Monitoring

The completion of the groundwater monitoring activities included the following tasks:

- Pinchin notified the Client prior to field activities, and subsequently mobilized staff from the Sudbury office to both the closed and active sites;
- Static groundwater levels were collected at all monitoring well locations using a Solinsttm water level tape. Measurements were collected from the top of riser pipe;
- During the monitoring event, groundwater from each monitoring well was purged prior to the collection of the sample, using a moderate-flow sample methodology via high-density polyethylene (HDPE) 3/8" tubing and a Waterratm inertial footvalve system. The HDPE system was chosen as an approved method to minimize sediment/particulate within each sample, and to minimize sample agitation and well trauma in accordance with the MECP Sampling Document. Pinchin purged a minimum of three well volumes to a maximum of six well volumes using the inertial pump system until the well volume column was representative of the surrounding formation. During purging activities, additional groundwater monitoring parameters were collected from each monitoring well using a YSI-556 water quality meter for measurement of field parameters. Sample residual was disposed of onto the ground surface, on-site and up-gradient within the landfill confines;
- Groundwater samples were collected from each of the existing groundwater monitoring locations, using the HDPE system in accordance with the MECP Sampling Document. Dissolved metals were field-filtered using a dedicated in-line 0.45 micron disposable filter. Upon completion of field sampling and monitoring activities, all samples collected were submitted to the project laboratory, AGAT Laboratories (AGAT) in Mississauga, Ontario. All parameters were analyzed by the project laboratory using MECP approved procedures and are consistent with the analytical methods prescribed in the Analytical Methods document; and

- The groundwater samples collected were analyzed at the project laboratory for the comprehensive parameters listed in Column 1 of Schedule 5 of the MECP Landfill Standards. Groundwater sample results were compared to the applicable ODWQS as applied in accordance with the ODWQS Guideline document, as well as Schedule 4 of Ontario Regulation 347/90, as amended in order to assess leachate concentrations. Groundwater sample results were also compared to the reasonable usage parameters and were assessed using Guideline B-7 to establish and determine levels of contaminant discharges to the groundwater formation, which would be considered acceptable by the MECP from naturally attenuating landfill sites, with respect to human consumption and potable considerations.

2.5 Surface Water Monitoring

The completion of the surface water monitoring activities included the following tasks:

- Pinchin notified the Client prior to field activities, and subsequently mobilized staff from the Sudbury office to the active site;
- All field activities at each monitoring location were initiated at down-stream locations working up-stream to avoid sediment disturbance and influencing sample integrity;
- Surface water samples were collected during each sampling event using a direct grab sampling methodology in accordance with the MECP Sampling Document. Upon completion of field sampling and monitoring activities, all samples collected were submitted to AGAT. All parameters were analyzed by the project laboratory using MECP approved procedures and are consistent with the analytical methods prescribed in the Analytical Methods document;
- During sampling activities, surface water monitoring field parameters were collected at each surface water monitoring location using a YSI-556 water quality meter; and
- Surface water samples were analyzed during the monitoring event at the pre-determined monitoring locations for the comprehensive parameters listed in the Column 3 of Schedule 5 in the MECP Landfill Standards Guideline document as well as the analysis of sodium, dissolved organic carbon (DOC), and dissolved manganese. Sample results were compared to the applicable Provincial Water Quality Objectives, (PWQO), Aquatic Protection Values (APV) and Canadian Water Quality Guidelines (CWQG) criteria.

The locations of the surface water monitoring stations are presented in Figure 3 and further location details are provided in Table 3.

2.6 Groundwater and Surface Water Field Measurements

Prior to sampling groundwater in the wells, Pinchin monitored groundwater depth using a Solinst™ 30-metre electronic water level meter. The water level tape is calibrated in 1.0 mm increments. Reproducibility of the depth measurements is generally within 2.0 mm or less.

Subsequent to groundwater depth measurement and during purging activities, additional groundwater monitoring parameters were collected from each monitoring well using a YSI-556 water quality meter for measurement of field parameters. Field parameters at each surface water monitoring location were also collected using the YSI-556. The following field parameters were measured during the 2019 monitoring program:

- *Dissolved Oxygen* (DO) refers to the relative quantity of oxygen molecules which are dissolved or carried within a quantity of water. Oxygen enters water as rooted aquatic plants and algae undergo photosynthesis, and as oxygen is transferred across an air and water interface. Oxygen's solubility in water is indirectly correlated with water's temperature, salinity and pressure. DO concentrations have a significant effect on groundwater quality by regulating the valence state of trace of metals and constraining the bacterial metabolism of dissolved organic species;
- *Conductivity* is the measurement of water's capacity to pass an electrical current. It is considered to be a reasonable indicator of ionic activity and dissolved solids concentration levels. It is affected by the presence of inorganic dissolved solids which carry a negative charge such as chloride, nitrate, sulfate and phosphate anions or a positive charge such as sodium, magnesium, calcium, iron, and aluminum cations. Organic compounds such as oil and phenol do no conduct an electrical current very well and would therefore have low conductivity in water. Conductivity is also directly correlated to the water temperature. Specific conductivity is a measurement of conductivity values which have been compensated to 25ºC;
- *pH* is a measure of water's acidic/basic properties on a logarithmic scale from 1 (strongly acidic) to 14 (strongly alkaline or basic). It determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals. For example, in addition to affecting how much and what form of phosphorus is most abundant in the water, pH also determines whether aquatic life can use it. The degree to which heavy metals are soluble determines their toxicity. Metals tend to be more toxic at lower pH values because they are more soluble. Excessively high and low pHs can have serious environmental and health effects. A high pH may cause the release of iron, copper or lead into potable water, corrosion on water pipes and water using appliances and

reduces the effectiveness of water disinfection with chlorine. Low pH values corrode substances such as metals and plastics. Fluctuations in groundwater pH values may be indicative of groundwater contamination;

- *Temperature;* has a dramatic influence on water quality. The rate of chemical reactions is generally correlated to temperature, which in turn affects the biological availability of nutrients within the water. As previously mentioned, oxygen's solubility in water is indirectly correlated with its temperature. Declining concentrations of oxygen within warming water is magnified by aquatic plants increasing metabolism as water temperature increases. Low concentrations of DO weaken aquatic plants resistance to disease, parasites and other pollutants; and
- *Oxidation-reduction potential* (ORP) characterizes the oxidation-reduction state of the water on a scale from approximately -300mV (strongly reducing) up to +500mV (strongly oxidizing). The primary application of ORP is recording significant changes in the redox potential which is observed when purging a stagnant water column in piezometer and replacing it with "fresh" groundwater.

Field parameter data collected at the groundwater and surface water monitoring locations are provided in Appendix III.

2.7 Historical Waste Deposit Investigations

On July 10, 2019, Pinchin conducted the Historical Waste Deposit borehole investigation at the closed landfill site utilizing borehole drilling to quantify the volume of the historical waste deposits. Pinchin retained a licensed well drilling sub-contractor (Marathon Drilling) to conduct the borehole drilling. Boreholes were advanced utilizing a track-mounted CME-55 drilling unit complete with steel hollow split-spoon sampling equipment or hand augers. Three boreholes were advanced at the closed site (BH1, BH2 and BH3) to a maximum depth of 2.44 meters below ground surface (mbgs) until natural subsurface materials were encountered in order to delineate the vertical limits of the buried waste. The locations of the boreholes are presented on Figure 4. The borehole profile was recorded on preliminary field logs, with observations of any evidence of soil contamination (staining or olfactory evidence) being recorded. Borehole logs depicting the soil profile and details at each of the locations are provided in Appendix II. One soil sample was collected from each of the borehole locations within the natural subsurface materials. The soil samples were then submitted for laboratory analysis of VOC's, metals and inorganics.

2.8 QA/QC Protocols

Various quality assurance/quality control (QA/QC) protocols were followed during the Landfill Assessment to ensure that representative samples were obtained and that representative analytical data were reported by the laboratory.

Field QA/QC protocols that were employed by Pinchin included the following:

- Soil samples were extracted from the interior of the sampling device (where possible), rather than from areas in contact with the sampler walls to minimize the potential for cross-contamination;
- Soil and groundwater samples were placed in laboratory-supplied glass sample jars;
- The monitoring wells were developed following installation and were purged to remove stagnant water prior to sample collection so that representative groundwater samples could be obtained. Dedicated purging and sampling equipment was used for monitoring well development, purging and sampling to minimize the potential for cross-contamination;
- Soil and groundwater samples were placed in coolers on ice immediately upon collection, with appropriate sample temperatures maintained prior to submission to the laboratory; and
- Dedicated and disposable nitrile gloves were used for sample handling.

3.0 FINDINGS AND INTERPRETATIONS

3.1 Hydrogeological Setting

Bedrock geology surrounding the active landfill site is characterized as Hough Lake Group, Mississagi Formation comprising quartz-felspar sandstone, argillite and conglomerate (Ontario Geological Survey, 2011). Based on the results of the aquifer instrumentation program, the subsurface soil conditions at the active site generally consists of medium sand overlaying grey silt. Bedrock was not encountered at the borehole location during the aquifer instrumentation program.

Bedrock geology surrounding the closed landfill site is characterized as Quirke Lake Group, Bruce Formation comprising conglomerate with minor sandstone and siltstone (Ontario Geological Survey, 2011). Based on the results of the aquifer instrumentation program, the subsurface soil conditions at the closed site generally consists of fine sand and clay. Bedrock was not encountered at any borehole locations during the aquifer instrumentation program.

Prior to sampling groundwater in the wells, Pinchin monitored groundwater depth using a Solinst™ 30 m electronic water level meter. The meter tape is calibrated in 1.0 millimetre (mm) increments.

Reproducibility of the depth measurements is generally within 2.0 mm or less. The measured static groundwater levels for each newly installed monitoring well are provided in Table 1 and Table 2 for the active and closed sites, respectively. The static groundwater level within the monitoring wells was encountered at depths between 1.08 mbgs and 1.96 mbgs at the active landfill site and between 0.50 mbgs and 1.78 mbgs at the closed landfill site. One monitoring well at the closed landfill site (MW1) was observed to be dry.

The ground water table elevations recorded within the monitoring wells varied between 248.45 meters above sea level (masl) at MW1 and 240.03 masl at MW4 for the active site and between 242.95 masl at MW2 and 242.60 masl at MW4 for the closed site. Groundwater elevations were triangulated in order to develop inferred groundwater contours, as presented on Figure 5 and Figure 6 for the active and closed sites, respectively. The resultant inferred groundwater contours indicate that groundwater flow is interpreted to be directed to the south and southeast at the active site and towards the northeast at the closed site, essentially mirroring topography.

3.2 Soil Sample Characterization

3.2.1 Site Condition Standards

It is Pinchin's understanding that potable water for both the active and closed landfill sites and surrounding area is supplied by the City of Greater Sudbury, with the Vermillion River serving as the water source.

Ontario Regulation 153/04 (as amended) states that a Site is classified as an "environmentally sensitive area" if the pH of the surface soil (less than 1.5 mbgs) is less than 5 or greater than 9, the pH of the subsurface soil (greater than 1.5 mbgs) is less than 5 or greater than 11, or if the Site is an area of natural significance or is adjacent to or contains land within 30 metres of an area of natural significance. The pH values measured in the submitted soil samples for both the active and close landfill sites were within the limits for non-sensitive sites, as shown in Tables 4 and 5. The sites are also not areas of natural significance and are not adjacent to, nor do they contain land within 30 metres of an area of natural significance. As such, the sites are not environmentally sensitive areas.

Based on the results of the borehole investigations, the soil at the active site (sand and silt) and closed site (sand and clay) is interpreted to be medium/fine-textured for the purpose of selecting the appropriate *MECP Standards.*

Based on the above, the appropriate Site Condition Standards for the sites are:

- "Table 3: Full Depth Generic Site Condition Standards for Use in a Non-Potable Ground Water Condition", provided in the *MECP Standards* (*Table 3 Standards*) for:
    - Medium/fine-textured soils; and
    - Industrial/Commercial/Community property use.

As such, the analytical results for the active and closed landfill sites have been compared to these *Table 3 Standards*.

As the Site also falls under Federal jurisdiction, the soil sample results have also been compared to the CCME Soil Quality Guidelines for the Protection of Environment and Human Health for Industrial property use (CCME Soil Quality Guidelines).

3.3 Soil Sample Results

As indicated in Tables 4 and 5, reported concentrations of VOCs, metals and inorganics in the soil samples submitted for analysis met the applicable standards as required in Table 3 of the MECP Site Condition Standards and the CCME Soil Quality Guidelines.

The field observations during the borehole drilling indicted that no odours were observed in the soil samples collected for both the active and closed sites. Orange staining was observed in MW1 at the active site to a depth of 3.05 mbgs and in MW4 at the closed site throughout the full depth of the borehole.

3.4 Groundwater Characterization

3.4.1 The Ontario Drinking Water Quality Standards (ODWQS)

Through the establishment of the ODWQS, the province of Ontario has determined legally enforceable standards on contaminants in drinking water. The standards are designed to protect public health by restricting the quality of specific contaminants in drinking water. Three categories of contaminates are regulated under the Ontario Regulation 169/03 Drinking Water Standards:

- Microbiological – Originating from human and animals waste, coliforms and bacteria are common in the environment. Most are harmless however their presence may be indicative of other harmful bacteria in the water. Under the ODWQS, Escherichia coli ("E. Coli"), fecal coliforms and total coliforms must be non-detectable in drinking water;

- Chemical – ODWQS regulates maximum quantities of organic and inorganic chemicals allowed in drinking water. Industrial discharges or agricultural runoff are not necessarily removed by drinking water treatment. Consuming water exhibiting a greater concentration of these chemicals than the ODWQS may cause serious health problems; and
- Radiation – Natural and artificial radio nuclides are also regulated in the ODWQS. Standards are expressed as maximum allowable concentrations in becquerels per litre ("L"). Radiological contaminants include radio nuclides, such as radium 228, which are caused from the erosion of naturally occurring deposits, or artificial radio nuclides, such as tritium, released into the water by nuclear power plants. Radiological contaminants do not naturally occur within the study area and the disposal of radiological waste was not suspected in the Site and as a result radiation was not monitored for this study.

The ODWQS Guideline Document is the MECP technical guidance document which provides guidance on applicability of the ODWQS and also provides applicable interim guidelines where legal standards are absent.

3.4.2 Schedule 4 – Leachate Quality Criteria

Comparison of leachate concentrations was also completed, in accordance of with the Toxicity Characteristic Leaching Procedure (TCLP) as per Ontario Regulation 347/90 (as amended). This comparison is intended to identify any potential contaminants of concern form the leachate generated from the WDS. Schedule 4 of Ontario Regulation 347/90 (as amended) refers to Leachate Quality Criteria (Schedule 4 Criteria).

3.4.3 The Reasonable Use Criteria Assessment (RUC)

The "reasonable use concept" (RUC) approach, is the MECP's groundwater management strategy for mitigating the effect of landfill derived contamination on properties adjacent to its source. It establishes procedures for determining the reasonable use of groundwater on a property adjacent to sources of contaminants and establishes limits on the discharge of contaminants from facilities which dispose of waste into the shallow subsurface.

The application of "reasonable use" is outlined in Procedure B-7-1 "*Determination of Contaminant Limits and Attenuation Zones*". The procedure determines the maximum concentration (Cm) of a particular contaminant that would be acceptable in the groundwater beneath an adjacent property and is calculated in accordance with the relationship:

$$C_m = C_b + x(C_r - C_b)$$

> C_b – This is the background concentration of the particular groundwater contaminant in consideration before it has been affected by human activities. From this it is possible to calculate the extent of human activities impact on contaminant levels.
>
> C_r – In accordance with the Ontario Water Management Guideline, this is the maximum concentration of a particular contaminant that should be present in the groundwater. This value is dependent on property's use of the groundwater as outlined in B-7. It also allows for the total amount of contamination. Pinchin conservatively assumes that the reasonable use of the groundwater on-site is potentially for potable drinking water purposes.
>
> x – As determined by the MECP, this constant determines the extent which the contamination has on the groundwater's use. For drinking water x is 0.5 for non-health related parameters or 0.25 for health-related parameters. For other reasonable uses it is 0.5.

Contamination concentrations which exceed C_m may have an appreciable effect on the use of an adjacent property and as such the Site should be managed in a manner to minimize environmental damage, or the operation should be modified. It is acceptable to modify the operation of the disposal site to meet the specified limits. However, if these limits are exceeded, all waste disposals, except for that done in conjunction with a reasonable plan for closure or with remedial activities, should be terminated until the specified limits have been met, or until monitoring data indicate that these limits will be met. Determination of the replacement of contaminated water supplies and the abatement of the contaminate plume must be made on a case-by-case basis in accordance of *"Resolution of Groundwater Quality Interference Problems*" Guideline B-9.

3.5 Groundwater Results

The following discussion of parameters documents the groundwater quality in comparison to the Ontario Drinking Water Quality Standards (ODWQS), Schedule 4 Criteria and the Guideline B-7 criteria for the active and closed sites.

Monitoring well MW1 at the active site and monitoring well MW1 at the closed site are located in areas potentially hydraulically upgradient of the sites and have been used to estimate the background water quality at the respective sites before influence or coming into contact with the waste deposits. The remainder of the monitoring wells are considered to be downgradient of the current and historical waste deposits.

The analytical data for each well in comparison to the applicable regulatory criteria are provided in Tables 6 and 7 of Appendix III for the active and closed sites, respectively. The analytical data for each well in comparison to the Guideline B-7 criteria are provided in Tables 8 and 9 for the active and closed sites, respectively. Due to the background monitoring well at the closed site, MW1, being dry at the time of the sampling event, no background water quality results were available to complete the Guideline B-7 calculations. Therefore, to be conservative, the Guideline B-7 criteria for the closed site were calculated by assuming pristine background conditions (i.e., concentrations of 0 mg/L for all parameters). Copies of the laboratory analytical reports are presented in Appendix IV. The following is a summary of the water quality observed at the monitoring well locations with comparison to the background quality.

3.5.1 Background Water Quality Evaluation

Background water quality at the active site (MW1) appears reasonably non-impacted by landfill leachate contaminants and the data did not identify elevated levels of common landfill-related contaminant parameters such as conductivity, alkalinity, chloride, calcium, sodium, potassium or nitrate. The exceedances quantified at this location during the spring 2019 sampling event include dissolved organic carbon, iron and manganese. Considering the groundwater flow direction, concentrations of baseline indicator parameters quantified at this location are considered to be representative of regional background water quality in the aquifer intersected by the well screen.

Background water quality at the closed site (MW1) could not be characterized during the spring 2019 monitoring event due to the well being dry. Continued monitoring is required to characterize the background water quality at this site.

3.5.2 Downgradient Water Quality Evaluation

Groundwater quality is measured at various locations downgradient of the current and historical waste deposits, using monitoring wells MW2, MW3 and MW4 at the active site and using monitoring wells MW2, MW3, MW4 and MW5 at the closed site.

Active Landfill Water Quality

In comparison to background water quality at the active landfill site, groundwater observed downgradient of the waste fill area was observed to have slightly higher concentrations of baseline indicator parameters quantified at downgradient monitoring wells MW2 and MW3, but very similar concentrations further downgradient at MW4. Elevated concentrations of dissolved organic carbon (DOC) and manganese were observed to exceed the ODWQS at all monitoring locations. Elevated DOC and manganese concentrations are quantified at the background location, indicating that this exceedance is not landfill derived. Additional concentration exceedances of the ODWQS were observed for depressed alkalinity at MW4 and total dissolved solids (TDS) at MW2. Further monitoring events are required in order to confirm these results. DOC, manganese, alkalinity and TDS are operational guidelines or aesthetical objectives for drinking water systems set by the ODWQS and is not considered to be a significant environmental concern. In general, the groundwater quality of the downgradient wells observed during the spring 2019 monitoring and sampling event for the active site is similar to the inferred background conditions.

Based on the formula provided above and utilizing MW1 as background conditions, the site-specific C_m value for TDS has been calculated to be 399 mg/L; as a result, monitoring wells MW2 and MW3 are both in exceedance of the Guideline B-7 criteria for TDS. TDS is a non-health related parameter established based on aesthetic or operational limits for drinking water systems set by the ODWQS and are not considered to be a significant environmental concern originating from the active landfill site.

Closed Landfill Water Quality

During the spring 2019 monitoring event at the closed landfill site, monitoring wells MW1 and MW2 were observed to be dry. Water quality downgradient of the waste fill area at monitoring wells MW3, MW4 and MW5 observed to have low concentrations of baseline landfill indicator parameters such as conductivity, alkalinity, chloride, calcium, sodium, potassium or nitrate. Elevated concentrations of DOC at MW4 and manganese at MW3 were observed to exceed the ODWQS. Although the background monitoring location at the closed site, MW1, was observed to be dry, concentrations of DOC and manganese quantified at the background monitoring location at the active landfill site were observed to be in exceedance of the ODWQS. It is inferred that these concentrations are naturally present at elevated concentrations in this area and are therefore not landfill derived. This interpretation should be confirmed during future sampling events. Additionally, concentrations of DOC and manganese are operational guidelines or aesthetical objectives for drinking water systems set by the ODWQS and is not considered to be a significant environmental concern.

Based on the formula provided above and assuming pristine background conditions, no exceedances of the Guideline B-7 criteria were quantified for any parameters at any of the downgradient monitoring locations for the closed landfill site. It is therefore interpreted that no significant environmental impacts to groundwater are occurring at the closed site. Further investigations are required in order to confirm this interpretation.

At this time, no historical water quality monitoring data for the active and closed landfill sites were provided to Pinchin, and as such no interpretation of the trends of concentration versus time were analyzed for this Landfill Assessment.

Based on the observed hydrogeological conditions, including the inferred groundwater flow direction and the 2019 groundwater chemistry results, it is interpreted that the current landfill derived plumes at the active and closed landfill sites are limited to the areas in the immediate vicinity of the current waste deposits. Monitoring wells positioned in areas considered to be downgradient of the historical waste deposits do not suggest any significant landfill-leachate derived impacts.

Continued monitoring of these monitoring well locations is recommended during the spring and fall, for a minimum of three years, to quantify and establish a scientifically defensible database to base management decisions upon.

3.6 Groundwater Field Measurement Results

Pinchin collected groundwater monitoring parameters from each monitoring well using a YSI-556 water quality meter for real-time in-situ measurement of field parameters (July 17th, 2019 at the active site and July 16th, 2019 at the closed site). The field parameter measurements are provided in Tables 10 and 11.

A review of the field parameters for the active and closed sites identified no significant concerns in the water quality during the monitoring event. The measured field parameters were within the normal variability associated with shallow groundwater monitoring systems.

3.7 Surface Water Characterization

3.7.1 The Provincial Water Quality Objectives (PWQO)

The PWQO are numerical and narrative criteria which serve as chemical and physical indicators representing satisfactory levels for surface water and groundwater where it discharges to the surface. The PWQO are levels which are protective of the water quality for all forms of aquatic life during their indefinite exposures to the water. The PWQO levels include protection for anthropogenic recreational water uses where there is a high potential of exposure and are based on public health and aesthetic considerations.

In general, the PWQO state that the surface water quality of a water body shall be "free from contaminating levels of substances and materials attributable to human activities which in themselves, or in combination with other factors can: settle to form objectionable deposits; float as debris or scum or oil or other matter to form nuisances; product objectionable colour, odour, taste, or turbidity; injure, are toxic to, or produce adverse physiological or behavioural responses in humans, animals, or plants; or enhance the production of undesirable aquatic life or result in the dominance of nuisance species".

3.7.2 Aquatic Protection Values (APV)

Under Ontario Regulation 153/04, the MECP have developed APVs to protect aquatic organisms exposed to contaminants from migration of contaminated groundwater to surface water. Protection of aquatic biota from migration of contaminants by overland flow is provided by a Site being designated an environmentally sensitive area if the property includes or is adjacent to a water body or includes land that is within 30 m of a water body.

APVs are designed to provide a scientifically defensible and reasonably conservative level of protection for most aquatic organisms from the migration of contaminated groundwater to surface water resources.

3.7.3 Canadian Water Quality Guidelines (CWQG)

The CWQG were developed by the Canadian Council of Resources and Environment, to provide basic scientific information about the effects of water quality parameters on uses in order to assess water quality issues and concerns and to establish water quality objectives for specific sites. The guidelines contain recommendations for chemical, physical, radiological and biological parameters necessary to protect and enhance designated uses of water. They apply only to inland surface waters and groundwater, and not to estuarine and marine waterbodies. The rationale for each parameter is included to assist in the development of water quality objectives to suit local water conditions.

3.7.4 CCME Water Quality Guidelines

As the Site also falls under Federal jurisdiction, the surface water sample results have also been compared to the CCME Water Quality Guidelines for the Protection of Aquatic Life for Freshwater in Long Term context (CCME Water Quality Guidelines). These established guidelines were developed to provide science-based goals for the quality of aquatic and terrestrial ecosystems. CCME Water Quality Guidelines are voluntary, however, they provide a national-level perspective for overall ecosystem health and quality.

3.8 Surface Water Results

Pinchin collected surface water samples from all surface water monitoring locations at the active site, with the exception of SW4 which was observed to be dry, during the spring monitoring event, to monitor the surface water for contaminants of concern. A summary of water quality monitoring data relative to the regulatory standards is presented in Table 12. Copies of the laboratory analytical reports are presented in Appendix IV. Based on the limited data set available for review, a full review of historical datasets and temporal trend analysis charts could not be prepared or evaluated.

Surface water monitoring station SW1 is situated potentially hydraulically upgradient of the active site, in Whitefish Lake, and is considered to be representative of the surface water quality prior to influence from the waste deposits. During the spring 2019 sampling event, the quantified phenols concentration at this location was in exceedance of the PWQO standards, however, no landfill related impacts are interpreted to be occurring at this location.

The remainder of the surface water monitoring locations (SW2, SW3 and SW4) are situated downgradient of the active site. All parameters analyzed at these locations met the regulatory standards, with the exception of phenols which exceeded the PWQO standards at SW2 and SW3, however, It should be noted that the parameter phenols measured at surface water stations SW2 and SW3 met the applicable APV, CCME and CWQG standards. These elevated concentrations are likely not attributed to impacts originating from the landfill, as this parameter has not been quantified at these levels within the source contributing aquifer and were also detected at similar levels within the background (upstream) monitoring location, suggesting that they may be the result of natural processes. Future sampling events are required in order to confirm this interpretation.

Continued monitoring of these locations is recommended during the spring, summer and fall, for a minimum of three years, to quantify and establish a scientifically defensible database to base management decisions upon.

3.9 Surface Water Field Measurement Results

On July 22, 2019, Pinchin collected surface water monitoring parameters from each surface water monitoring location at the active site using a YSI-556 water quality meter for real-time in-situ measurement of field parameters. The field parameter measurements for each of the monitoring locations are provided in Table 10.

A review of the field parameters for the project identified no significant concerns in the water quality during the monitoring event. The quality at the surface water monitoring locations did not change significantly between each of the monitoring locations and the measured field parameters were within the normal variability associated with surface water bodies.

3.10 QA/QC Results

In order to provide confidence in the data obtained, a comprehensive QA/QC component was included in the monitoring program. The QA/QC procedures developed for this monitoring program are prepared in accordance with MECP Sampling Document, and in most cases, exceed the minimum requirements.

Soil and water quality samples collected by Pinchin were generated in accordance with acceptable procedures. No analytical hold times were exceeded for samples submitted for analyses and sample temperatures upon receipt at the project laboratory were below 10˚ Celsius.

One duplicate sample was collected from each of the sites, from the groundwater and surface water media, at monitoring well MW1 and surface water monitoring location SW1 at the active site and at monitoring well MW4 at the closed site, during the spring monitoring event and submitted for laboratory analysis of the full suite of analytical parameters.

3.10.1 Groundwater and Surface Water Duplicate Results

The calculated RPDs for the original and field duplicate groundwater sample has been compared to the performance standards considered acceptable by Pinchin (i.e., 50%), as provided in Tables 13 and 14 for the active site and in Table 15 for the closed site. RPDs were not calculated unless the parameter concentration in both the original and duplicate sample had detectable concentrations above the corresponding reasonable detection limit (RDL) for the parameter, which is equal to five times the lowest laboratory RDL. Each of the calculated RPDs met the corresponding performance standard, with the exception of phenols in SW1 at the active site. The duplicate groundwater data are interpreted to indicate representative the groundwater quality results.

Upon review of the QA/QC results for the spring program, Pinchin has not identified any significant concerns that would warrant the invalidation of any of the field or laboratory data, therefore considers the data generated as part of this program to be reliable.

The analytical laboratory employed to perform the laboratory analyses (AGAT) is accredited by the Standards Council of Canada/Canadian Association for Laboratory Accreditation in accordance with ISO/IEC 17025:1999 – "*General Requirements for the Competence of Testing and Calibration Laboratories*" for the tested parameters and has met the standards for proficiency testing developed by the Standards Council of Canada for parameters set out in the Soil, Ground Water and Sediment Standards.

Sample analysis dates provided on the laboratory analytical reports issued by AGAT indicate that all sample analyses were performed within the required sample/extract hold times, as indicated by the dates presented in columns for each sample parameter on the analytical report. The laboratory minimum detection limits were reported to be at or lower than the required MECP reporting detection limits for the parameters analyzed. A comparison of the internal laboratory duplicate samples indicates that all samples and the respective duplicates are within acceptable limits.

3.11 Waste Disposal Areas

Active Landfill

The active site is accessed via a 160 m length road running southeast off of Reserve Road. The intersection of the access road from Reserve Road is approximately 2.2 km south from Old Highway 17. The active site approval and operation is not controlled by an Environmental Compliance Approval (ECA) or other provincial document. As a result, there are no limitations, conditions or restrictions that dictate the waste deposition volumes or areas or compliance requirements for the ongoing operations. In addition, there are no regulated water quality monitoring programs. In general, the historic waste deposition practices consisted of area filling landfill methods (i.e., filling in a low-lying area with a mound of above grade waste deposits).

Waste disposal is completed by either direct disposal at the active landfill by the AAFN Community residents or through weekly waste collection services completed by the AAFN Public Works staff. Currently, a recycling program is in place for the AAFN Community, which is maintained by the AAFN Public Works department.

The site utilizes a system whereby residents dispose of their waste in large bins near the gate entrance to the northwest portion of the site. Once full, the bins are emptied into the active fill area and periodically covered with natural soils. The active area for the deposition of domestic waste is located in the southeast portion of the active site.

Closed Landfill

The closed site is accessed via the east side of Blackwater Road, which extends approximately 2.5 km off Ojibway Road. Ojibway Road is located off the east side of Panache Lake Road.

Based on the results of the boreholes advanced for the Historical Waste Deposit borehole investigation (BH1, BH2 and BH3) and historical document review, it is estimated that the majority of the historical waste on the closed site is located in the eastern central fill area. The locations of the boreholes are provided on Figure 4. A review of the borehole logs indicated that the waste is found to be deposited to a maximum depth of approximately 2.0 mbgs and is overlain by a 15 centimeter (cm) layer of silty clay and a 15 cm layer of topsoil. Therefore, a depth of approximately 1.7 m of waste is currently deposited at the closed site.

3.12 Current Waste Volumes

Active Landfill

The information collected during the elevation survey at the active site was used to create topographic contours, as presented in Figure 7, to estimate the volume of the waste deposits currently at the active site. The depth of the waste deposits was estimated using the difference in elevation between active waste deposits and that of the ground surface at the toe of the deposits. The general slope of the surrounding, exposed bedrock topography was interpolated beneath the waste deposits to estimate the assume base of the waste deposits. The estimated total volume of waste currently in place at te active Site is approximately 54,750 cubic metres (m^3).

Closed Landfill

The information collected during the historic waste deposits borehole drilling at the closed site was used to determine the depth of waste in order to estimate the volume of the waste deposits currently at the closed site. Based on the observed depth and the aerial extents of the waste deposits, the estimated total volume of buried waste is approximately 2,100 cubic metres (m^3).

3.13 Proposed Future Waste Disposal Areas

Active Landfill

Based on the results of the elevation survey and historical document review, the active site was found to contain the majority of the historical and active waste to be located in the centralized and southeastern portions of the site. It is Pinchin’s opinion that the majority of the southeast portion of the active site can be utilized for future area filling. This future area filling could continue in the southeast in order to achieve the desired final slope of the waste deposits required for closure of the landfill. It is estimated that this would equate to an additional volume of 10,000 m^3. In addition to adding future waste deposits to the current active face, to work towards progressive closure of this area through a slope that is safe and manageable, some additional waste deposits will also be required on top of the current waste deposits to develop a "crown" in order assist with the shedding of water from the plateau area and avoid the infiltration of water through the waste deposits, which would result in potential leachate generation.

As this future waste disposal is only recommended as a means to achieve safe slopes for closure, it is also recommended that the Community initiate the search for an alternate waste management strategy.

Closed Landfill

Based on the results of the historic waste deposits borehole investigation and historic document review, the closed site was found to contain the majority of the historical waste within a small contained area. The closed site has been inactive for several years and the results of the soil, groundwater and surface water quality analyses did not indicate any significant negative environmental impacts originating from the closed landfill. It is therefore Pinchin's opinion that the closed landfill should remain closed and no future waste deposits should be placed at the site.

3.14 Site Operations at the Active Landfill

3.14.1 Site Boundaries

As described in the introduction of this report, the active site is completely located within the AAFN boundaries, which is located within the district of Sudbury, approximately 19 kilometres (km) west of the City of Greater Sudbury, Ontario. The AAFN Community is approximately 17,810 hectares (44,000 acres) in size and includes 18 lakes within its boundaries. There is a parcel of land to the northeast containing the First Nation settlement and the AAFN WDS. The AAFN WDS is located 2.3 km east of Old Highway 17, on the southeast side of the Reserve Road. As the Site and fill area are greater than 150 m southeast of Reserve Road, the forested area surrounding the Site obstructs the lines of sight from the fill area to publicly accessible areas. The total Site area is 3 ha (although no formal boundary exists) with historic and active waste disposal activities within a 0.75 ha fill area.

3.14.2 Site Buffer Zone

A buffer zone is defined in the MECP Landfill Standards Guideline, as a green belt or zone located on-Site between the waste fill area and the site boundaries that allows for contaminant attenuation and provides enough space around the waste fill area to accommodate vehicle entry, exit and turning; to permit access to all areas of the site for monitoring, maintenance, and environmental control activities; and to provide sufficient space to accommodate all anticipated structures, equipment and activities. The buffer area must completely surround the waste fill area. O. Reg. 232/98 indicates that the buffer area must be a minimum of 100 m wide unless the Site Owner can demonstrate that a smaller buffer (minimum of 30 m) can satisfy all the buffer area purposes.

Maintaining a 30 m buffer zone around the entire fill area accounts for 1.25 ha of the difference between the total Site area (3 ha) and the waste disposal footprint area (0.75 ha).

The buffer area at the Site should consist of cleared, undeveloped areas, with bare mineral soils and minimal vegetative growth.

It is recommended that a minimum of 30 m wide area surrounding the active fill area be cleared of trees to act as a fire break.

3.14.3 Leachate Attenuation Zone

The AAFN active landfill site has been designed and operated as a natural attenuation type facility. Natural attenuation is defined as a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants. As water/precipitation infiltrates into the waste area and comes in contact with the waste deposits, there is the potential for the water to increase the leachate generation potential of the active site. The landfill derived leachate is subsequently attenuated over the course of the groundwater flow system. The 1986 MECP Guideline B-7 (i.e., the Reasonable Use Concept) is MECP's groundwater management strategy for mitigating the effect of contamination on properties adjacent to its source. Guideline B-7 and accompanying trigger level and contingency plans typically establish the procedures for determining what constitutes the reasonable-use of groundwater on a property adjacent to sources of contaminants and establishes limits on the discharge of contaminants from landfills which have a potential to migrate hydraulically downgradient and off-Site and impair the current and future groundwater use at downgradient properties. Currently, the Site does not have a defined leachate attenuation zone, however, based on the current water quality data, landfill derived leachate impacts appear to attenuate within close proximity to the landfill confines. The current and previous investigations completed by others have resulted in the instrumentation of the unconfined aquifer on the active site through a series of four (4) monitoring wells.

3.14.4 Fill Area

The waste is end dumped by users into the active face, but there is minimal compaction applied to the waste. To maximize compaction and the active site's capacity, waste should be applied to the active face in lift thicknesses of 30 centimetre (cm) to 60 cm, with heavy equipment being used to compact each lift until the active area reaches the required fill height. Once the equipment cannot further compress the waste when driving over the working face, the surface area of the exposed garbage is to be minimized to reduce the amount of cover material required, and, for equipment operator safety, a maximum slope of a 4:1 on all exposed sides (MECP, 2009). Applying waste in lifts thicker than 60 cm will result in poor compaction and increase the amount of cover material required, and as a result reduce the lifespan of the Site.

3.14.5 Cover

Ontario Regulation 232/98 (O.Reg. 232/98) states that the owner and operator of a landfilling site must ensure that all waste accepted for disposal at the site is deposited in a waste fill area and is covered at the end of each day. Given the intermittent use of the Site, the AAFN should apply a minimum of 15 cm of cover (soil or other material as described in O.Reg. 232/98 or as approved) at a bi-weekly rate.

Cover as described in the Landfill Standards Guideline, is used to control potential nuisance effects including windblown waste, odour, nuisance birds, bears and other wildlife, to facilitate vehicle access on the site, and to keep a site looking acceptable and tidy.

Once an entire fill area has reached capacity, final cover must be applied as indicated in Section 4.4 below. A vegetative cap should be encouraged to reduce methane emissions and prevent rainfall from penetrating into the waste deposits, resulting in additional leachate generation.

3.14.6 Slopes

The MECP regulations stipulate that the slopes of the active fill area following application of final cover are to be no steeper than 4 horizontal to 1 vertical (25%) and no shallower than 20 horizontal to 1 vertical (5%). During active operations, the MECP (2009) recommends a slope of at least 3 horizontal to 1 vertical (33%). The current slope of the active face at the AAFN Active Landfill Site is 4 m horizontal to 2 m vertical (50%), much steeper than this and effort should be made to initiate reduction of this slope.

3.14.7 Record Keeping, Complaints and Inspections

The AAFN maintains the landfill through occasional maintenance by their internal personnel and equipment, including opening and closing fill areas, removal of unacceptable items and general site clean-up. Regular (weekly) inspections of the active site conditions and operations should be conducted by AAFN personnel to verify that nuisance factors associated with housekeeping procedures, such as dust, litter and odour, are under control, thereby preventing routine operational nuisances from developing into more serious environmental problems. The AAFN should maintain a “Monthly Inspection Report”, which records weather conditions, any housekeeping or nuisance problems observed during the inspection, and the need for and type of corrective action(s) required to resolve any problems. The checklist should include opening condition, operating conditions, as well as closing conditions. If required the landfill operator will undertake corrective action(s) as soon as possible after identification.

3.14.8 Dust Control

Dust generation is common at most landfill sites due to the handling of soils and the movement of vehicles along gravel and dirt roads. Dust impacts typically result from the landfill site traffic, landfill operations, soil borrow operations and wind erosion. Dust in the vicinity of a landfill site should not be problematic under normal conditions and is usually controllable under extreme dry/windy conditions.

Due to the remoteness of the Site and the low-use frequency, generation of dust on the active site is not anticipated to be a problem. The vehicular traffic at the active site has not resulted in significant historic dust impacts, over extended periods of time. If dust raised by vehicle traffic becomes problematic, the application of calcium chloride is an acceptable method to treat on-Site roads.

3.14.9 Litter

Litter can be an issue from an aesthetic perspective and present a safety and health hazard. Litter is presently is considered to be an issue at the Site, and an attempt to clean up this windblown litter and dumping outside the active fill area.

Due to the type of waste received at the active site, there should be limited problems with respect to litter control. To ensure that litter does not become more problematic at the site during normal or extremely windy conditions, the following control measures could be implemented (if required):

- All vehicular traffic transporting waste to and around the Site will be adequately loaded to prevent debris from blowing out of the vehicle;
- Waste cover soil will be placed over the working face of the landfill, as required, in order to minimize blowing debris;
- The area of active face of the landfill will be kept to a minimum. This may be accomplished by placing waste cover soils over a portion of the active tipping area, should windy conditions warrant this action;
- Windblown litter should be recovered and returned to the active tipping area; and
- AAFN staff will continue to monitor and collect windblown debris, as conditions dictate, to prevent it from leaving the boundaries of the Site.

3.14.10 Odour Control

In general, landfills have the potential to emit two types of odours: waste odour and landfill gas odour. Waste odour is generated by recently deposited waste at the active face and landfill gas odour is generated by the anaerobic decomposition of organic waste materials. In addition, odour emissions can also result from leachate seeps, ponded leachate or stagnant water on the surface of the landfill entering into an anaerobic state. Historically, operations at the active site have not had significant problems with respect to odour. Additionally, at this time no evidence has been documented to suggest that methane gas generation from the active site is a significant concern.

3.14.11 Vector and Vermin Controls

The terms vector and vermin refer to objectionable insects, rodents and birds that may establish a habitat at the landfill. Common landfill vector and vermin include flies, rats and gulls. The impact of these species is of concern from both a health and aesthetic perspective. The AAFN should operate the Site to control vector and vermin on the landfill site property.

There has not been a significant problem with vectors and vermin at the active site, as a result of the type and volume of waste it receives. However, should vector and vermin become problematic then the following control measures will be undertaken:

- Should an outbreak of flies occur at the site then an insect exterminator will be contracted to control the population on an as-required basis;
- Should rodents come to inhabit the site, then extermination will be conducted by a licensed exterminator, on an as required basis; and
- Should the presence of gulls at the site become problematic, increased daily cover should be utilized.

3.15 Method of Operation

The active site is operated using the area fill method with the fill areas being above grade.

The area fill method, sometimes known as the progressive slope or ramp method, involves construction of successive cells of waste that are compacted against a slope. Waste is typically off-loaded either on undisturbed ground or on a prepared tipping pad. Wastes are then pushed uphill onto a starter berm or sloped bank in lifts and then compacted. Over a typical operating day, wastes are placed, compacted, trimmed and covered with soil. This daily accumulation of wastes is referred to as a cell. Area fills are usually located in moderately rolling topography or in large pits, ravines or canyons if cover material sources are readily available. Cover material for the operation is usually obtained from previously constructed stockpiles, off-site borrow areas or adjacent areas of higher elevation (cut areas).

As the topography of the actual fill area of the active site is relatively flat, aside from the eastern end, there is the potential for increased infiltration should the final cap material start to settle or deform as a result of degradation and/or compression of the underlying waste materials. As a result, it is recommended that the landfill operations be tailored to shape the site in preparation of closure, whereby the waste deposits will be positioned on top of the current active face in order to divert clean surface water run off around the perimeter of the waste footprint. The site should be filled to create a crown, completed with a perimeter ditch network to assist with the conveyance of water away from the waste deposits. Further details on the final site contouring are provided in Section 4.3.

3.16 Scavenging

Both Ontario Regulation 347 (O.Reg. 347) and O.Reg. 232/98 prohibit scavenging at a landfill site. Scavenging is the uncontrolled removal of waste materials from a landfill site. Scavenging is prohibited due to safety concerns, and the potential for damage to environmental controls, monitoring equipment and other works at a landfill.

Currently, the AAFN has implemented the following measures to prevent scavenging:

- Waste is covered occasionally; and
- There is a treed buffer surrounding the active fill area on-Site that is comprised of coniferous trees dense enough to visually buffer the site and to discourage access to the site at any location other than the site entrance.

If scavenging becomes an issue in spite of the above-mentioned measures, the AAFN may consider fencing additional perimeter of the active site.

4.0 SITE CLOSURE

The recommended Site Closure Strategy for the active landfill site is outlined below and is focused on the active and future fill operations, as the historic waste deposits currently do not appear to be having negative effects on the groundwater or surface water conditions.

4.1 Proposed End Use

Active Site

There is presently no end use plan formalized for the active site. It is anticipated that most of the site area will be returned to green space in a naturalized condition, with no future land use planned or permitted for it. Use for the site will most likely consist of a small area utilized as a waste transfer site, where waste will be containerized for transportation of the waste to licensed waste management site located outside of the Community. The remainder of the site will also consist of space utilized for passive recreation with enhanced regeneration/restoration through natural succession of plant and tree species.

4.2 Closure and Post-Closure Care & Maintenance

Active Site

Final closure of the landfill will be completed in a manner that is aesthetically pleasing and ensures long term protection of the environment. Active site closure activities involve the progressive closure of each individual cell as they reach capacity, which includes contouring for diversion of surface water away from the filled area. Small natural attenuation sites such as this, typically only require completion of the final vegetative cover and post-closure monitoring and maintenance.

The post-closure care period for a landfill depends on the environmental setting, the level of engineering, the required service lives of any engineered works, and the type of waste and remaining contaminant concentrations. The post-closure period typically lasts approximately 25 years. However, this is dependent of the contaminating lifespan of the fill. The contaminant concentrations throughout the post-closure period depend on the type of waste deposited in the landfill and the rate of waste stabilization. Waste stabilization is affected by site design, for example the final cover characteristics, and whether operational procedures have been practiced. For a natural attenuation site, limiting infiltration and leachate production is significant in reducing post-closure monitoring costs.

4.3 Final Contours

Active Site

A maximum slope of 4 horizontal to 1 vertical (4:1) and minimum slope of 20 horizontal to 1 vertical (20:1) have been used for the conceptual final contour plan, as specified by MECP guidelines. The grade around the perimeter of the landfill area will facilitate the incorporation of perimeter surface water drainage ditches in the final cover construction. The use of minimum slope criteria is necessary to provide adequate surface water runoff and reduce infiltration, and consequently leachate production, particularly after long-term consolidation of the disposed waste has occurred. A maximum slope criteria relates to soil erosion during storm events and ensures that slopes are manageable for construction and maintenance equipment. Figure 7 illustrates the conceptual final contours of the active landfill. The development of the AAFN WDS appears to be within relatively flat glacial outwash deposit. In order to minimize potential contact between clean surface water runoff for the surrounding area, as well as infiltration with waste deposits, the final waste contours should be established to divert overland flows around the perimeter of the waste footprint.

4.4 Final Cover

Closed Site

A review of the borehole logs advanced at the closed site (BH1, BH2, and BH3) indicated that the existing cover at the site consists of a 15 cm layer of topsoil and a 15 cm layer of natural subsurface materials (silty clay) overtop of the waste deposits. It is Pinchin's opinion that the existing cover is sufficient to minimize infiltration and leachate generation as the current water quality results do not indicate that any significant negative impacts to the groundwater or surface water, originating from the landfill, are occurring at the site. Therefore, no additional cover is required at the closed site.

Active Site

A progressive, final cover is recommended throughout remaining active site life, in order to minimize infiltration and leachate generation. As final contours are reached the final cover will be progressively placed. Two final cover system alternatives are suitable for the site. These alternatives consist of either a traditional soil cover system or a synthetic cover system. The proposed final contours for the top of the preferred final cover system (utilizing the traditional soil cover system) are presented on Figure 8.

4.4.1 Traditional Soil Cover

The low permeable soil will have to be obtained from an off-Site borrow pit as the materials available on-Site do not constitute low permeability material. This material will be placed directly over the uncompacted waste in continuous, uniform, loose lifts not exceeding 0.2 m in thickness. In accordance with standard industry practices, the low permeable soil will be compacted to a minimum of 95 percent of the material's Standard Proctor Maximum Dry Density (SPMDD) and at or to 4 percent above the optimum moisture content. The low permeable soil must have a minimum of 60 percent fines (silt and clay), by weight, passing the No. 200 sieve (0.074 mm opening), of which a minimum of 15 percent is clay (0.002 mm). This material should be placed to achieve an in-situ hydraulic conductivity of $1x10^{-6}$ cm/s. A 150 mm vegetative topsoil cover will be placed over the cover material as specified in Section 4.4.3. Details regarding the traditional soil cover system are provided in Figure 9.

4.4.2 Synthetic Cover

To provide a contingency for the availability of a suitable clay source or seasonal considerations, the option of a final cover construction utilizing a synthetic cover system has also been provided. The synthetic final cover design would be constructed from a Geosynthetic Clay Liner (GCL) underlying a minimum 300 mm protective soil cover material and 150 mm vegetated topsoil layer. The GCL should be a high strength needle punched bentonite composite such as a Bentofix GCL type NW, or equivalent, with a maximum hydraulic conductivity of $5x10^{-9}$ cm/s upon hydration. The GCL may be placed directly on the refuse as long as the surface is free of sharp, angular projections that may puncture the GCL. In the event that a suitable surface is not available, a 300 mm layer of sand may be used as a cushion/drainage layer beneath the GCL. The GCL should be placed in accordance with the manufacturer's specifications. All GCL joints should overlap a minimum of 300 mm and sandwich a bead of granular bentonite at an application rate of 0.4 kg/m.

The GCL will be covered with a minimum 300 mm (up to 600 mm if there is a concern for animal borrowing) of well graded soils, sands, or crushed gravel free of sharp edge stones larger than 25 mm in diameter. The cover material will be placed and compacted to a minimum of 90 percent SPMDD. A 150 mm vegetative topsoil layer will be placed over top, as discussed in the section below. Details regarding the synthetic cover system are provided in Figure 9.

4.4.3 Topsoil and Vegetative Cover

Topsoil will be secured from suitable off-Site sources and placed directly over the low permeable soil or the synthetic liner protective cover material. Organic composted material from the Site may be mixed with the topsoil to obtain and organic content in the range of 5 percent to 20 percent. The mixed topsoil should be fertile, agricultural soil typical for the area of the Site. The topsoil should be free of clay, impurities, plants, weeds and roots. The pH of the topsoil should range from 5.4 to 7.

The vegetative cover will be established, as soon as practically possible, after the placement of the topsoil layer, to minimize erosion of the topsoil layer. A typical grass seed mixture which is used at landfills, which may be used at the Site, is as follows:

- 30 percent - Tall Fescue
- 20 percent - Annual Rye Grass (nurse crop)
- 20 percent - Creeping Red Fescue
- 10 percent - Timothy
- 10 percent - Birdsfoot Trefoil
- 5 percent - White Dutch
- 5 percent - Alisalce Clover

The above seed mixture has been successful in establishing a heavy root mat in a short period of time to minimize soil erosion, sustain periods of drought, and does not require excessive maintenance.

4.4.4 Perimeter Ditching

Currently, surface water drainage at the active site in controlled by infiltration of precipitation into the site and overland flow towards the unnamed wetland system to the south. The landfill and surrounding topography are similar in elevation and the closure design strategy has been developed to follow this shape, blending the waste deposits with the surrounding terrain. Following installation of the final cover system, surface water drainage should be managed by a network of perimeter ditching, in order to direct any heavy precipitation of spring freshet away from the landfill to minimize infiltration and/or ponding of water on the cap. These perimeter drainage ditches will be directed towards the vegetated area to the south between the active site and the aforementioned wetland. This area would act to slow down runoff and surface water flow received from the drainage ditches and direct water away from the landfill. The proposed perimeter ditching is presented in Figure 8.

4.5 Post Closure Monitoring for the Active and Closed Sites

4.5.1 Site Inspections

In order to ensure that the active and closed sites continue to meet the closure requirements, the MECP Landfill Guideline Standard recommend annual site inspections. These annual site inspections would consist of the following activities:

- Inspection of the integrity of the final cover;
- Inspection of the final cover;
- Inspection of the effectiveness of site drainage; and
- A general inspection of the site, including the adequacy of the closure strategy as outlined in Section 4.0 above.

4.5.2 Groundwater Monitoring

At the time of preparation of this report, a total of nine (9) groundwater wells have been installed on-Sites (4 wells at the active site and 5 wells at the closed site) in order to characterize the environmental status of the groundwater. According to O.Reg. 232/98 (as amended by O.Reg. 268/11) the contaminating lifespan of a landfill is to be a minimum of 25 years from the date of final waste deposition. As a result, the post-closure monitoring program typically would span this duration.

Given the available groundwater monitoring network and the existing historical database, Pinchin is recommending the continuation of the groundwater monitoring program developed as part of this study, during the post-closure monitoring period.

Monitoring at the active and closed sites should, at a minimum, include the existing groundwater monitoring well network of nine (9) monitoring wells. The groundwater monitoring wells would then be completed with analyses for the comprehensive list of parameters detailed in Column 1 of Schedule 5 of the MECP Landfill Standards in the spring and the indicator list of parameters provided in Column 2 of Schedule 5 of the MECP Landfill Standards in the fall. This monitoring program would be subject to future revisions dependant on the findings.

It is likely that the monitoring program for the closed site could be discontinued sooner since the site has not received waste for over 25 years and has been capped for an equivalent length of time.

4.5.3 Surface Water Monitoring at the Active Site

At the time of preparation of this report, only four surface water monitoring stations have been established both on and off-site at the active landfill in order to characterize the environmental status of the surrounding surface water. According to O.Reg. 232/98 the contaminating lifespan of a landfill is to be a minimum of 25 years from the date of final waste deposition. As a result, the post-closure monitoring program typically would span this duration.

Surface water monitoring of the active site should include the existing network of four surface water stations. The monitoring of the surface water stations would then be completed with laboratory analysis of the parameters provided in Column 3 of Schedule 5 of the MECP Landfill Standards in the in the spring and summer of each year and the indicator list of parameters listed in Column 4 of Schedule 5 of the MECP Landfill Standards in the fall. Similar to the groundwater monitoring component, this surface water monitoring program would be subject to future revisions dependant on the findings.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the Landfill Assessment completed on the Atikameksheng Anishnawbek First Nation Waste Disposal Sites, Pinchin offers the following summary of findings:

- In addition to the existing monitoring well network, several additional groundwater monitoring wells were advanced across the sites (one at the active site and three at the closed site) to investigate subsurface conditions. The subsurface conditions were observed to generally consist of medium sand overlying silt at the active site and fine sand and silt at the closed site;
- The static groundwater levels were recorded across the sites with an inferred groundwater flow direction to the south and southeast at the active site and towards the northeast at the closed site;
- All reported concentrations in the groundwater samples submitted for analysis satisfied the respective ODWQS parameters with the exception of:
    - Dissolved organic carbon (DOC), manganese, alkalinity and total dissolved solids (TDS) at the active site; and
    - DOC and manganese at the closed site.

- All reported concentrations in the groundwater samples collected from the downgradient monitoring wells met the applicable Guideline B-7 criteria for all parameters analyzed with the exception of TDS at the active landfill.
- The surface water quality results for the active landfill indicate phenols exceedances of the PWQO at SW1, SW2 and SW3. Further sampling events are required to confirm the interpretation that these impacts are not landfill derived;
- The groundwater and surface water quality monitoring and sampling suggests a limited/local extent of landfill derived impacts to the area directly downgradient of the current waste deposits at both the active and closed landfill sites;
- The estimated total volume of waste currently is calculated to be 54,750 m^3 at the active site and 2,100 m^3 at the closed site;
- A potential future deposition area exists at the active landfill site to the southeast of the current waste deposition area in order to achieve the desired final slope of the waste deposits required for closure of the landfill. It is estimated that this would equate to an additional volume of 10,000 m^3. In addition to adding future waste deposits to the current active face, to work towards progressive closure of this area through a slope that is safe and manageable, some additional waste deposits will also be required on top of the current waste deposits to develop a “crown” in order assist with the shedding of water from the plateau area and avoid the infiltration of water through the waste deposits, which would result in potential leachate generation. As this future waste disposal is only recommended as a means to achieve safe slopes for closure, it is also recommended that the Community initiate the search for an alternate waste management strategy; and
- The landfill cover system at the active site should focus on the current active and proposed waste deposition areas and will comprise of either a traditional low permeability soil cover or a CGL system, each with a thickness of 600 mm and a minimum of 150 mm organic materials placed directly over the low permeable soil or the synthetic liner protective cover material. No additional cover is required at the closed site.

As a result of these findings, Pinchin makes the following recommendations:

- The closed landfill site should remain closed with no future waste deposits placed at the site;
- As the potential fill area for future waste disposal at the active landfill is relatively small in volume, it is recommended that the Community initiate the search for an alternate waste management strategy;
- Area filling of the future landfilling activities at the active site should be subject to progressive closure (interim or final) as they reach final grade to minimize infiltration and leachate generation;
- Based on the groundwater results, an annual groundwater monitoring program should be continued on the existing monitoring well network of nine monitoring wells at both the active and closed sites. The groundwater monitoring wells should be completed with analyses for the comprehensive list of parameters detailed in Column 1 of Schedule 5 of the MECP Landfill Standards in the spring and summer and the indicator list of parameters detailed in Column 2 of Schedule 5 of the MECP Landfill Standards in the fall; and
- Surface water monitoring of the active site should include the existing network of four surface water stations. The monitoring of the surface water stations would then be completed with laboratory analysis of the parameters detailed in Column 3 of Schedule 5 of the MECP Landfill Standards in the in the spring and summer of each year and the indicator list of parameters detailed in Column 4 of Schedule 5 of the MECP Landfill Standards in the fall.

6.0 LIMITATIONS

This Landfill Assessment was performed for Atikameksheng Anishnawbek First Nation (Client) in order to investigate and document the existing conditions at the Atikameksheng Anishnawbek First Nation Active and Closed Waste Disposal Sites. The term recognized environmental condition means the presence or likely presence of any hazardous substance on a property under conditions that indicate an existing release, past release, or a material threat of a release of a hazardous substance into structures on the property or into the ground, groundwater, or surface water of the property. This Landfill Assessment does not quantify the extent of the current and/or recognized environmental condition or the cost of any remediation or corrective measure.

Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sampling or intrusive investigation (borehole) locations.

No environmental site assessment can wholly eliminate uncertainty regarding the potential for recognized environmental conditions on a property. Performance of this Landfill Assessment to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the potential for recognized environmental conditions on the sites and recognizes reasonable limits on time and cost.

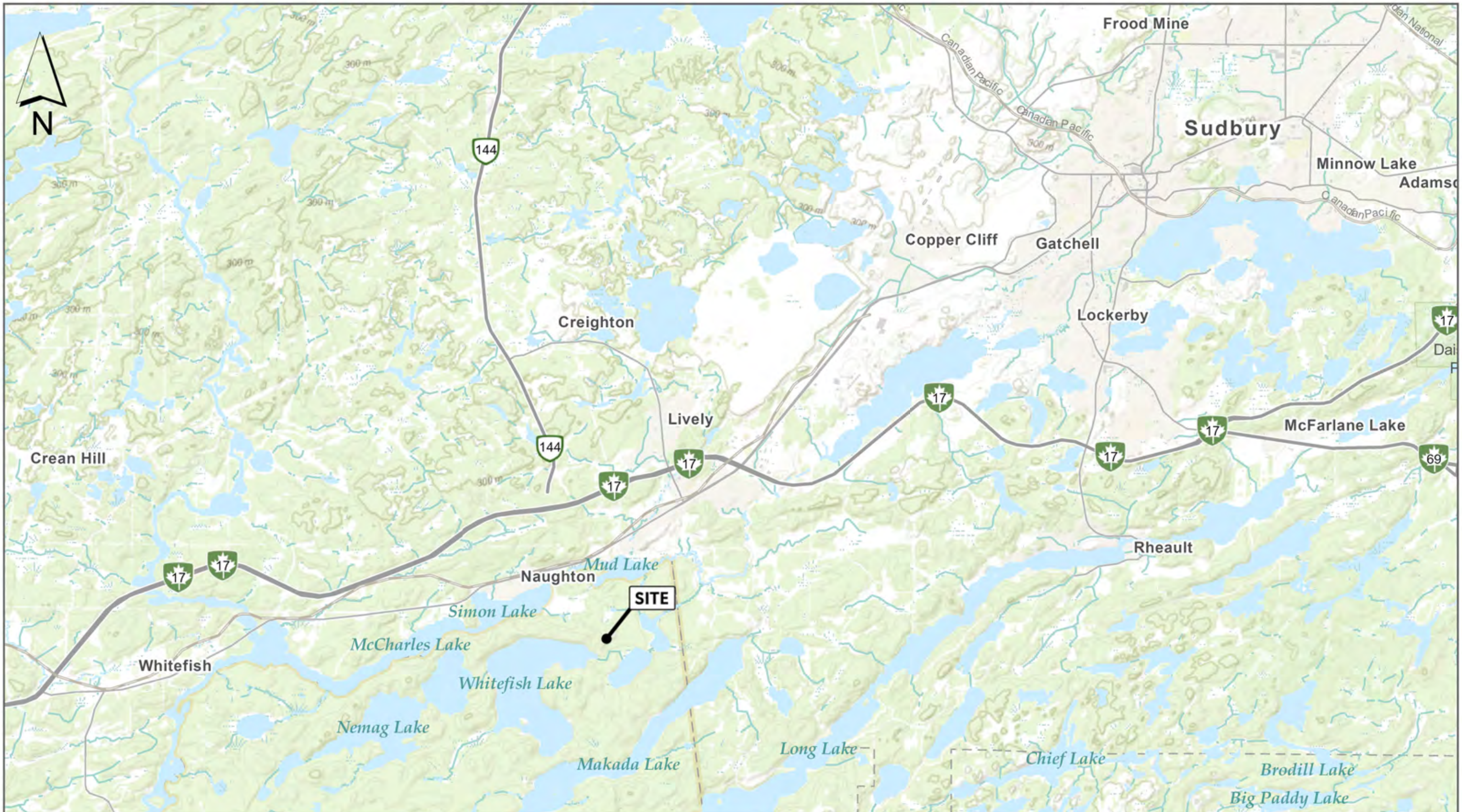
This Landfill Assessment was performed in general compliance with currently acceptable practices for environmental site investigations, and specific Client requests, as applicable to these sites.

This report was prepared for the exclusive use of the Client, subject to the terms, conditions and limitations contained within the duly authorized proposal for this project. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted.

If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law.

Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and these interpretations may change over time.

APPENDIX I
Figures



SCALE

0 1000 2000 3000 4000 5000

Meters

1:135,000

KEY PLAN

LEGEND

SITE Site Location

NOTES, REFERENCES AND SOURCES

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Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Esri Canada

PROJECT NAME

ACTIVE WHITEFISH LAKE LANDFILL RPAS/UAV SURVEY

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

PINCHIN

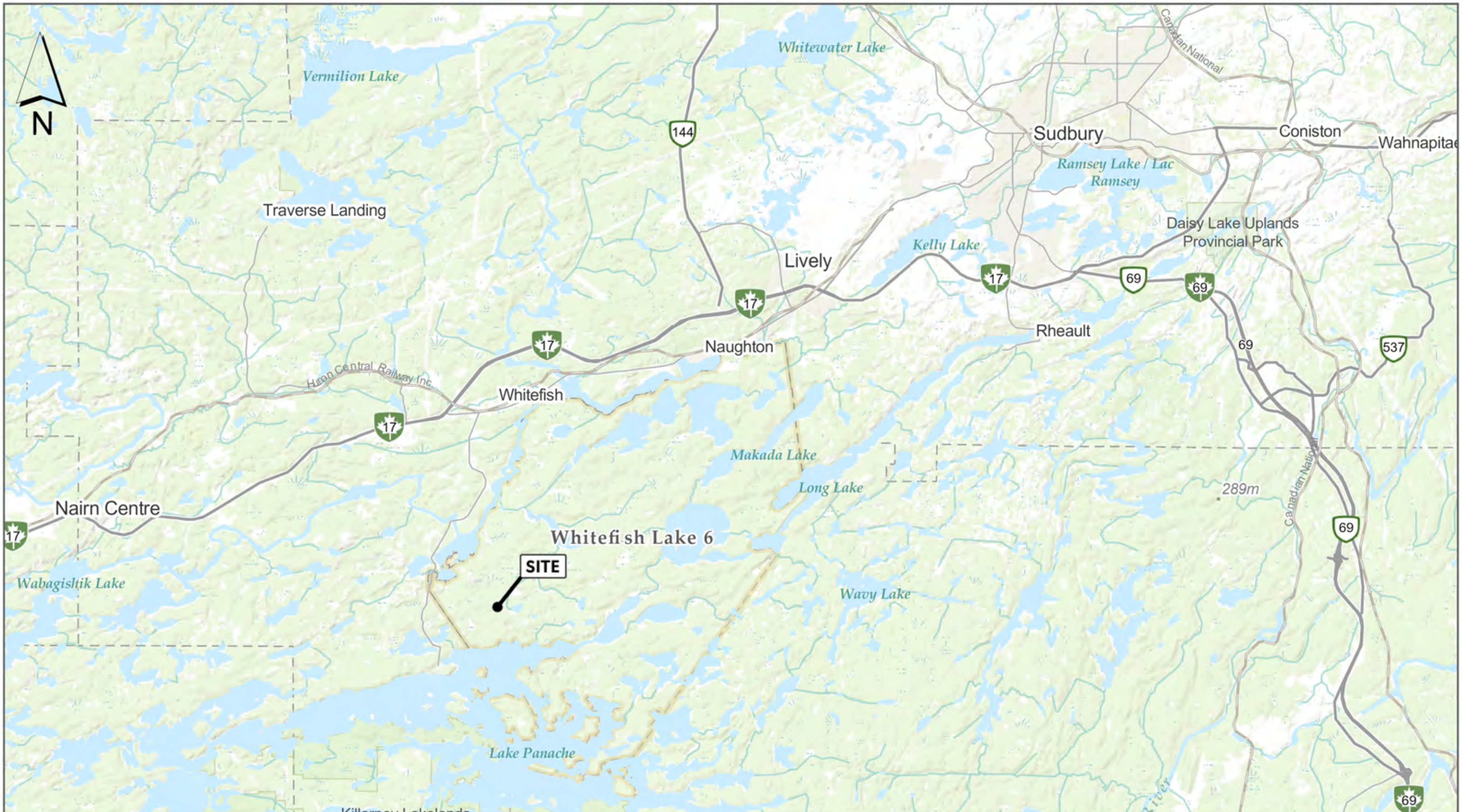
TITLE **KEY MAP FOR ACTIVE LANDFILL**

FIGURE **1**

PROJECT **224078.000**

DATE **JANUARY 2020**

PREPARED **PKM** REVIEWED **TIM**



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Meters

1:250,000

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KEY PLAN

LEGEND

SITE Site Location

PROJECT NAME

LANDFILL ASSESSMENT FOR ATIKAMEKSHENG ANISHNAWBEK

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

PINCHIN

TITLE **KEY MAP FOR CLOSED LANDFILL**	FIGURE **2**
PROJECT	**224078.000**
DATE	**JANUARY 2020**
PREPARED **PKM**	REVIEWED **TIM**

PINCHIN

LEGEND

- UAV Survey Area
- Benchmark
- Monitoring Well
- Surface Water Sample
- Landfill Boundary
- Major Topographic Contour (2m)
- Minor Topographic Contour (50cm)

SCALE

0 9 18 27 36 45
Meters
1:800

NOTES, REFERENCES AND SOURCES

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4) Coordinate system: NAD 1983 UTM Zone 17N

Sources:

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

KEY PLAN

PROJECT LOCATION

WHITEFISH LANDFILL

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE	FIGURE
SITE MAP FOR ACTIVE LANDFILL	3
PROJECT	224078.000
DATE	JANUARY 2020
PREPARED PKM	REVIEWED TIM

PINCHIN

LEGEND

- Borehole
- Benchmark
- Monitoring Well
- Major Topographic Contour (1m)
- Groundwater Contours (1m)
- Minor Topographic Contour (50cm)

SCALE

0 5.5 11 16.5 22 27.5
Meters
1:500

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KEY PLAN

PROJECT LOCATION

WHITEFISH HISTORIC LANDFILL

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE: **SITE MAP FOR CLOSED LANDFILL**	FIGURE: **4**
PROJECT	**224078.000**
DATE	**JANUARY 2020**
PREPARED: **PKM**	REVIEWED: **TIM**

PINCHIN

LEGEND

- Benchmark
- Monitoring Well
- Surface Water Sample
- Landfill Boundary
- Groundwater Contours (1m)
- Groundwater Flow Direction

SCALE

0 10 20 30 40 50
Meters
1:900

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KEY PLAN

PROJECT LOCATION

WHITEFISH LANDFILL

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE

INFERRED GROUNDWATER CONTOURS FOR ACTIVE LANDFILL

FIGURE

5

PROJECT	224078.000
DATE	JANUARY 2020
PREPARED	PKM
REVIEWED	TIM

LEGEND

SCALE

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Sources:

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KEY PLAN

PROJECT LOCATION

WHITEFISH LANDFILL (CLOSED)

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE **INFERRED GROUNDWATER CONTOURS FOR CLOSED LANDFILL**	FIGURE **6**
PROJECT	**224078.000**
DATE	**JANUARY 2020**
PREPARED **PKM**	REVIEWED **TIM**

LEGEND

- Top of Waste Contours (1m)
- Perimeter Ditch
- Major Topographic Contour (2m)
- Minor Topographic Contour (50cm)

SCALE

0 8 16 24 32 40
Meters
1:683

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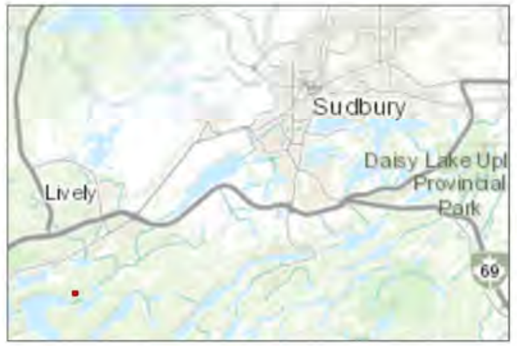
KEY PLAN



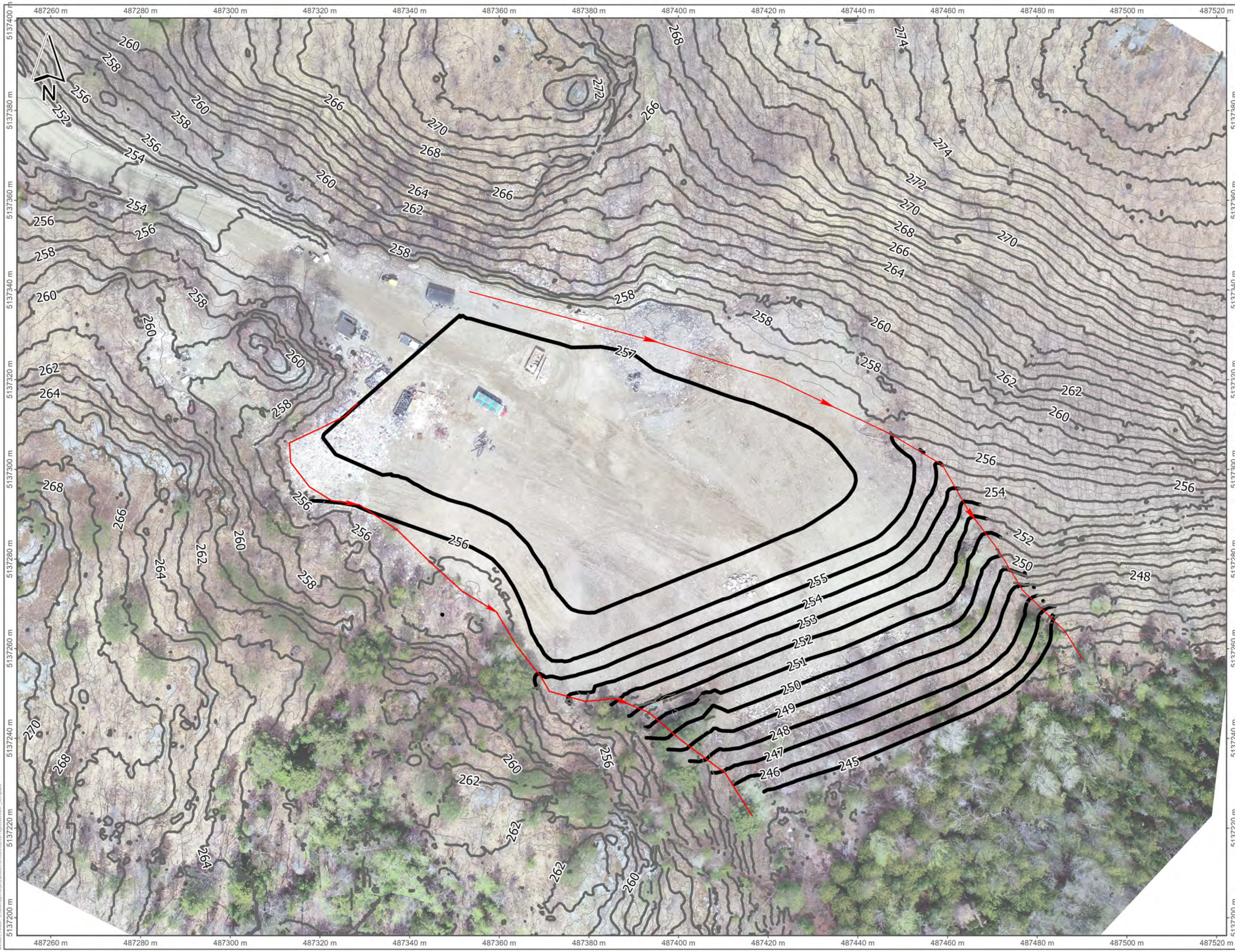
PROJECT LOCATION

WHITEFISH LANDFILL

CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE	FIGURE
FINAL TOP OF WASTE CONTOURS FOR THE ACTIVE LANDFILL	7
PROJECT	2244078.000
DATE	JANUARY 2020
PREPARED PKM	REVIEWED TIM



LEGEND

Top of Cover Contours (1m)

Major Topographic Contour (1m)

Minor Topographic Contour (50cm)

Perimeter Ditch

SCALE

0 9 18 27 36 45

Meters

1:800

NOTES, REFERENCES AND SOURCES

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2) Do not scale drawing
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4) Coordinate system: NAD 1983 UTM Zone 17N

Sources:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

KEY PLAN

PROJECT LOCATION

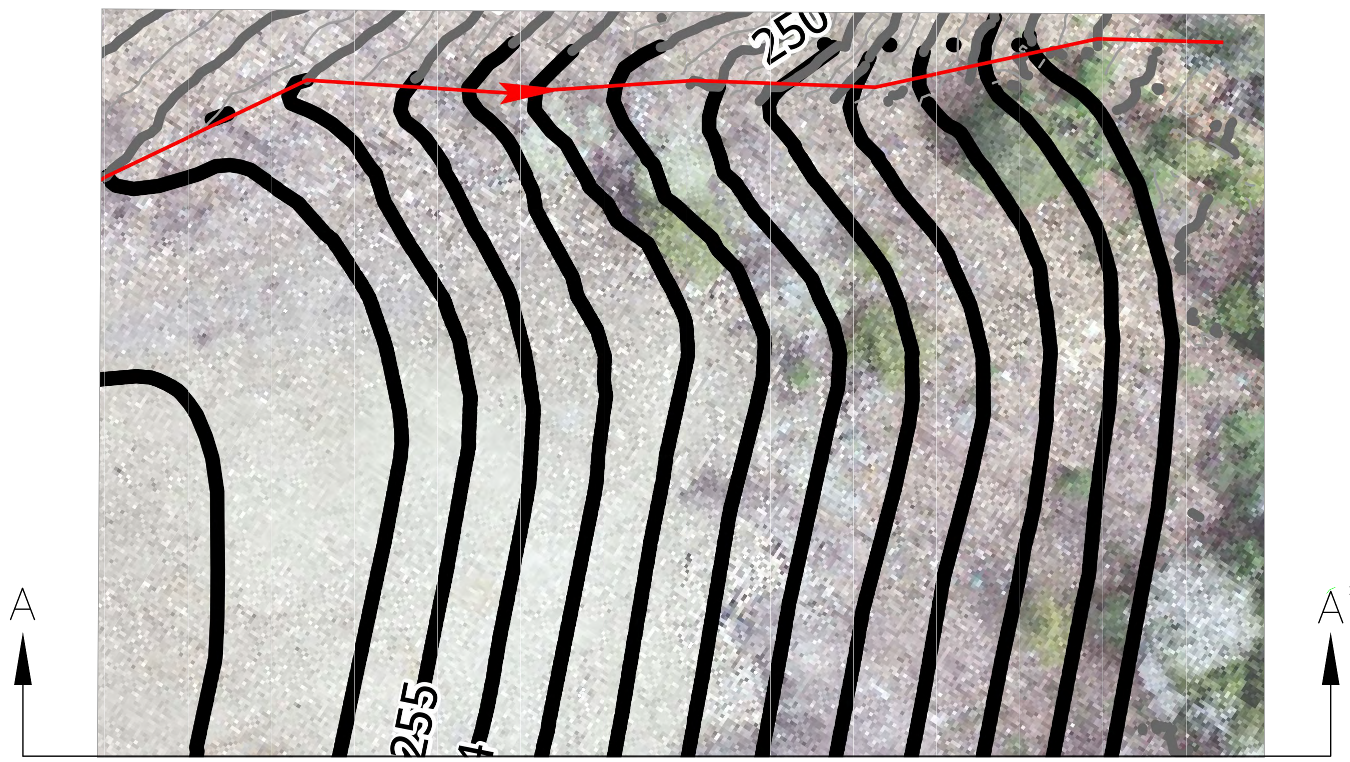
WHITEFISH LANDFILL

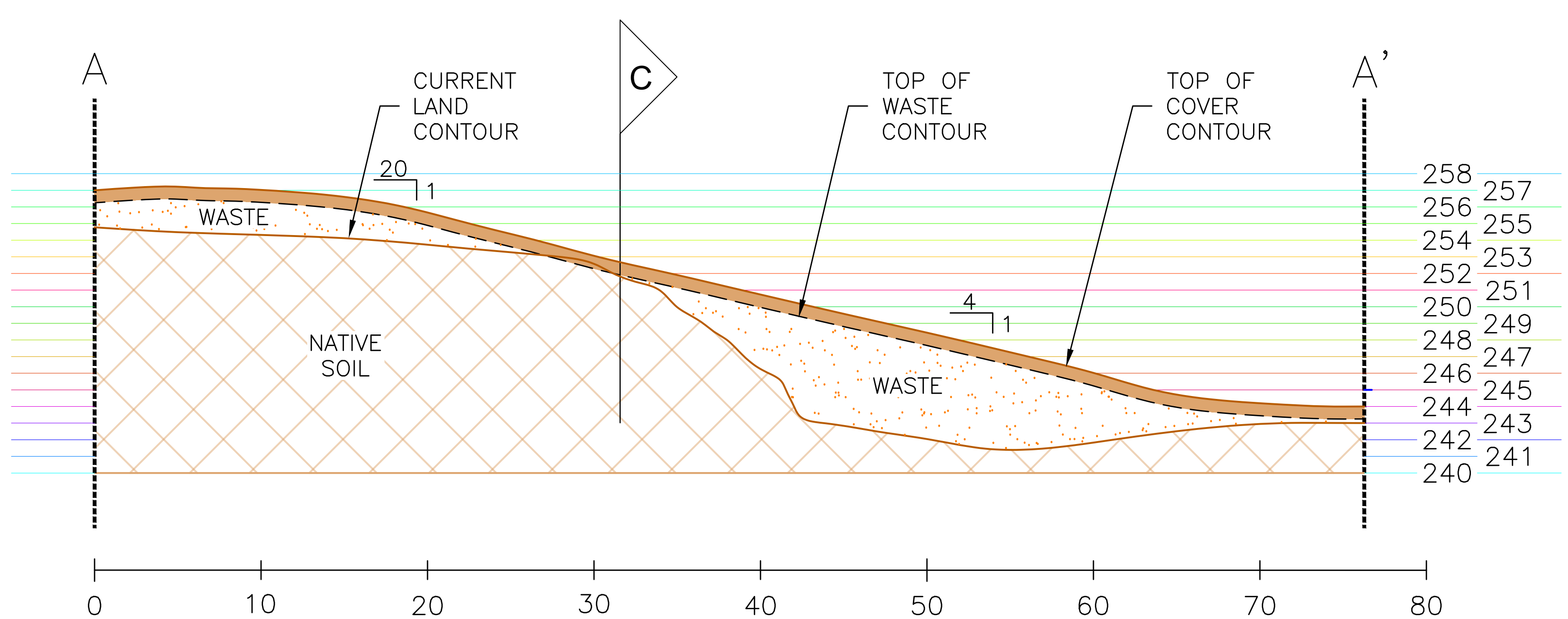
CLIENT

ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

TITLE	FIGURE
FINAL TOP OF COVER CONTOURS FOR THE ACTIVE LANDFILL	8

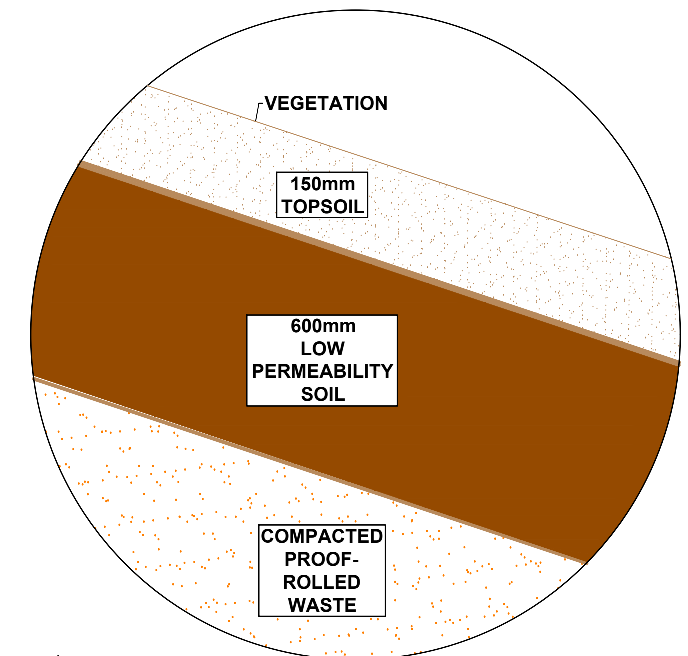
PROJECT	224078.000
DATE	JANUARY 2020
PREPARED	PKM
REVIEWED	TIM





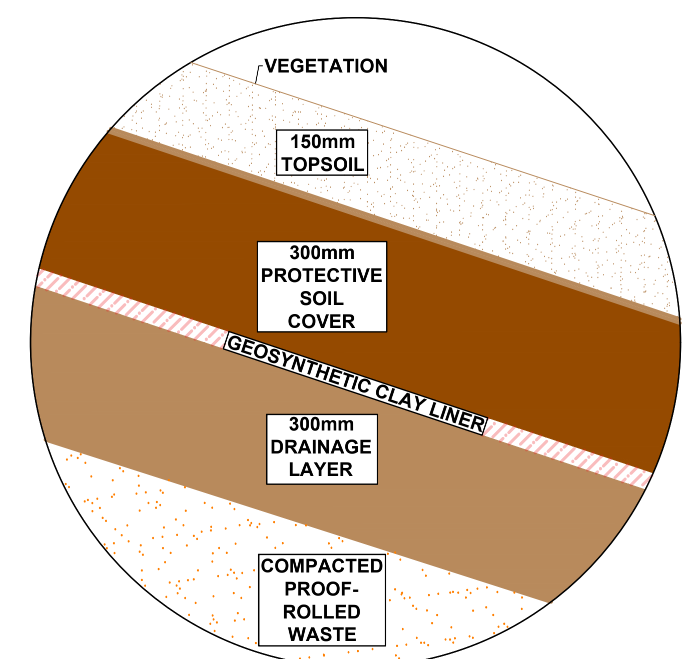
SECTION A-A' PROPOSED WASTE COVER CONTOURS

AS NOTED



C DETAIL TRADITIONAL SOIL COVER

OPTION 1



C DETAIL SYNTHETIC COVER

OPTION 2

LEGEND

- CROSS-SECTION LINES
- PROPOSED FINAL CAP CONTOUR
- PROPOSED CAPPING
- PROPOSED FINAL WASTE CONTOUR
- WASTE
- NATIVE SOIL

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

PINCHIN

PROJECT NAME: LANDFILL ASSESSMENT FOR ATIKAMEKSHENG ANISHNAWBEK	
CLIENT NAME: FIRST NATIONS ENGINEERING SERVICES LTD.	
PROJECT LOCATION: ATIKAMEKSHENG ANISHNAWBEK NAUGHTON, ONTARIO	
FIGURE NAME: FINAL COVER CROSS-SECTION ACTIVE LANDFILL	
PROJECT NUMBER: 224078	SCALE: AS SHOWN
DRAWN BY: MC	REVIEWED BY: KM
DATE: JANUARY 2020	FIGURE NUMBER: 9

APPENDIX II
Borehole Logs

Log of Borehole: MW1

Project #: 224078 **Logged By:** D.J.

Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

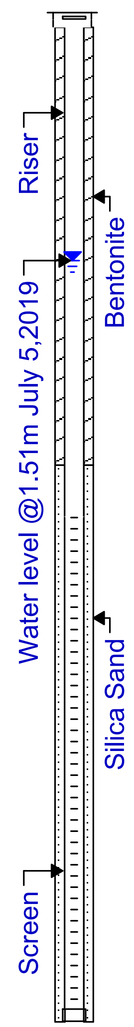
Location: Active Landfill, Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 5, 2019

SUBSURFACE PROFILE / SAMPLE

Description	Measured Depth (m)	Sample ID
Ground Surface	0.00	
Boulders with Sand and Gravel	0.30	SS1
Sand Medium with trace coarse sand, orange staining	1.52	SS2
Sandy Silt with Sand Seams Orange staining	3.05	SS3, SS4
Silt with Clay Grey, moist	4.57	SS5
Silt, Trace Gravel Grey, saturated	6.10	SS6, SS7
End of Borehole		

Columns also printed: Depth (ft 0–22, m 0–6), Symbol, Monitoring Well Details, Recovery (%), Soil Vapour Concentration (ppm) CGI/PID, Laboratory Analysis.



Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: 5.08 cm

Grade Elevation: 264 m

Top of Casing Elevation: 264.89 m

Sheet: 1 of 1

Log of Borehole: BH1

Project #: 224078 **Logged By:** D.J.

Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 10, 2019

SUBSURFACE PROFILE					SAMPLE			
Depth (ft / m)	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
0 / 0		Ground Surface	0.00	No Monitoring Well Installed				
		Topsoil	0.15					
		Silty Clay	0.30					
		Waste Deposits	1.68					
		Sand some Silt Brown, dry	2.44					
		End of Borehole						

Depth scale: ft 0–16; m 0–4

Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: N/A

Grade Elevation: N/M

Top of Casing Elevation: N/A

Sheet: 1 of 1

Log of Borehole: BH2

Project #: 224078 **Logged By:** D.J.

Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 10, 2019

SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis	
0 / 0		Ground Surface	0.00	No Monitoring Well Installed					
		Topsoil	0.15						
		Silty Clay	0.30						
		Waste Deposits	1.98						
		Sand some Silt Brown, dry	2.29						
		End of Borehole							

Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: N/A

Grade Elevation: N/M

Top of Casing Elevation: N/A

Sheet: 1 of 1

Log of Borehole: BH3

Project #: 224078 **Logged By:** D.J.

Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naugton, Ontario

Drill Date: July 10, 2019

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
ft 0 / m 0		Ground Surface	0.00	No Monitoring Well Installed				
		Topsoil	0.15					
		Silty Clay	0.30					
		Waste Deposits	1.98					
		Sand some Silt Brown, dry	2.29					
		End of Borehole						

Depth scale: ft 0–16; m 0–4

Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: N/A

Grade Elevation: N/M

Top of Casing Elevation: N/A

Sheet: 1 of 1

Log of Borehole: MW1

Project #: 224078 ***Logged By:*** D.J.

Project: Landfill Assessment for Atikameksheng Anishnawbek

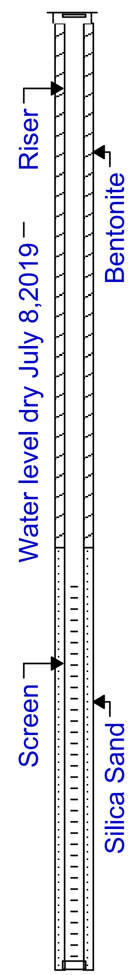
Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 8, 2019

SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	Description	Measured Depth (m)	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
0	Ground Surface	0.00				
0–2.5 ft / 0–0.76 m	***Sand with Gravel*** Brown, dry	0.76		SS1		
2.5–10 ft / 0.76–3.05 m	***Sand some Silt*** Brown, dry	3.05		SS2, SS3, SS4		
10–20 ft / 3.05–6.10 m	***Sand some Silt*** Fine, dry	6.10		SS5, SS6, SS7, SS8		
20–27 ft / 6.10–8.23 m	***Sand some Silt and Gravel*** Dry	8.23		SS9, SS10		
	End of Borehole					



Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: 5.08 cm

Grade Elevation: N/M

Top of Casing Elevation: 0.74 m

Sheet: 1 of 1

Log of Borehole: MW3

Project #: 224078 **Logged By:** D.J.

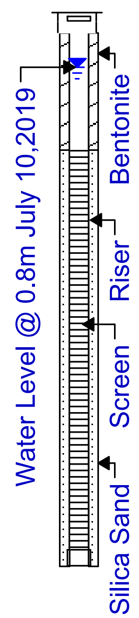
Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 10, 2019

SUBSURFACE PROFILE					SAMPLE			
Depth (ft / m)	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
0 / 0		Ground Surface	0.00					
0–4 ft / 0–1.22 m		**Clay** Dark brown, saturated	1.22			GS1		
4 ft		End of Borehole						



Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: 5.08 cm

Grade Elevation: N/M

Top of Casing Elevation: 0.80m

Sheet: 1 of 1

Log of Borehole: MW4

Project #: 224078 **Logged By:** D.J.

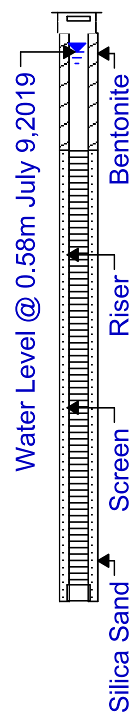
Project: Landfill Assessment for Atikameksheng Anishnawbek

Client: First Nations Engineering Services Ltd.

Location: Closed Landfill-Atikameksheng Anishnawbek, Naughton, Ontario

Drill Date: July 9, 2019

SUBSURFACE PROFILE					SAMPLE			
Depth (ft / m)	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
0 / 0		Ground Surface	0.00					
0–4 ft / 0–1.22 m		**Clay** Grey, saturated, staining throughout	1.22			GS1		
		End of Borehole						



Contractor: Marathon Drilling

Drilling Method: CME 55/75, Hollow

Well Casing Size: 5.08 cm

Grade Elevation: N/M

Top of Casing Elevation: 0.83m

Sheet: 1 of 1

APPENDIX III
Tables

First Nation Engineering Services Ltd.
Landfill Assessment

Atikameksheng Anishnawbek First Nation Waste Disposal Sites
Naughton, Ontario
August 2019

TABLE 1
Groundwater Elevation Data
Active Site

Well ID	UTM Coordinates (Zone 17 T)		Ground Surface Elevation (masl)	TOC Elevation (masl)	Water Level Measurement from TOC (m)	Total Well Depth from TOC (m)	Height of TOC from Ground Surface (m)	Depth to Groundwater (mbgs)	Groundwater Elevation (masl)
	Easting (m)	Northing (m)							
MW1	487229	5137412	250.84	249.97	1.52	6.64	0.8	0.72	248.45
MW2	487467	5137250	241.58	242.05	1.29	3.25	0.95	0.34	240.76
MW3	487436	5137245	240.81	241.78	1.08	3.1	0.97	0.11	240.70
MW4	487439	5137254	240.80	241.99	1.96	2.52	0.92	1.04	240.03

Notes:

masl Meters above sea level

ND no data available

TABLE 2
Groundwater Elevations History

Well ID	UTM Coordinates (Zone 17T)		Ground Surface Elevation (mREL)	TOC Elevation (mREL)	Water Level Measurement from TOC (m)	Total Well Depth from TOC (m)	Height of TOC from Ground Surface (m)	Depth to Groundwater (mbgs)	Groundwater Elevation (mREL)
	Easting (m)	Northing (m)							
MW1	475647	5127011	254.24	255.06	DRY	8.35	0.75	DRY	DRY
MW2	475664	5126953	243.73	244.73	1.78	2.99	1.04	0.74	242.95
MW3	475678	5126981	242.53	243.48	0.74	3.33	0.88	-0.14	242.74
MW4	475712	5126983	242.41	243.19	0.5	3.26	0.72	-0.22	242.69
MW5	475711	5126997	242.94	243.83	1.23	2.32	0.82	0.41	242.60

Notes:

mREL Indicates elevation relative to the site benchmark (meters)

ND no data available

TABLE 3
Surface Water Locations
Active Site

Monitoring Location ID	Description	UTM Coordinates (Zone 17 T)		Comments
		Easting (m)	Northing (m)	
SW1	Whitefish Lake	487117	5136777	
SW2	Unnamed creek connecting Whitefish Lake and Fly Lake.	487525	5136990	Stagnant at edges of creek, flowing in the center. Lots of algae.
SW3	Marsh area of Fly Lake	487683	5136996	Marsh area.
SW4	Stream to the southeast of the site.	487506	5137132	

First Nation Engineering Services Ltd.
Landfill Assessment

Atikameksheng Anishnawbek First Nation Waste Disposal Sites
Naughton, Ontario
August 2019

TABLE 4
Soil Active

Parameters	Units	Schedule 4** (2)	MECP Table 3 Standards (1)	CCME(4)	MW1 - SS3	MW1- SS5
Metals and Inorganics					**Jul-19**	**Jul-19**
Antimony	µg/g	-	50	40	<0.20	<0.20
Arsenic	µg/g	2500	18	12	2.7	**13**
Barium	µg/g	100000	670	2000	93	170
Beryllium	µg/g	-	10	8	0.46	0.74
Boron	µg/g	500000	120	-	<5.0	7.1
Boron (Hot Water Soluble)	µg/g	-	2	-	<0.050	0.068
Cadmium	µg/g	500	1.9	22	0.12	<0.10
Chromium	µg/g	5000	160	87	51	83
Cobalt	µg/g	-	100	300	9.5	16
Copper	µg/g	-	300	91	42	35
Lead	µg/g	5000	120	600	6.3	9.0
Molybdenum	µg/g	-	40	40	0.56	<0.50
Nickel	µg/g	-	340	89	43	49
Selenium	µg/g	1000	5.5	2.9	<0.50	<0.50
Silver	µg/g	5000	50	40	<0.20	<0.20
Thallium	µg/g	-	3.3	1	0.12	0.17
Uranium	µg/g	10000	33	300	1.7	0.93
Vanadium	µg/g	-	86	130	39	55
Zinc	µg/g	-	340	410	44	64
Chromium VI	µg/g	-	10	1.4	0.5	0.4
Mercury	µg/g	1000	20	8	<0.050	<0.050
Moisture Content	%	-	-	50	19	33
pH, 2:1 CaCl2 Extraction	pH Units	-	-	6.0 - 8.0	5.85	6.91
VOC's						
Acetone	µg/g	-	28	-	<0.50	<0.50
Benzene	ug/g	500	0.4	-	<0.020	<0.020
Bromodichloromethane	ug/g	-	18	-	<0.050	<0.050
Bromoform	ug/g	-	1.7	-	<0.050	<0.050
Bromomethane	ug/g	-	0.05	-	<0.050	<0.050
Carbon Tetrachloride	ug/g	500	1.5	50	<0.050	<0.050
Chlorobenzene	ug/g	8000	2.7	50	<0.050	<0.050
Chloroform	ug/g	10000	0.18	-	<0.050	<0.050
Dibromochloromethane	ug/g	-	13	-	<0.050	<0.050
1,2-Dichlorobenzene	ug/g	20000	8.5	50	<0.050	<0.050
1,3-Dichlorobenzene	ug/g	-	12	-	<0.050	<0.050
1,4-Dichlorobenzene	ug/g	500	0.84	-	<0.050	<0.050
Dichlorodifluoromethane	ug/g	-	25	50	<0.050	<0.050
1,1-Dichloroethane	ug/g	500	21	50	<0.050	<0.050
1,2-Dichloroethane	ug/g	1400	0.05	50	<0.050	<0.050
1,1-Dichloroethylene	ug/g	-	0.48	50	<0.050	<0.050
Cis- 1,2-Dichloroethylene	ug/g	-	37	0.0068	<0.050	<0.050
Trans- 1,2-Dichloroethylene	ug/g	-	9.3	50	<0.050	<0.050
1,2-Dichloropropane	ug/g	-	0.68	0.01	<0.050	<0.050
1,3-Dichloropropene	ug/g	-	0.21	-	<0.030	<0.030
Ethylbenzene	ug/g	-	19	-	<0.020	<0.020
Ethylene Dibromide	ug/g	-	0.05	50	<0.050	<0.050
n-Hexane	ug/g	200000	88	0.08	<0.050	<0.050
Methyl Ethyl Ketone	ug/g	-	88	-	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g	-	210	-	<0.50	<0.50
Methyl tert-butyl Ether	ug/g	-	3.2	0.6	<0.050	<0.050
Methylene Chloride	ug/g	-	2	-	<0.050	<0.050
Styrene	ug/g	-	43	-	<0.050	<0.050
1,1,1,2-Tetrachloroethane	ug/g	-	0.11	0.018	<0.050	<0.050
1,1,2,2-Tetrachloroethane	ug/g	-	0.094	-	<0.050	<0.050
Tetrachloroethylene	ug/g	3000	21	-	<0.050	<0.050
Toluene	ug/g	-	78	50	<0.020	<0.020
1,1,1-Trichloroethane	ug/g	-	12	50	<0.050	<0.050
1,1,2-Trichloroethane	ug/g	-	0.11	-	<0.050	<0.050
Trichloroethylene	ug/g	5000	0.61	10	<0.050	<0.050
Trichlorofluoromethane	ug/g	-	5.8	10	<0.050	<0.050
Vinyl Chloride	ug/g	200	0.25	10	<0.020	<0.020
Xylene Mixture	ug/g	-	30	2.4	<0.020	<0.020

Notes:

(1) Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011, Table 3 Standards, Medium/Fine-Textured Soils, Non-Potable Groundwater Condition, for Residential/Parkland/Institutional Property Use.

(2) Schedule 4** Ontario Regulation 347.90 -
(3) Exceedance of the Site Condition Standard indictaed by **BOLD** and shaded entries.
(4) Canadian Council of Ministers of the Environment Soil Quality Guidelines for the Protection of Environmental and Human Health.
(5) Exceedance of the Schedule 4 Standard indictaed by *Italic* entries.

TABLE 5
Soil History

Parameters	Units	Schedule 4** (2)	MECP Table 3 Standards (1)	CCME(4)	MW1 - SS3	MW1 - SS5	MW3 - GS1	MW4 - GS1	BH1	BH2	BH3
Metals and Inorganics					**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**
Antimony	µg/g	-	50	40	<0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20
Arsenic	µg/g	2500	18	12	2.9	2.8	3.3	1.3	2.1	2.1	1.9
Barium	µg/g	100000	670	2000	180	150	120	57	35	27	27
Beryllium	µg/g	-	10	8	0.69	0.59	0.46	0.30	<0.20	<0.20	<0.20
Boron	µg/g	500000	120	-	5.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Boron (Hot Water Soluble)	µg/g	-	2	-	<0.050	<0.050	0.58	0.077	<0.050	0.11	0.074
Cadmium	µg/g	500	1.9	22	<0.10	<0.10	0.54	<0.10	<0.10	<0.10	<0.10
Chromium	µg/g	5000	160	87	77	64	45	32	23	20	18
Cobalt	µg/g	-	100	300	17	15	9.3	8.3	5.7	5.1	5.2
Copper	µg/g	-	300	91	40	32	42	11	16	19	15
Lead	µg/g	5000	120	600	8.3	7.3	23	4.0	3.9	2.9	2.8
Molybdenum	µg/g	-	40	40	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nickel	µg/g	-	340	89	45	41	67	18	15	13	12
Selenium	µg/g	1000	5.5	2.9	<0.50	<0.50	0.86	<0.50	<0.50	<0.50	<0.50
Silver	µg/g	5000	50	40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Thallium	µg/g	-	3.3	1	0.20	0.17	0.15	0.073	<0.050	<0.050	<0.050
Uranium	µg/g	10000	33	300	1.1	0.96	0.85	0.92	0.56	0.67	0.41
Vanadium	µg/g	-	86	130	60	53	34	28	22	21	21
Zinc	µg/g	-	340	410	60	52	68	33	32	16	13
Chromium VI	µg/g	-	10	1.4	0.3	0.4	<0.2	0.3	<0.2	<0.2	<0.2
Mercury	µg/g	1000	20	8	<0.050	<0.050	0.10	0.070	<0.050	<0.050	<0.050
Moisture Content	%	-	-	50	20	21	29	15	14	14	16
pH, 2:1 CaCl2 Extraction	pH Units	-	-	6.0 - 8.0	6.22	6.36	5.16	6.11	5.55	5.55	5.32
VOC's											
Acetone	µg/g	-	28	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzene	ug/g	500	0.4	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Bromodichloromethane	ug/g	-	18	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bromoform	ug/g	-	1.7	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bromomethane	ug/g	-	0.05	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Carbon Tetrachloride	ug/g	500	1.5	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlorobenzene	ug/g	8000	2.7	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloroform	ug/g	10000	0.18	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibromochloromethane	ug/g	-	13	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichlorobenzene	ug/g	20000	8.5	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichlorobenzene	ug/g	-	12	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-Dichlorobenzene	ug/g	500	0.84	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dichlorodifluoromethane	ug/g	-	25	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethane	ug/g	500	21	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichloroethane	ug/g	1400	0.05	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethylene	ug/g	-	0.48	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cis- 1,2-Dichloroethylene	ug/g	-	37	0.0068	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trans- 1,2-Dichloroethylene	ug/g	-	9.3	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichloropropane	ug/g	-	0.68	0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichloropropene	ug/g	-	0.21	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Ethylbenzene	ug/g	-	19	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Ethylene Dibromide	ug/g	-	0.05	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
n-Hexane	ug/g	200000	88	0.08	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Methyl Ethyl Ketone	ug/g	-	88	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g	-	210	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g	-	3.2	0.6	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Methylene Chloride	ug/g	-	2	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Styrene	ug/g	-	43	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1,2-Tetrachloroethane	ug/g	-	0.11	0.018	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2,2-Tetrachloroethane	ug/g	-	0.094	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tetrachloroethylene	ug/g	3000	21	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene	ug/g	-	78	50	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
1,1,1-Trichloroethane	ug/g	-	12	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2-Trichloroethane	ug/g	-	0.11	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trichloroethylene	ug/g	5000	0.61	10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trichlorofluoromethane	ug/g	-	5.8	10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Vinyl Chloride	ug/g	200	0.25	10	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Xylene Mixture	ug/g	-	30	2.4	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020

Notes:

(1) Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011, Table 3 Standards, Medium/Fine-Textured Soils, Non-Potable Groundwater Condition, for Residential/Parkland/Institutional Property Use.

(2) Schedule 4** Ontario Regulation
(3) Exceedance of the Site Condition Standard indictaed by **BOLD** and shaded entries.
(4) Canadian Council of Ministers of the Environment Soil Quality Guidelines for the Protection of Environmental and Human Health.
(5) Exceedance of the Schedule 4 Standard indictaed by *Italic* entries.

TABLE 6
Groundwater Data
Active Site

Parameters	Units	Schedule 4** (7)	ODWQS (1)	MW1	MW2	MW3	MW4
General Chemistry				**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**
Alkalinity	mg/L	-	30-500 OG (2)	34	291	258	**26**
Ammonia (total) (N)	mg/L	-		0.24	0.05	0.13	0.14
Biological Oxygen Demand (BOD)	mg/L	-		<5	<5	<5	<5
Chemical Oxygen Demand (COD)	mg/L	-		33	54	45	20
Chloride	mg/L	-	250 AO (3)	2.35	23.10	22.30	1.83
Conductivity	uS/cm	-		102	910	715	94
Dissolved Organic Carbon (DOC)	mg/L	-	5 AO	**6.1**	**24.0**	**9.4**	**10.7**
Hardness	mg/L	-	80-100 OG				
Nitrate (N)	mg/L	1000	10 MAC (4)	<0.05	<0.25	<0.10	<0.05
Nitrite (N)	mg/L	1000	1 MAC	<0.05	<0.25	<0.10	<0.05
pH	pH units	-	6.5-8.5 OG	7.20	7.29	7.27	7.02
Phenols	mg/L	-		<0.001	0.006	0.0	0.0
Total Phosphorus	mg/L	-		15.1	0.73	12.00	14.70
Sulphate	mg/L	-	500 AO	13	205	107	15
Total Dissolved Solids (TDS)	mg/L	-	500 AO	298	**594**	434	184
Total Kjeldahl Nitrogen (TKN)	mg/L	-		0.32	0.8	0.62	0.4
Total Suspended Solids (TSS)	mg/L	-		50500	1420	20500	5690
Metals							
Arsenic	mg/L	2.5	0.01 IMAC (5)	0.002	0.001	<0.001	<0.001
Barium	mg/L	100	1 MAC	0.044	0.059	0.035	0.003
Boron	mg/l	500	5 IMAC	<0.01	1.04	0.41	0.030
Cadmium	mg/L	0.2	0.005 MAC	<0.001	<0.001	<0.001	<0.001
Calcium	mg/L	-		9.52	136	87	8.74
Chromium	mg/L	5	0.05 MAC	0.004	<0.002	<0.002	<0.002
Copper	mg/L	-	1 AO	0.012	0.015	0.006	0.003
Iron	mg/L	-	0.3 AO	**2.14**	<0.01	<0.01	<0.01
Lead	mg/L	5	0.01 MAC	0.004	<0.001	<0.001	<0.001
Manganese	mg/L	-	0.05 AO	**0.185**	**0.09**	**0.45**	**0.06**
Magnesium	mg/L	-		3.06	18	24.1	2
Mercury	mg/L	1	0.001 MAC	<0.0001	<0.0001	<0.0001	<0.0001
Potassium	mg/L	-		1.2	2.2	1.7	0.4
Sodium	mg/L	-	200 AO	3.13	35.7	24.2	3.5
Zinc	mg/L	-	5 AO	0.019	0.017	0.008	0.008

Notes:

(1) MECP Ontario Drinking Water Quality Standards.

(2) Operational Guideline (OG) within ODWQS.

(3) Aesthetic Objective (AO) within ODWQS.

(4) Maximum Acceptable Concentration (MAC) within ODWQS.

(5) Interim Maximum Acceptable Concentration (IMAC) within ODWQS.

(6) ODWQS exceedances indicated by **bold** entries.

(7) Schedule 4** Ontario Regulateion 347.90 - As Amended

(8) Exceedance of the Schedule 4 Standard indictaed by Italic entries.

TABLE 7
Groundwater Data History

Parameters	Units	Schedule 4** (7)	ODWQS (1)	MW1	MW2	MW3	MW4	MW5
General Chemistry				**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**
Alkalinity	mg/L	-	30-500 OG (2)	**DRY**	**INSUFFICIENT**	111	93	87
Ammonia (total) (N)	mg/L	-			**VOLUME**	0.15	0.29	0.10
Biological Oxygen Demand (BOD)	mg/L	-			**TO SAMPLE**	<5	<5	<5
Chemical Oxygen Demand (COD)	mg/L	-				7	<5	14
Chloride	mg/L	-	250 AO (3)			2.14	1.40	1.82
Conductivity	uS/cm	-				265	233	242
Dissolved Organic Carbon (DOC)	mg/L	-	5 AO			3.2	**14.2**	5.0
Hardness	mg/L	-	80-100 OG					
Nitrate (N)	mg/L	1000	10 MAC (4)			0.1	0.2	0.12
Nitrite (N)	mg/L	1000	1 MAC			<0.05	<0.05	<0.05
pH	pH units	-	6.5-8.5 OG			7.60	7.51	7.41
Phenols	mg/L	-				<0.001	<0.001	0.0
Total Phosphorus	mg/L	-				3.75	1.36	2.21
Sulphate	mg/L	-	500 AO			25	21	35
Total Dissolved Solids (TDS)	mg/L	-	500 AO			164	238	148
Total Kjeldahl Nitrogen (TKN)	mg/L	-				0.25	0.27	0.2
Total Suspended Solids (TSS)	mg/L	-				9170	6190	4410
Metals								
Arsenic	mg/L	2.5	0.01 IMAC (5)			<0.001	<0.001	<0.001
Barium	mg/L	100	1 MAC			0.020	0.012	0.013
Boron	mg/l	500	5 IMAC			0.020	0.010	0.030
Cadmium	mg/L	0.2	0.005 MAC			<0.001	<0.001	<0.001
Calcium	mg/L	-				26	18	24
Chromium	mg/L	5	0.05 MAC			<0.002	0.002	<0.002
Copper	mg/L	-	1 AO			<0.002	<0.002	<0.002
Iron	mg/L	-	0.3 AO			<0.01	<0.01	<0.01
Lead	mg/L	5	0.01 MAC			<0.001	<0.001	<0.001
Manganese	mg/L	-	0.05 AO			**0.13**	0.01	<0.002
Magnesium	mg/L	-				11.9	5.7	11
Mercury	mg/L	1	0.001 MAC			<0.0001	<0.0001	<0.0001
Potassium	mg/L	-				2.2	0.4	1.1
Sodium	mg/L	-	200 AO			6.8	21.8	5.4
Zinc	mg/L	-	5 AO			0.005	<0.005	<0.005

Notes:

(1) MECP Ontario Drinking Water Quality Standards.

(2) Operational Guideline (OG) within ODWQS.

(3) Aesthetic Objective (AO) within ODWQS.

(4) Maximum Acceptable Concentration (MAC) within ODWQS.

(5) Interim Maximum Acceptable Concentration (IMAC) within ODWQS.

(6) ODWQS exceedances indicated by **bold** entries.

(7) Schedule 4** Ontario Regulateion 347.90 - As Amended

(8) Exceedance of the Schedule 4 Standard indictaed by Italic entries.

TABLE 8
B-7 Table
Active Site

Reasonable Use Calculation (Guideline B-7)				**Downgradient Monitoring Well Concentrations**		
Parameter	**ODWS (3)** C_r **(mg/L)**	**Background Concentration** $C_{b\ (1)}$ **(mg/L)**	**Maximum Concentration** $C_m=C_b+x(C_r-C_b)$ **(mg/L)**	**MW2 (mg/L)**	**MW3 (mg/L)**	**MW4 (mg/L)**
Health Related			x=0.25(2)			
Barium	1	0.044	0.28	0.059	0.035	0.003
Boron	5	0.0050	1.25	1.04	0.41	0.03
Nitrate-N	10	0.03	2.52	<0.25	<0.10	<0.05
Non-Health Related			x=0.50(2)			
Chloride	250	2.4	126	23.1	22.3	1.8
Iron	0.3	2.14	1.22	<0.01	<0.01	<0.01
Sodium	200	3.1	102	35.7	24.2	3.5
Sulphate	500	12.8	256	205.0	107.0	15.4
TDS	500	298	399	**594**	**434**	184

Notes:

(1) Average of valid sampling rounds at MW1.

(2) x - Defined according to Guideline B-7 (MOE, 1994).

(3) ODWQS - Ontario Drinking Water Quality Standards (MOE, 2001).

(4) **BOLD** and shaded - Indicates an exceedance of the Maximum Concentration.

TABLE 9
B-7 Table Closed

Reasonable Use Calculation (Guideline B-7)				Downgradient Monitoring Well Concentrations		
Parameter	ODWS (3) C_r (mg/L)	Background Concentration $C_{b\,(1)}$ (mg/L)	Maximum Concentration $C_m=C_b+x(C_r-C_b)$ (mg/L)	MW3 (mg/L)	MW4 (mg/L)	MW5 (mg/L)
Health Related			$x=0.25^{(2)}$			
Barium	1	0.00	0.25	0.020	0.012	0.013
Boron	5	0.00	1.25	0.02	0.01	0.03
Nitrate-N	10	0.00	2.50	0.1	0.2	0.1
Non-Health Related			$x=0.50^{(2)}$			
Chloride	250	0.00	125	2.1	1.4	1.8
Iron	0.3	0.00	0.15	<0.01	<0.01	<0.01
Sodium	200	0.00	100	6.8	21.8	5.4
Sulphate	500	0.00	250	25.4	21.3	34.7
TDS	500	0.00	250	164	238	148

Notes:
(1) Background well MW1 dry. Assumed pristine conditions.
(2) x - Defined according to Guideline B-7 (MOE, 1994).
(3) ODWQS - Ontario Drinking Water Quality Standards (MOE, 2001).
(4) **BOLD** and shaded - Indicates an exceedance of the Maximum Concentration.

TABLE 10
Field Chem Active

Monitoring Location ID	Field Parameter						
	Well Volume Purged (L)	Temperature (°C)	Conductivity (uS/cm)	TDS (g/L)	DO (mg/L)	pH	ORP (mV)
MW1	30	10.17	66	0.06	22.36	7.08	104.2
MW2	8.5	12.5	657	0.559	5.18	6.34	220.6
MW3	12	12.14	498	0.423	7.79	6.54	214.2
MW4	2	12.78	75	0.063	15.2	6.94	215.6
SW1	-	23.8	45.7	-	6.3	8.31	54.3
SW2	-	20.9	46.8	-	6.48	6.6	130.4
SW3	-	25.5	42.2	-	6.21	7.28	132
SW4	DRY						

First Nation Engineering Services Ltd.
Landfill Assessment

Atikameksheng Anishnawbek First Nation Waste Disposal Sites
Naughton, Ontario
August 2019

TABLE 11
Field Chem Hist

Monitoring Location ID	Field Parameter						
	Well Volume Purged (L)	Temperature (^{o}C)	Conductivity (uS/cm)	TDS (g/L)	DO (mg/L)	pH	ORP (mV)
MW1	DRY						
MW2	1	INSUFFICIENT VOLUME TO SAMPLE					
MW3	16	10.38	177	0.16	28.1	6.76	185.7
MW4	16.5	10.49	149	0.135	6.89	6.48	136.7
MW5	5	13.61	179	0.149	4.69	6.46	109.4

TABLE 12
Surfacewater Data

Parameters	Units	Schedule 4** [7]	PWQO[1]	APV[2]	CWQG[3]	CCME[8]	SW1	SW2	SW3	SW4
General Chemistry							**Jul-19**	**Jul-19**	**Jul-19**	**Jul-19**
Alkalinity	mg/L	-	-	-	-	-	18	13	13	**DRY**
Ammonia (total) (N)	mg/L	-	-	-	-	0.021 [5]	0.13	0.14	0.12	
Biological Oxygen Demand (BOD)	mg/L	-	-	-	-	-	<5	<5	<5	
Chemical Oxygen Demand (COD)	mg/L	-	-	-	-	-	10	12	10	
Chloride	mg/L	-	-	180	128	120	0.67	0.74	0.7	
Conductivity	uS/cm	-	-	-	-	-	49	45	45	
Dissolved Organic Carbon (DOC)	mg/L	-		-	-	-	4.2	4.4	4.3	
Nitrate (N)	mg/L	-	-	-	2.9	13	<0.05	<0.05	<0.05	
Nitrite (N)	mg/L	-	-	-	0.06	-	<0.05	<0.05	<0.05	
pH	pH units	-	6.5 - 8.5	6.0 - 9.0	-	6.5 - 9.0	7.50	7.14	7.07	
Phenols	mg/L	-	0.001	0.04	0.004	0.004	**0.002**	**0.002**	**0.003**	
Total Phosphorus	mg/L	-	0.03	-	-	0.004 [6]	<0.02	0.03	0.03	
Sulphate	mg/L	-	-	100	-	-	8	8	8	
Total Dissolved Solids (TDS)	mg/L	-	-	-	-	-	44	44	40	
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	-	-	-	0.58	0.59	0.66	
Total Suspended Solids (TSS)	mg/L	-	-	-	-	+25 [7]	<10	<10	23	
Metals										
Aluminum	mg/L	-	0.075	-	0.1		0.005	0.005	0.006	
Arsenic	mg/L	2.5	0.1	0.15	-	0.005	<0.003	<0.003	<0.003	
Barium	mg/L	100	-	-	-		0.005	0.005	0.005	
Boron	mg/l	500	0.20	3.55	0.20	1.5	0.013	<0.010	<0.010	
Cadmium	mg/L	0.2	0.0002	0.00021	0.000017	0.00004	<0.0001	<0.0001	<0.0001	
Chromium	mg/L	5	-	-	-		<0.003	<0.003	<0.003	
Copper	mg/L	-	0.005	0.0069	-	0.002	0.004	0.004	0.004	
Iron	mg/L	-	0.3	1	-	0.3	<0.010	<0.010	<0.010	
Lead	mg/L	5	0.005	0.002	-	0.001	<0.001	<0.001	<0.001	
Magnesium	mg/L	-	-	-	-		1.53	1.56	1.48	
Manganese	mg/L	-	-	-	-		0.015	0.011	0.012	
Sodium	mg/L	-	-	180	-		1.25	1.25	1.2	
Zinc	mg/L	-	0.03	0.089	0.03	NC	<0.005	<0.005	<0.005	

Notes:

(1) Provicial Water Quality Objectives.

(2) Aquatic Protection Values.

(3) Canadian Water Quality Guidelines.

(4) PWQO exceedances indicated by **BOLD** and shaded entries.

(5) APV exceedances indicated by *ITALICIZED* entries.

(6) CWQG exceedances indicated by UNDERLINED entries.

(7) Schedule 4** Ontario Regulateion 347.90 - As Amended

(8) Canadian Council of Ministers of the Environment Water Quality Guidelines for the Protection of Aquatic Life, Long Term, Freshwater.

TABLE 13
Groundwater DUP
Active

Parameters	Units	MW1	GW DUP	Relative Percent Difference (%)
General Chemistry				
Alkalinity	mg/L	34	33	2.99
Ammonia (total) (N)	mg/L	0.24	0.22	8.70
Biological Oxygen Demand (BOD)	mg/L	<5	<5	NC
Chemical Oxygen Demand (COD)	mg/L	33	28	16.39
Chloride	mg/L	2.35	2.3	2.15
Conductivity	uS/cm	102	101	0.99
Dissolved Organic Carbon (DOC)	mg/L	6.1	7.3	17.91
Hardness	mg/L			
Nitrate (N)	mg/L	<0.05	<0.05	NC
Nitrite (N)	mg/L	<0.05	<0.05	NC
pH	pH units	7.2	7.19	0.14
Phenols	mg/L	<0.001	<0.001	NC
Total Phosphorus	mg/L	15.1	13.6	10.45
Sulphate	mg/L	12.8	12.8	0.00
Total Dissolved Solids (TDS)	mg/L	298	260	13.62
Total Kjeldahl Nitrogen (TKN)	mg/L	0.32	0.37	14.49
Total Suspended Solids (TSS)	mg/L	50500	34900	36.53
Metals				
Arsenic	mg/L	0.002	0.002	0.00
Barium	mg/L	0.044	0.038	14.63
Boron	mg/l	<0.01	0.020	NC
Cadmium	mg/L	<0.001	<0.001	NC
Calcium	mg/L	9.52	9.5	0.21
Chromium	mg/L	0.004	0.003	28.57
Copper	mg/L	0.012	0.012	0.00
Iron	mg/L	2.14	1.88	12.94
Lead	mg/L	0.004	0.004	0.00
Manganese	mg/L	0.185	0.184	0.54
Magnesium	mg/L	3.06	3.07	0.33
Mercury	mg/L	<0.0001	<0.0001	NC
Potassium	mg/L	1.2	1.21	0.83
Sodium	mg/L	3.13	3.11	0.64
Zinc	mg/L	0.019	0.017	11.11

Notes:

NC	Not Calculable as one or both concentrations are below the laboratory method detection limit.
BOLD	Exceeds the 50% industry standard.

TABLE 14
Surfacewater DUP

Parameters	Units	SW1	SW DUP	Relative Percent Difference (%)
General Chemistry				
Alkalinity	mg/L	18	11	48.28
Ammonia (total) (N)	mg/L	0.13	0.11	16.67
Biological Oxygen Demand (BOD)	mg/L	<5	<5	NC
Chemical Oxygen Demand (COD)	mg/L	10	10	0.00
Chloride	mg/L	0.67	0.7	4.38
Conductivity	uS/cm	49	45	8.51
Dissolved Organic Carbon	mg/L	4.2	4.5	6.90
Nitrate (N)	mg/L	<0.05	<0.05	NC
Nitrite (N)	mg/L	<0.05	<0.05	NC
pH	pH units	7.5	7.08	5.76
Phenols	mg/L	0.002	0.001	**66.67**
Total Phosphorus	mg/L	<0.02	0.02	NC
Sulphate	mg/L	7.75	7.56	2.48
Total Dissolved Solids (TDS)	mg/L	44	38	14.63
Total Kjeldahl Nitrogen (TKN)	mg/L	0.58	0.73	22.90
Total Suspended Solids (TSS)	mg/L	<10	<10	NC
Metals				
Aluminum	mg/L	0.005	0.004	22.22
Arsenic	mg/L	<0.003	<0.003	NC
Barium	mg/L	0.005	0.005	0.00
Boron	mg/L	0.013	<0.010	NC
Cadmium	mg/L	<0.0001	<0.0001	NC
Chromium	mg/L	<0.003	<0.003	NC
Copper	mg/L	0.004	0.004	0
Iron	mg/L	<0.010	<0.010	NC
Lead	mg/L	<0.001	<0.001	NC
Magnesium	mg/L	1.53	1.52	0.66
Manganese	mg/L	0.015	0.015	0.00
Sodium	mg/L	1.25	1.2	4.08
Zinc	mg/L	<0.005	<0.005	NC

Notes:

NC	Not Calculable as one or both concentrations are below the laboratory method detection limit.
BOLD	Exceeds the 50% industry standard.

TABLE 15
Groundwater DUP Hist

Parameters	Units	MW4	GW DUP	Relative Percent Difference (%)
General Chemistry				
Alkalinity	mg/L	93	96	3.17
Ammonia (total) (N)	mg/L	0.29	0.3	3.39
Biological Oxygen Demand (BOD)	mg/L	<5	<5	NC
Chemical Oxygen Demand (COD)	mg/L	<5	<5	NC
Chloride	mg/L	1.4	1.62	14.57
Conductivity	uS/cm	233	228	2.17
Dissolved Organic Carbon (DOC)	mg/L	14.2	13.3	6.55
Hardness	mg/L			
Nitrate (N)	mg/L	0.17	0.17	0.00
Nitrite (N)	mg/L	<0.05	<0.05	NC
pH	pH units	7.51	7.51	0.00
Phenols	mg/L	<0.001	<0.001	NC
Total Phosphorus	mg/L	1.36	1.48	8.45
Sulphate	mg/L	21.3	21.3	0.00
Total Dissolved Solids (TDS)	mg/L	238	284	17.62
Total Kjeldahl Nitrogen (TKN)	mg/L	0.27	0.28	3.64
Total Suspended Solids (TSS)	mg/L	6190	6310	1.92
Metals				
Arsenic	mg/L	<0.001	<0.001	NC
Barium	mg/L	0.012	0.013	8.00
Boron	mg/l	0.01	0.010	0.00
Cadmium	mg/L	<0.001	<0.001	NC
Calcium	mg/L	17.8	19.3	8.09
Chromium	mg/L	0.002	0.002	0.00
Copper	mg/L	<0.002	<0.002	NC
Iron	mg/L	<0.01	<0.01	NC
Lead	mg/L	<0.001	<0.001	NC
Manganese	mg/L	0.005	0.005	0.00
Magnesium	mg/L	5.74	6.08	5.75
Mercury	mg/L	<0.0001	<0.0001	NC
Potassium	mg/L	0.44	0.43	2.30
Sodium	mg/L	21.8	18.1	18.55
Zinc	mg/L	<0.005	<0.005	NC

Notes:

NC	Not Calculable as one or both concentrations are below the laboratory method detection limit.
BOLD	Exceeds the 50% industry standard.

APPENDIX IV

Laboratory Certificate of Analysis

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
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CLIENT NAME: **PINCHIN LTD.**
957 CAMBRIAN HEIGHTS DRIVE, UNIT 203
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(705) 521-0560

ATTENTION TO: **Kathleen Murr**

PROJECT: **Atikameksheng Anishnawbek - Closed LF**

AGAT WORK ORDER: **19T494183**

WATER ANALYSIS REVIEWED BY: **Parvathi Malemath, Data Reviewer**

DATE REPORTED: **Jul 29, 2019**

PAGES (INCLUDING COVER): **8**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Certificate of Analysis

AGAT WORK ORDER: 19T494183

PROJECT: Atikameksheng Anishnawbek - Closed LF

CLIENT NAME: PINCHIN LTD.

ATTENTION TO: Kathleen Murr

SAMPLING SITE:Closed Landfill

SAMPLED BY:KM, AV

Inorganic Chemistry (Water)

DATE RECEIVED: 2019-07-18

DATE REPORTED: 2019-07-29

				SAMPLE DESCRIPTION:	MW3	MW5		MW4	Dup1
				SAMPLE TYPE:	Water	Water		Water	Water
				DATE SAMPLED:	2019-07-17	2019-07-17		2019-07-17	2019-07-17
Parameter	**Unit**	**G / S: A**	**G / S: B**	**RDL**	**362801**	**362835**	**RDL**	**362836**	**362837**
BOD (5)	mg/L			5	<5	<5	5	<5	<5
Electrical Conductivity	µS/cm			2	265	242	2	233	228
pH	pH Units		6.5-8.5	NA	7.60	7.41	NA	7.51	7.51
Total Dissolved Solids	mg/L		500	20	164[<B]	148[<B]	20	238[<B]	284[<B]
Total Suspended Solids	mg/L			10	9170	4410	10	6190	6310
Alkalinity (as CaCO3)	mg/L		30-500	5	111	87	5	93	96
Chloride	mg/L		250	0.10	2.14[<B]	1.82[<B]	0.10	1.40[<B]	1.62[<B]
Nitrate as N	mg/L	10.0		0.05	0.11[<A]	0.12[<A]	0.05	0.17[<A]	0.17[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05	<0.05	0.05	<0.05	<0.05
Sulphate	mg/L		500	0.10	25.4[<B]	34.7[<B]	0.10	21.3[<B]	21.3[<B]
Ammonia as N	mg/L			0.02	0.15	0.10	0.02	0.29	0.30
Total Kjeldahl Nitrogen	mg/L			0.10	0.25	0.22	0.10	0.27	0.28
Total Phosphorus	mg/L			0.02	3.75	2.21	0.02	1.36	1.48
Chemical Oxygen Demand	mg/L			5	7	14	5	<5	<5
Dissolved Organic Carbon	mg/L		5	0.5	3.2[<B]	5.0[B]	1.0	14.2[>B]	13.3[>B]
Phenols	mg/L			0.001	<0.001	0.001	0.001	<0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

362836-362837 The elevated RDL for DOC indicate the dilution prior to sample analysis.

Certified By:

CHARTERED CHEMIST Parvathi Malemari

Results relate only to the items tested. Results apply to samples as received.

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Certificate of Analysis

AGAT WORK ORDER: 19T494183

PROJECT: Atikameksheng Anishnawbek - Closed LF

CLIENT NAME: PINCHIN LTD. **ATTENTION TO: Kathleen Murr**

SAMPLING SITE:Closed Landfill **SAMPLED BY:KM, AV**

Metals Scan (Water)

DATE RECEIVED: 2019-07-18 **DATE REPORTED: 2019-07-29**

				SAMPLE DESCRIPTION:	MW3	MW5	MW4	Dup1
				SAMPLE TYPE:	Water	Water	Water	Water
				DATE SAMPLED:	2019-07-17	2019-07-17	2019-07-17	2019-07-17
Parameter	**Unit**	**G / S: A**	**G / S: B**	**RDL**	**362801**	**362835**	**362836**	**362837**
Arsenic	mg/L	0.025		0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	1		0.002	0.020[<A]	0.013[<A]	0.012[<A]	0.013[<A]
Boron	mg/L	5		0.01	0.02[<A]	0.03[<A]	0.01[<A]	0.01[<A]
Cadmium	mg/L	0.005		0.001	<0.001	<0.001	<0.001	<0.001
Calcium	mg/L			0.05	26.0	23.7	17.8	19.3
Chromium	mg/L	0.05		0.002	<0.002	<0.002	0.002[<A]	0.002[<A]
Copper	mg/L		1	0.002	<0.002	<0.002	<0.002	<0.002
Iron	mg/L		0.3	0.01	<0.01	<0.01	<0.01	<0.01
Lead	mg/L	0.01		0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L			0.05	11.9	10.6	5.74	6.08
Manganese	mg/L		0.05	0.002	0.130[>B]	<0.002	0.005[<B]	0.005[<B]
Mercury	mg/L	0.001		0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium	mg/L			0.05	2.19	1.09	0.44	0.43
Sodium	mg/L	20	200	0.05	6.76[<A]	5.37[<A]	21.8[A-B]	18.1[<A]
Zinc	mg/L		5	0.005	0.005[<B]	<0.005	<0.005	<0.005

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

CHARTERED CHEMIST

Guideline Violation

AGAT WORK ORDER: 19T494183

PROJECT: Atikameksheng Anishnawbek - Closed LF

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CLIENT NAME: PINCHIN LTD.

ATTENTION TO: Kathleen Murr

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
362801	MW3	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.130
362836	MW4	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	14.2
362836	MW4	O.Reg.169/03(mg/L)	Metals Scan (Water)	Sodium	mg/L	20	21.8
362837	Dup1	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	13.3

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Quality Assurance

CLIENT NAME: PINCHIN LTD. | **AGAT WORK ORDER: 19T494183**

PROJECT: Atikameksheng Anishnawbek - Closed LF | **ATTENTION TO: Kathleen Murr**

SAMPLING SITE:Closed Landfill | **SAMPLED BY:KM, AV**

Water Analysis

RPT Date: Jul 29, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Water)															
BOD (5)	362801	362801	<5	<5	NA	< 5		75%	125%						
Electrical Conductivity	363949		94	92	2.2%	< 2	94%	80%	120%						
pH	363949		7.02	7.12	1.4%	NA	100%	90%	110%						
Total Dissolved Solids	362801	362801	164	162	1.2%	< 20	98%	80%	120%						
Total Suspended Solids	370849		<10	<10	NA	< 10	98%	80%	120%						
Alkalinity (as CaCO3)	363949		26	25	3.9%	< 5	98%	80%	120%						
Chloride	363947		23.1	21.7	6.3%	< 0.10	102%	90%	110%	109%	90%	110%	113%	85%	115%
Nitrate as N	363947		<0.25	<0.25	NA	< 0.05	99%	90%	110%	108%	90%	110%	108%	85%	115%
Nitrite as N	363947		<0.25	<0.25	NA	< 0.05	NA	90%	110%	95%	90%	110%	105%	85%	115%
Sulphate	363947		205	198	3.5%	< 0.10	104%	90%	110%	106%	90%	110%	106%	85%	115%
Ammonia as N	363127		0.57	0.55	3.6%	< 0.02	93%	90%	110%	95%	90%	110%	91%	70%	130%
Total Kjeldahl Nitrogen	362801	362801	0.25	0.28	NA	< 0.10	101%	80%	120%	99%	80%	120%	97%	70%	130%
Total Phosphorus	362801	362801	3.75	3.73	0.5%	< 0.02	100%	80%	120%	101%	90%	110%	108%	70%	130%
Chemical Oxygen Demand	362801	362801	7	7	NA	< 5	101%	80%	120%	97%	90%	110%	88%	70%	130%
Dissolved Organic Carbon	362801	362801	3.2	3.2	0.0%	< 0.5	100%	90%	110%	100%	90%	110%	91%	80%	120%
Phenols	362801	362801	<0.001	<0.001	NA	< 0.001	102%	90%	110%	103%	90%	110%	100%	80%	120%
Metals Scan (Water)															
Arsenic	362801	362801	<0.001	<0.001	NA	< 0.001	101%	90%	110%	102%	90%	110%	101%	70%	130%
Barium	362801	362801	0.020	0.020	2.2%	< 0.002	96%	90%	110%	98%	90%	110%	96%	70%	130%
Boron	362801	362801	0.02	0.02	NA	< 0.01	99%	90%	110%	107%	90%	110%	91%	70%	130%
Cadmium	362801	362801	<0.001	<0.001	NA	< 0.001	98%	90%	110%	106%	90%	110%	103%	70%	130%
Calcium	362226		73.2	74.3	1.5%	< 0.05	97%	90%	110%	98%	90%	110%	123%	70%	130%
Chromium	362801	362801	<0.002	<0.002	NA	< 0.002	99%	90%	110%	104%	90%	110%	103%	70%	130%
Copper	362801	362801	<0.002	<0.002	NA	< 0.002	105%	90%	110%	110%	90%	110%	105%	70%	130%
Iron	362801	362801	<0.01	<0.01	NA	< 0.01	103%	90%	110%	100%	90%	110%	89%	70%	130%
Lead	362801	362801	<0.001	<0.001	NA	< 0.001	98%	90%	110%	100%	90%	110%	95%	70%	130%
Magnesium	362226		4.56	4.54	0.4%	< 0.05	98%	90%	110%	99%	90%	110%	117%	70%	130%
Manganese	362801	362801	0.130	0.128	1.7%	< 0.002	102%	90%	110%	104%	90%	110%	103%	70%	130%
Mercury	364299		<0.0001	<0.0001	NA	< 0.0001	101%	90%	110%	95%	80%	120%	92%	80%	120%
Potassium	362226		1.55	1.57	1.1%	< 0.05	97%	90%	110%	97%	90%	110%	120%	70%	130%
Sodium	362226		3.12	3.14	0.7%	< 0.05	96%	90%	110%	96%	90%	110%	119%	70%	130%
Zinc	362801	362801	0.005	<0.005	NA	< 0.005	105%	90%	110%	108%	90%	110%	108%	70%	130%

Certified By:

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Method Summary

CLIENT NAME: PINCHIN LTD. **AGAT WORK ORDER: 19T494183**

PROJECT: Atikameksheng Anishnawbek - Closed LF **ATTENTION TO: Kathleen Murr**

SAMPLING SITE:Closed Landfill **SAMPLED BY:KM, AV**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
BOD (5)	INOR-93-6006	SM 5210 B	DO METER
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	SM 4500-NH3 H	LACHAT FIA
Total Kjeldahl Nitrogen	INOR-93-6048	QuikChem 10-107-06-2-I & SM 4500-Norg D	LACHAT FIA
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA
Chemical Oxygen Demand	INOR-93-6042	SM 5220 D	SPECTROPHOTOMETER
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Phenols	INOR-93-6050	MOE ROPHEN-E 3179 & SM 5530 D	TECHNICON AUTO ANALYZER
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Mercury	MET-93-6100	EPA SW-846 7470 & 245.1	CVAAS
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

3 x 1s Blk

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Laboratory Use Only

Work Order #: 19T494183

Cooler Quantity: 3

Arrival Temperatures: See Attached

Custody Seal Intact: ☐ Yes ☐ No ☒ N/A

Notes: ICE

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Report Information:

Company: Pinchin Ltd.
Contact: Kathleen Muir
Address: 957 Cambrian Heights Dr.
Sudbury, ON P3C 5S5
Phone: 705-521-0560 Fax:
Reports to be sent to:
1. Email: Kmuir@pinchin.com
2. Email:

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☒ Other
ODWQS *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: Atikameksheng Anishnawbek - Closed LF
Site Location: Closed Landfill
Sampled By: K.M and A.V
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Analyses: Field Filtered - Metals, Hg, CrVI (Y/N); O. Reg 153: Metals and Inorganics (☒ All Metals ☐ 153 Metals (excl. Hydrides)); ☐ Hydride Metals; ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☒ Hg ☒ pH ☐ SAR; Full Metals Scan; Regulation/Custom Metals; Nutrients: ☒ TP ☒ NH3 ☒ TKN ☒ NO3 ☒ NO2 ☒ NO3+NO2; Volatiles: ☐ VOC ☐ BTEX ☐ THM; CCME Fractions 1 to 4; ABNs; PAHs; PCBs: ☐ Total ☐ Aroclors; Organochlorine Pesticides; TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs; Sewer Use; BOD/DOC; TDS/TSS; Nutrients; Phenols

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered Y/N	Metals and Inorganics	Hydride Metals	ORPs	Full Metals Scan	Regulation/Custom Metals	Nutrients	Volatiles	CCME Fractions 1 to 4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use	BOD/DOC	TDS/TSS	Nutrients	Phenols		
MW3	July 17, 19	1:00PM	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓		
MW5	↓	↓	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓		
MW4	↓	↓	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓		
DUP1	↓	3:00PM	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓		

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Kathleen Muir K.Muir	July 17, 19	4:00PM	N. Berry	July 18	9:00

Page 1 of 1

Nº: T 069347

AGAT Laboratories

Sample Temperature Log

Client: Pinchin

# of Coolers: 3

COC# or Work Order #: T069314 & T069347

# of Submissions: ______

Arrival Temperatures - Branch/Driver

Cooler #1:	7.0	6.7	6.3
Cooler #2:	5.8	6.5	6.9
Cooler #3:	6.0	6.7	6.7
Cooler #4:			
Cooler #5:			
Cooler #6:			
Cooler #7:			
Cooler #8			
Cooler #9:			
Cooler #10:			

IR Gun ID: ______

Taken By: ______

Date (yyyy/mm/dd): ______ Time: ___:___ AM / PM

Arrival Temperatures - Laboratory

Cooler #1:			
Cooler #2:			
Cooler #3:			
Cooler #4:			
Cooler #5:			
Cooler #6:			
Cooler #7:			
Cooler #8			
Cooler #9:			
Cooler #10:			

IR Gun ID: ______

Taken By: ______

Date (yyyy/mm/dd): ______ Time: ___:___ AM / PM

Instructions for use of this form: 1) complete all fields of info including total # of coolers and # of submissions rec'd, 2) photocopy and place in each submission prior to giving a WO#, 3) Proceed as normal, write the WO# and scan (please make sure to scan along with the COC)

Document ID: SR-78-9511.003
Date Issued: 2017-2-23

Page:______ of ______

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CLIENT NAME: PINCHIN LTD.
957 CAMBRIAN HEIGHTS DRIVE, UNIT 203
SUDBURY, ON P3C 5S5
(705) 521-0560

ATTENTION TO: Kathleen Murr

PROJECT: Atikameksheng Anishnawbek - Active LF

AGAT WORK ORDER: 19T494185

WATER ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician

DATE REPORTED: Jul 25, 2019

PAGES (INCLUDING COVER): 10

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Certificate of Analysis

AGAT WORK ORDER: 19T494185

PROJECT: Atikameksheng Anishnawbek - Active LF

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http://www.agatlabs.com

CLIENT NAME: PINCHIN LTD.

ATTENTION TO: Kathleen Murr

SAMPLING SITE:Active Landfill

SAMPLED BY:KM, AV

Inorganic Chemistry (Water)

DATE RECEIVED: 2019-07-18

DATE REPORTED: 2019-07-25

				SAMPLE DESCRIPTION:	MW1		MW2		MW3		MW4
				SAMPLE TYPE:	Water		Water		Water		Water
				DATE SAMPLED:	2019-07-17		2019-07-17		2019-07-17		2019-07-17
Parameter	Unit	G / S: A	G / S: B	RDL	363944	RDL	363947	RDL	363948	RDL	363949
BOD (5)	mg/L			5	<5	5	<5	5	<5	5	<5
Electrical Conductivity	µS/cm			2	102	2	910	2	715	2	94
pH	pH Units		6.5-8.5	NA	7.20	NA	7.29	NA	7.27	NA	7.02
Total Dissolved Solids	mg/L		500	20	298[<B]	20	594[>B]	20	434[<B]	20	184[<B]
Total Suspended Solids	mg/L			10	50500	10	1420	10	20500	10	5690
Alkalinity (as CaCO3)	mg/L		30-500	5	34	5	291	5	258	5	26
Chloride	mg/L		250	0.10	2.35[<B]	0.50	23.1[<B]	0.20	22.3[<B]	0.10	1.83[<B]
Nitrate as N	mg/L	10.0		0.05	<0.05[<A]	0.25	<0.25[<A]	0.10	<0.10[<A]	0.05	<0.05[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]	0.25	<0.25[<A]	0.10	<0.10[<A]	0.05	<0.05[<A]
Sulphate	mg/L		500	0.10	12.8[<B]	0.50	205[<B]	0.20	107[<B]	0.10	15.4[<B]
Ammonia as N	mg/L			0.02	0.24	0.02	0.05	0.02	0.13	0.02	0.14
Total Kjeldahl Nitrogen	mg/L			0.10	0.32	0.10	0.78	0.10	0.62	0.10	0.41
Total Phosphorus	mg/L			0.10	15.1	0.02	0.73	0.10	12.0	0.10	14.7
Chemical Oxygen Demand	mg/L			5	33	5	54	5	45	5	20
Dissolved Organic Carbon	mg/L		5	1.0	6.1[>B]	1.0	24.0[>B]	0.5	9.4[>B]	1.0	10.7[>B]
Phenols	mg/L			0.001	<0.001	0.001	0.006	0.001	0.003	0.001	0.002

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 19T494185
PROJECT: Atikameksheng Anishnawbek - Active LF

CLIENT NAME: PINCHIN LTD.
ATTENTION TO: Kathleen Murr
SAMPLING SITE:Active Landfill
SAMPLED BY:KM, AV

Inorganic Chemistry (Water)

DATE RECEIVED: 2019-07-18
DATE REPORTED: 2019-07-25

				SAMPLE DESCRIPTION:	DUP1
				SAMPLE TYPE:	Water
				DATE SAMPLED:	2019-07-17
Parameter	Unit	G / S: A	G / S: B	RDL	363950
BOD (5)	mg/L			5	<5
Electrical Conductivity	µS/cm			2	101
pH	pH Units		6.5-8.5	NA	7.19
Total Dissolved Solids	mg/L		500	20	260[<B]
Total Suspended Solids	mg/L			10	34900
Alkalinity (as CaCO3)	mg/L		30-500	5	33
Chloride	mg/L		250	0.10	2.30[<B]
Nitrate as N	mg/L	10.0		0.05	<0.05[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]
Sulphate	mg/L		500	0.10	12.8[<B]
Ammonia as N	mg/L			0.02	0.22
Total Kjeldahl Nitrogen	mg/L			0.10	0.37
Total Phosphorus	mg/L			0.10	13.6
Chemical Oxygen Demand	mg/L			5	28
Dissolved Organic Carbon	mg/L		5	1.0	7.3[>B]
Phenols	mg/L			0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

363944-363950 Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

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Certificate of Analysis

AGAT WORK ORDER: 19T494185

PROJECT: Atikameksheng Anishnawbek - Active LF

CLIENT NAME: PINCHIN LTD.

ATTENTION TO: Kathleen Murr

SAMPLING SITE:Active Landfill

SAMPLED BY:KM, AV

Metals Scan (Water)

DATE RECEIVED: 2019-07-18

DATE REPORTED: 2019-07-25

				SAMPLE DESCRIPTION:	MW1	MW2	MW3	MW4	DUP1
				SAMPLE TYPE:	Water	Water	Water	Water	Water
				DATE SAMPLED:	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17
Parameter	Unit	G / S: A	G / S: B	RDL	363944	363947	363948	363949	363950
Arsenic	mg/L	0.025		0.001	0.002[<A]	0.001[<A]	<0.001[<A]	<0.001[<A]	0.002[<A]
Barium	mg/L	1		0.002	0.044[<A]	0.059[<A]	0.035[<A]	0.003[<A]	0.038[<A]
Boron	mg/L	5		0.01	<0.01[<A]	1.04[<A]	0.41[<A]	0.03[<A]	0.02[<A]
Cadmium	mg/L	0.005		0.001	<0.001[<A]	<0.001[<A]	<0.001[<A]	<0.001[<A]	<0.001[<A]
Calcium	mg/L			0.05	9.52	136	87.0	8.74	9.50
Chromium	mg/L	0.05		0.002	0.004[<A]	<0.002[<A]	<0.002[<A]	<0.002[<A]	0.003[<A]
Copper	mg/L		1	0.002	0.012[<B]	0.015[<B]	0.006[<B]	0.003[<B]	0.012[<B]
Iron	mg/L		0.3	0.01	2.14[>B]	<0.01[<B]	<0.01[<B]	<0.01[<B]	1.88[>B]
Lead	mg/L	0.01		0.001	0.004[<A]	<0.001[<A]	<0.001[<A]	<0.001[<A]	0.004[<A]
Magnesium	mg/L			0.05	3.06	17.8	24.1	2.48	3.07
Manganese	mg/L		0.05	0.002	0.185[>B]	0.089[>B]	0.451[>B]	0.058[>B]	0.184[>B]
Mercury	mg/L	0.001		0.0001	<0.0001[<A]	<0.0001[<A]	<0.0001[<A]	<0.0001[<A]	<0.0001[<A]
Potassium	mg/L			0.05	1.20	2.23	1.66	0.37	1.21
Sodium	mg/L	20	200	0.05	3.13[<A]	35.7[A-B]	24.2[A-B]	3.53[<A]	3.11[<A]
Zinc	mg/L		5	0.005	0.019[<B]	0.017[<B]	0.008[<B]	0.008[<B]	0.017[<B]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Ontario Drinking Water Quality Standards. Na value is derived from O. Reg. 248, B Refers to Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Guideline Violation

AGAT WORK ORDER: 19T494185

PROJECT: Atikameksheng Anishnawbek - Active LF

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CLIENT NAME: PINCHIN LTD.

ATTENTION TO: Kathleen Murr

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
363944	MW1	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	6.1
363944	MW1	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Iron	mg/L	0.3	2.14
363944	MW1	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.185
363947	MW2	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	24.0
363947	MW2	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Total Dissolved Solids	mg/L	500	594
363947	MW2	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.089
363947	MW2	O.Reg.169/03(mg/L)	Metals Scan (Water)	Sodium	mg/L	20	35.7
363948	MW3	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	9.4
363948	MW3	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.451
363948	MW3	O.Reg.169/03(mg/L)	Metals Scan (Water)	Sodium	mg/L	20	24.2
363949	MW4	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Alkalinity (as CaCO3)	mg/L	30-500	26
363949	MW4	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	10.7
363949	MW4	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.058
363950	DUP1	O.Reg. 169(mg/L)AO&OG	Inorganic Chemistry (Water)	Dissolved Organic Carbon	mg/L	5	7.3
363950	DUP1	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Iron	mg/L	0.3	1.88
363950	DUP1	O.Reg. 169(mg/L)AO&OG	Metals Scan (Water)	Manganese	mg/L	0.05	0.184

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Quality Assurance

CLIENT NAME: PINCHIN LTD.
PROJECT: Atikameksheng Anishnawbek - Active LF
SAMPLING SITE:Active Landfill

AGAT WORK ORDER: 19T494185
ATTENTION TO: Kathleen Murr
SAMPLED BY:KM, AV

Water Analysis

RPT Date: Jul 25, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Water)															
BOD (5)	361741		<125	6490	NA	< 5	NA	75%	125%						
Electrical Conductivity	362658		1790	1800	0.6%	< 2	99%	80%	120%						
pH	362658		7.91	7.83	1.0%	NA	100%	90%	110%						
Total Dissolved Solids	362801		164	162	1.2%	< 20	98%	80%	120%						
Total Suspended Solids	370849		<10	<10	NA	< 10	98%	80%	120%						
Alkalinity (as CaCO3)	362658		413	411	0.5%	< 5	98%	80%	120%						
Chloride	363947	363947	23.1	21.7	6.3%	< 0.10	102%	90%	110%	109%	90%	110%	113%	85%	115%
Nitrate as N	363947	363947	<0.25	<0.25	NA	< 0.05	99%	90%	110%	108%	90%	110%	108%	85%	115%
Nitrite as N	363947	363947	<0.25	<0.25	NA	< 0.05	NA	90%	110%	95%	90%	110%	105%	85%	115%
Sulphate	363947	363947	205	198	3.5%	< 0.10	104%	90%	110%	106%	90%	110%	102%	85%	115%
Ammonia as N	363127		0.57	0.55	3.6%	< 0.02	93%	90%	110%	95%	90%	110%	100%	70%	130%
Total Kjeldahl Nitrogen	362801		0.25	0.28	NA	< 0.10	101%	80%	120%	99%	80%	120%	97%	70%	130%
Total Phosphorus	362801		3.75	3.73	0.5%	< 0.02	100%	80%	120%	101%	90%	110%	108%	70%	130%
Chemical Oxygen Demand	362801		7	7	NA	< 5	101%	80%	120%	97%	90%	110%	88%	70%	130%
Dissolved Organic Carbon	362801		3.2	3.2	0.0%	< 0.5	100%	90%	110%	100%	90%	110%	91%	80%	120%
Phenols	362801		<0.001	<0.001	NA	< 0.001	102%	90%	110%	103%	90%	110%	100%	80%	120%
Metals Scan (Water)															
Arsenic	363944	363944	0.002	0.002	NA	< 0.001	94%	90%	110%	98%	90%	110%	111%	70%	130%
Barium	363944	363944	0.044	0.042	4.7%	< 0.002	102%	90%	110%	104%	90%	110%	106%	70%	130%
Boron	363944	363944	<0.01	<0.01	NA	< 0.01	101%	90%	110%	99%	90%	110%	87%	70%	130%
Cadmium	363944	363944	<0.001	<0.001	NA	< 0.001	101%	90%	110%	104%	90%	110%	108%	70%	130%
Calcium	362226		73.2	74.3	1.5%	< 0.05	97%	90%	110%	98%	90%	110%	123%	70%	130%
Chromium	363944	363944	0.004	0.003	NA	< 0.002	102%	90%	110%	103%	90%	110%	101%	70%	130%
Copper	363944	363944	0.012	0.012	0.0%	< 0.002	105%	90%	110%	110%	90%	110%	108%	70%	130%
Iron	363944	363944	2.14	2.00	6.8%	< 0.01	105%	90%	110%	110%	90%	110%	79%	70%	130%
Lead	363944	363944	0.004	0.004	NA	< 0.001	102%	90%	110%	106%	90%	110%	108%	70%	130%
Magnesium	362226		4.56	4.54	0.4%	< 0.05	98%	90%	110%	99%	90%	110%	117%	70%	130%
Manganese	363944	363944	0.185	0.178	3.9%	< 0.002	98%	90%	110%	101%	90%	110%	97%	70%	130%
Mercury	363944	363944	<0.0001	<0.0001	NA	< 0.0001	102%	90%	110%	95%	80%	120%	94%	80%	120%
Potassium	362226		1.55	1.57	1.3%	< 0.05	97%	90%	110%	97%	90%	110%	120%	70%	130%
Sodium	362226		3.12	3.14	0.6%	< 0.05	96%	90%	110%	96%	90%	110%	119%	70%	130%
Zinc	363944	363944	0.019	0.017	NA	< 0.005	101%	90%	110%	107%	90%	110%	110%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

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Quality Assurance

CLIENT NAME: PINCHIN LTD.
PROJECT: Atikameksheng Anishnawbek - Active LF
SAMPLING SITE:Active Landfill

AGAT WORK ORDER: 19T494185
ATTENTION TO: Kathleen Murr
SAMPLED BY:KM, AV

Water Analysis (Continued)

RPT Date: Jul 25, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

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Method Summary

CLIENT NAME: PINCHIN LTD. AGAT WORK ORDER: 19T494185

PROJECT: Atikameksheng Anishnawbek - Active LF ATTENTION TO: Kathleen Murr

SAMPLING SITE:Active Landfill SAMPLED BY:KM, AV

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
BOD (5)	INOR-93-6006	SM 5210 B	DO METER
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	SM 4500-NH3 H	LACHAT FIA
Total Kjeldahl Nitrogen	INOR-93-6048	QuikChem 10-107-06-2-I & SM 4500-Norg D	LACHAT FIA
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA
Chemical Oxygen Demand	INOR-93-6042	SM 5220 D	SPECTROPHOTOMETER
Dissolved Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Phenols	INOR-93-6050	MOE ROPHEN-E 3179 & SM 5530 D	TECHNICON AUTO ANALYZER
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Mercury	MET-93-6100	EPA SW-846 7470 & 245.1	CVAAS
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

3x 1s BLK

AGAT Laboratories

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webearth.agatlabs.com

Laboratory Use Only

Work Order #: 19T494185

Cooler Quantity: 3

Arrival Temperatures: See Attached

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Report Information:

Company: Pinchin Ltd.
Contact: Kathleen Murr
Address: 957 Cambrian Heights Dr. Sudbury, ON P3C 5S5
Phone: 705-521-0560 Fax:
Reports to be sent to:
1. Email: Kmurr@pinchin.com
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ No Regulatory Requirement

☐ Regulation 153/04
Table ____ Indicate One
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ Indicate One

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☑ Other
ODWQS
Indicate One

Is this submission for a Record of Site Condition? ☐ Yes ☑ No

Report Guideline on Certificate of Analysis ☑ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: Atikameksheng Anishnawbek - Active LF
Site Location: Active Landfill
Sampled By: K.M and A.V.
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	O. Reg 153: ☑ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals	O. Reg 153: ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☑ Hg ☑ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☑ TP ☑ NH3 ☑ TKN ☑ NO3 ☑ NO2 ☑ NO3+NO2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	BOD/DOC	TDS/TSS	Nutrients	Phenols	
MW1	July 17, 19	10:00 AM	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓	
MW2			8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓	
MW3			8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓	
MW4			8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓	
Dup1		12 PM	8	GW		✓	✓	✓	✓			✓									✓	✓	✓	✓	

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Kathleen Murr K. Murr	Jul. 17, 19	4 PM	N. Bruny	July 18	7:00
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page ____ of ____

Nº: T 069314

AGAT Laboratories

Sample Temperature Log

Client: Pinchin

# of Coolers: 3

COC# or Work Order #: T069314 & T069347

# of Submissions: ______

Arrival Temperatures - Branch/Driver

Cooler #1:	7.0	6.7	6.3
Cooler #2:	5.8	6.5	6.9
Cooler #3:	6.0	6.7	6.7
Cooler #4:			
Cooler #5:			
Cooler #6:			
Cooler #7:			
Cooler #8			
Cooler #9:			
Cooler #10:			

IR Gun ID: ______

Taken By: ______

Date (yyyy/mm/dd): ______ Time: ___:___ AM / PM

Arrival Temperatures - Laboratory

Cooler #1:			
Cooler #2:			
Cooler #3:			
Cooler #4:			
Cooler #5:			
Cooler #6:			
Cooler #7:			
Cooler #8			
Cooler #9:			
Cooler #10:			

IR Gun ID: ______

Taken By: ______

Date (yyyy/mm/dd): ______ Time: ___:___ AM / PM

Instructions for use of this form: 1) complete all fields of info including total # of coolers and # of submissions rec'd, 2) photocopy and place in each submission prior to giving a WO#, 3) Proceed as normal, write the WO# and scan (please make sure to scan along with the COC)

Document ID: SR-78-9511.003
Date Issued: 2017-2-23

Page:______ of ______

Your Project #: 224078
Site Location: WHITEFISH LK,FN
Your C.O.C. #: n/a

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/12
Report #: R5794778
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I5674
Received: 2019/07/05, 15:58

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Hot Water Extractable Boron	2	2019/07/08	2019/07/09	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum	2	N/A	2019/07/11		EPA 8260C m
Hexavalent Chromium in Soil by IC (1)	2	2019/07/10	2019/07/11	CAM SOP-00436	EPA 3060/7199 m
Strong Acid Leachable Metals by ICPMS	1	2019/07/08	2019/07/09	CAM SOP-00447	EPA 6020B m
Strong Acid Leachable Metals by ICPMS	1	2019/07/08	2019/07/10	CAM SOP-00447	EPA 6020B m
Moisture	2	N/A	2019/07/06	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT	2	2019/07/10	2019/07/10	CAM SOP-00413	EPA 9045 D m
Volatile Organic Compounds in Soil	2	N/A	2019/07/10	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
(1) Soils are reported on a dry weight basis unless otherwise specified.

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Your Project #: 224078
Site Location: WHITEFISH LK,FN
Your C.O.C. #: n/a

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/12
Report #: R5794778
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I5674
Received: 2019/07/05, 15:58

Encryption Key Antonella Brasil
Antonella Brasil
Senior Project Manager
12 Jul 2019 12:16:15

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: Antonella.Brasil@bvlabs.com
Phone# (905)817-5817

==

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BV Labs Job #: B9I5674
Report Date: 2019/07/12

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK,FN
Sampler Initials: DJ

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KEU705	KEU706		
Sampling Date		2019/07/05 14:00	2019/07/05 14:30		
COC Number		n/a	n/a		
	UNITS	**MW1-BACKGROUND ACTIVE**	**MW1-BACKGROUND ACTIVE 2**	**RDL**	**QC Batch**
Inorganics					
Moisture	%	19	33	1.0	6215387
Available (CaCl2) pH	pH	5.85	6.91		6220349

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK,FN
Sampler Initials: DJ

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		KEU705	KEU706			KEU706		
Sampling Date		2019/07/05 14:00	2019/07/05 14:30			2019/07/05 14:30		
COC Number		n/a	n/a			n/a		
	UNITS	MW1-BACKGROUND ACTIVE	MW1-BACKGROUND ACTIVE 2	RDL	QC Batch	MW1-BACKGROUND ACTIVE 2 Lab-Dup	RDL	QC Batch
Inorganics								
Chromium (VI)	ug/g	0.5	0.4	0.2	6220116			
Metals								
Hot Water Ext. Boron (B)	ug/g	<0.050	0.068	0.050	6216388			
Acid Extractable Antimony (Sb)	ug/g	<0.20	<0.20	0.20	6216393	<0.20	0.20	6216393
Acid Extractable Arsenic (As)	ug/g	2.7	13	1.0	6216393	13	1.0	6216393
Acid Extractable Barium (Ba)	ug/g	93	170	0.50	6216393	170	0.50	6216393
Acid Extractable Beryllium (Be)	ug/g	0.46	0.74	0.20	6216393	0.74	0.20	6216393
Acid Extractable Boron (B)	ug/g	<5.0	7.1	5.0	6216393	6.8	5.0	6216393
Acid Extractable Cadmium (Cd)	ug/g	0.12	<0.10	0.10	6216393	<0.10	0.10	6216393
Acid Extractable Chromium (Cr)	ug/g	51	83	1.0	6216393	82	1.0	6216393
Acid Extractable Cobalt (Co)	ug/g	9.5	16	0.10	6216393	16	0.10	6216393
Acid Extractable Copper (Cu)	ug/g	42	35	0.50	6216393	35	0.50	6216393
Acid Extractable Lead (Pb)	ug/g	6.3	9.0	1.0	6216393	8.9	1.0	6216393
Acid Extractable Molybdenum (Mo)	ug/g	0.56	<0.50	0.50	6216393	<0.50	0.50	6216393
Acid Extractable Nickel (Ni)	ug/g	43	49	0.50	6216393	50	0.50	6216393
Acid Extractable Selenium (Se)	ug/g	<0.50	<0.50	0.50	6216393	<0.50	0.50	6216393
Acid Extractable Silver (Ag)	ug/g	<0.20	<0.20	0.20	6216393	<0.20	0.20	6216393
Acid Extractable Thallium (Tl)	ug/g	0.12	0.17	0.050	6216393	0.18	0.050	6216393
Acid Extractable Uranium (U)	ug/g	1.7	0.93	0.050	6216393	0.90	0.050	6216393
Acid Extractable Vanadium (V)	ug/g	39	55	5.0	6216393	55	5.0	6216393
Acid Extractable Zinc (Zn)	ug/g	44	64	5.0	6216393	65	5.0	6216393
Acid Extractable Mercury (Hg)	ug/g	<0.050	<0.050	0.050	6216393	<0.050	0.050	6216393

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KEU705	KEU706		
Sampling Date		2019/07/05 14:00	2019/07/05 14:30		
COC Number		n/a	n/a		
	UNITS	**MW1-BACKGROUND ACTIVE**	**MW1-BACKGROUND ACTIVE 2**	**RDL**	**QC Batch**
Calculated Parameters					
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	<0.050	0.050	6215086
Volatile Organics					
Acetone (2-Propanone)	ug/g	<0.50	<0.50	0.50	6218197
Benzene	ug/g	<0.020	<0.020	0.020	6218197
Bromodichloromethane	ug/g	<0.050	<0.050	0.050	6218197
Bromoform	ug/g	<0.050	<0.050	0.050	6218197
Bromomethane	ug/g	<0.050	<0.050	0.050	6218197
Carbon Tetrachloride	ug/g	<0.050	<0.050	0.050	6218197
Chlorobenzene	ug/g	<0.050	<0.050	0.050	6218197
Chloroform	ug/g	<0.050	<0.050	0.050	6218197
Dibromochloromethane	ug/g	<0.050	<0.050	0.050	6218197
1,2-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6218197
1,3-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6218197
1,4-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6218197
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	<0.050	0.050	6218197
1,1-Dichloroethane	ug/g	<0.050	<0.050	0.050	6218197
1,2-Dichloroethane	ug/g	<0.050	<0.050	0.050	6218197
1,1-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6218197
cis-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6218197
trans-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6218197
1,2-Dichloropropane	ug/g	<0.050	<0.050	0.050	6218197
cis-1,3-Dichloropropene	ug/g	<0.030	<0.030	0.030	6218197
trans-1,3-Dichloropropene	ug/g	<0.040	<0.040	0.040	6218197
Ethylbenzene	ug/g	<0.020	<0.020	0.020	6218197
Ethylene Dibromide	ug/g	<0.050	<0.050	0.050	6218197
Hexane	ug/g	<0.050	<0.050	0.050	6218197
Methylene Chloride(Dichloromethane)	ug/g	<0.050	<0.050	0.050	6218197
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	<0.50	0.50	6218197
Methyl Isobutyl Ketone	ug/g	<0.50	<0.50	0.50	6218197
Methyl t-butyl ether (MTBE)	ug/g	<0.050	<0.050	0.050	6218197
Styrene	ug/g	<0.050	<0.050	0.050	6218197
1,1,1,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6218197
1,1,2,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6218197
RDL = Reportable Detection Limit QC Batch = Quality Control Batch					

VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KEU705	KEU706		
Sampling Date		2019/07/05 14:00	2019/07/05 14:30		
COC Number		n/a	n/a		
	UNITS	MW1-BACKGROUND ACTIVE	MW1-BACKGROUND ACTIVE 2	RDL	QC Batch
Tetrachloroethylene	ug/g	<0.050	<0.050	0.050	6218197
Toluene	ug/g	<0.020	<0.020	0.020	6218197
1,1,1-Trichloroethane	ug/g	<0.050	<0.050	0.050	6218197
1,1,2-Trichloroethane	ug/g	<0.050	<0.050	0.050	6218197
Trichloroethylene	ug/g	<0.050	<0.050	0.050	6218197
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	<0.050	0.050	6218197
Vinyl Chloride	ug/g	<0.020	<0.020	0.020	6218197
p+m-Xylene	ug/g	<0.020	<0.020	0.020	6218197
o-Xylene	ug/g	<0.020	<0.020	0.020	6218197
Total Xylenes	ug/g	<0.020	<0.020	0.020	6218197
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	90	89		6218197
D10-o-Xylene	%	100	106		6218197
D4-1,2-Dichloroethane	%	107	106		6218197
D8-Toluene	%	98	98		6218197

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9I5674
Report Date: 2019/07/12

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK,FN
Sampler Initials: DJ

TEST SUMMARY

BV Labs ID: KEU705
Sample ID: MW1-BACKGROUND ACTIVE
Matrix: Soil

Collected: 2019/07/05
Shipped:
Received: 2019/07/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6216388	2019/07/08	2019/07/09	Archana Patel
1,3-Dichloropropene Sum	CALC	6215086	N/A	2019/07/11	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6220116	2019/07/10	2019/07/11	Sally Norouz
Strong Acid Leachable Metals by ICPMS	ICP/MS	6216393	2019/07/08	2019/07/10	Daniel Teclu
Moisture	BAL	6215387	N/A	2019/07/06	Prgya Panchal
pH CaCl2 EXTRACT	AT	6220349	2019/07/10	2019/07/10	Surinder Rai
Volatile Organic Compounds in Soil	GC/MS	6218197	N/A	2019/07/10	Rebecca McClean

BV Labs ID: KEU706
Sample ID: MW1-BACKGROUND ACTIVE 2
Matrix: Soil

Collected: 2019/07/05
Shipped:
Received: 2019/07/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6216388	2019/07/08	2019/07/09	Archana Patel
1,3-Dichloropropene Sum	CALC	6215086	N/A	2019/07/11	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6220116	2019/07/10	2019/07/11	Sally Norouz
Strong Acid Leachable Metals by ICPMS	ICP/MS	6216393	2019/07/08	2019/07/09	Daniel Teclu
Moisture	BAL	6215387	N/A	2019/07/06	Prgya Panchal
pH CaCl2 EXTRACT	AT	6220349	2019/07/10	2019/07/10	Surinder Rai
Volatile Organic Compounds in Soil	GC/MS	6218197	N/A	2019/07/10	Rebecca McClean

BV Labs ID: KEU706 Dup
Sample ID: MW1-BACKGROUND ACTIVE 2
Matrix: Soil

Collected: 2019/07/05
Shipped:
Received: 2019/07/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	6216393	2019/07/08	2019/07/09	Daniel Teclu

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.0°C

Samples extracted from soil jars for VOC analysis with client's consent .

VOC Analysis: The soil samples were submitted in jars which is not consistent with Regulation 153 Protocol.

Results relate only to the items tested.

BUREAU VERITAS

BV Labs Job #: B9I5674
Report Date: 2019/07/12

QUALITY ASSURANCE REPORT

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK,FN
Sampler Initials: DJ

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6218197	4-Bromofluorobenzene	2019/07/10	95	60 - 140	98	60 - 140	91	%		
6218197	D10-o-Xylene	2019/07/10	119	60 - 130	78	60 - 130	85	%		
6218197	D4-1,2-Dichloroethane	2019/07/10	101	60 - 140	106	60 - 140	113	%		
6218197	D8-Toluene	2019/07/10	111	60 - 140	107	60 - 140	95	%		
6215387	Moisture	2019/07/06							2.2	20
6216388	Hot Water Ext. Boron (B)	2019/07/09	108	75 - 125	96	75 - 125	<0.050	ug/g	5.3	40
6216393	Acid Extractable Antimony (Sb)	2019/07/09	83	75 - 125	98	80 - 120	<0.20	ug/g	NC	30
6216393	Acid Extractable Arsenic (As)	2019/07/09	101	75 - 125	103	80 - 120	<1.0	ug/g	3.2	30
6216393	Acid Extractable Barium (Ba)	2019/07/09	NC	75 - 125	98	80 - 120	<0.50	ug/g	2.4	30
6216393	Acid Extractable Beryllium (Be)	2019/07/09	97	75 - 125	97	80 - 120	<0.20	ug/g	0.40	30
6216393	Acid Extractable Boron (B)	2019/07/09	98	75 - 125	93	80 - 120	<5.0	ug/g	5.4	30
6216393	Acid Extractable Cadmium (Cd)	2019/07/09	96	75 - 125	97	80 - 120	<0.10	ug/g	NC	30
6216393	Acid Extractable Chromium (Cr)	2019/07/09	NC	75 - 125	101	80 - 120	<1.0	ug/g	0.93	30
6216393	Acid Extractable Cobalt (Co)	2019/07/09	97	75 - 125	101	80 - 120	<0.10	ug/g	0.70	30
6216393	Acid Extractable Copper (Cu)	2019/07/09	NC	75 - 125	101	80 - 120	<0.50	ug/g	0.37	30
6216393	Acid Extractable Lead (Pb)	2019/07/09	98	75 - 125	101	80 - 120	<1.0	ug/g	0.55	30
6216393	Acid Extractable Mercury (Hg)	2019/07/09	103	75 - 125	104	80 - 120	<0.050	ug/g	NC	30
6216393	Acid Extractable Molybdenum (Mo)	2019/07/09	96	75 - 125	98	80 - 120	<0.50	ug/g	NC	30
6216393	Acid Extractable Nickel (Ni)	2019/07/09	NC	75 - 125	104	80 - 120	<0.50	ug/g	2.3	30
6216393	Acid Extractable Selenium (Se)	2019/07/09	97	75 - 125	104	80 - 120	<0.50	ug/g	NC	30
6216393	Acid Extractable Silver (Ag)	2019/07/09	101	75 - 125	101	80 - 120	<0.20	ug/g	NC	30
6216393	Acid Extractable Thallium (Tl)	2019/07/09	97	75 - 125	100	80 - 120	<0.050	ug/g	4.0	30
6216393	Acid Extractable Uranium (U)	2019/07/09	97	75 - 125	99	80 - 120	<0.050	ug/g	3.1	30
6216393	Acid Extractable Vanadium (V)	2019/07/09	NC	75 - 125	101	80 - 120	<5.0	ug/g	0.018	30
6216393	Acid Extractable Zinc (Zn)	2019/07/09	NC	75 - 125	102	80 - 120	<5.0	ug/g	2.2	30
6218197	1,1,1,2-Tetrachloroethane	2019/07/10	101	60 - 140	100	60 - 130	<0.050	ug/g	NC	50
6218197	1,1,1-Trichloroethane	2019/07/10	95	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6218197	1,1,2,2-Tetrachloroethane	2019/07/10	99	60 - 140	102	60 - 130	<0.050	ug/g	NC	50
6218197	1,1,2-Trichloroethane	2019/07/10	109	60 - 140	108	60 - 130	<0.050	ug/g	NC	50
6218197	1,1-Dichloroethane	2019/07/10	99	60 - 140	104	60 - 130	<0.050	ug/g	NC	50
6218197	1,1-Dichloroethylene	2019/07/10	106	60 - 140	110	60 - 130	<0.050	ug/g	NC	50
6218197	1,2-Dichlorobenzene	2019/07/10	90	60 - 140	86	60 - 130	<0.050	ug/g	NC	50

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6218197	1,2-Dichloroethane	2019/07/10	100	60 - 140	106	60 - 130	<0.050	ug/g	NC	50
6218197	1,2-Dichloropropane	2019/07/10	93	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6218197	1,3-Dichlorobenzene	2019/07/10	93	60 - 140	88	60 - 130	<0.050	ug/g	NC	50
6218197	1,4-Dichlorobenzene	2019/07/10	97	60 - 140	92	60 - 130	<0.050	ug/g	NC	50
6218197	Acetone (2-Propanone)	2019/07/10	105	60 - 140	109	60 - 140	<0.50	ug/g	NC	50
6218197	Benzene	2019/07/10	95	60 - 140	100	60 - 130	<0.020	ug/g	NC	50
6218197	Bromodichloromethane	2019/07/10	93	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6218197	Bromoform	2019/07/10	94	60 - 140	97	60 - 130	<0.050	ug/g	NC	50
6218197	Bromomethane	2019/07/10	121	60 - 140	127	60 - 140	<0.050	ug/g	NC	50
6218197	Carbon Tetrachloride	2019/07/10	93	60 - 140	96	60 - 130	<0.050	ug/g	NC	50
6218197	Chlorobenzene	2019/07/10	92	60 - 140	92	60 - 130	<0.050	ug/g	NC	50
6218197	Chloroform	2019/07/10	91	60 - 140	96	60 - 130	<0.050	ug/g	NC	50
6218197	cis-1,2-Dichloroethylene	2019/07/10	94	60 - 140	100	60 - 130	<0.050	ug/g	NC	50
6218197	cis-1,3-Dichloropropene	2019/07/10	96	60 - 140	101	60 - 130	<0.030	ug/g	NC	50
6218197	Dibromochloromethane	2019/07/10	99	60 - 140	100	60 - 130	<0.050	ug/g	NC	50
6218197	Dichlorodifluoromethane (FREON 12)	2019/07/10	82	60 - 140	85	60 - 140	<0.050	ug/g	NC	50
6218197	Ethylbenzene	2019/07/10	92	60 - 140	91	60 - 130	<0.020	ug/g	NC	50
6218197	Ethylene Dibromide	2019/07/10	97	60 - 140	97	60 - 130	<0.050	ug/g	NC	50
6218197	Hexane	2019/07/10	111	60 - 140	114	60 - 130	<0.050	ug/g	NC	50
6218197	Methyl Ethyl Ketone (2-Butanone)	2019/07/10	108	60 - 140	116	60 - 140	<0.50	ug/g	NC	50
6218197	Methyl Isobutyl Ketone	2019/07/10	104	60 - 140	115	60 - 130	<0.50	ug/g	NC	50
6218197	Methyl t-butyl ether (MTBE)	2019/07/10	89	60 - 140	89	60 - 130	<0.050	ug/g	NC	50
6218197	Methylene Chloride(Dichloromethane)	2019/07/10	88	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6218197	o-Xylene	2019/07/10	94	60 - 140	92	60 - 130	<0.020	ug/g	NC	50
6218197	p+m-Xylene	2019/07/10	102	60 - 140	100	60 - 130	<0.020	ug/g	NC	50
6218197	Styrene	2019/07/10	96	60 - 140	96	60 - 130	<0.050	ug/g	NC	50
6218197	Tetrachloroethylene	2019/07/10	92	60 - 140	90	60 - 130	<0.050	ug/g	NC	50
6218197	Toluene	2019/07/10	97	60 - 140	96	60 - 130	<0.020	ug/g	NC	50
6218197	Total Xylenes	2019/07/10					<0.020	ug/g	NC	50
6218197	trans-1,2-Dichloroethylene	2019/07/10	101	60 - 140	105	60 - 130	<0.050	ug/g	NC	50
6218197	trans-1,3-Dichloropropene	2019/07/10	111	60 - 140	108	60 - 130	<0.040	ug/g	NC	50
6218197	Trichloroethylene	2019/07/10	90	60 - 140	94	60 - 130	<0.050	ug/g	NC	50

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6218197	Trichlorofluoromethane (FREON 11)	2019/07/10	100	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6218197	Vinyl Chloride	2019/07/10	97	60 - 140	102	60 - 130	<0.020	ug/g	NC	50
6220116	Chromium (VI)	2019/07/11	80	70 - 130	90	80 - 120	<0.2	ug/g	1.7	35
6220349	Available (CaCl2) pH	2019/07/10			100	97 - 103			1.1	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

FUNDAMENTAL LABORATORY ACCEPTANCE GUIDELINE

Invoice To:
Pinchin Ltd
ATTN: Accounts Payable
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5
Client Contact:
Tim McBride

BV Labs Job #:	B9I5674
Date Received:	2019/07/05
Your C.O.C. #:	n/a
Your Project #:	224078
BV Labs Project Manager:	Antonella Brasil
Quote #:	A70927

No discrepancies noted.

Report Comments

Received Date:	2019/07/05	**Time:**	15:58	**By:**	
Inspected Date:		**Time:**		**By:**	
FLAG Created Date:		**Time:**		**By:**	

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I5674
Report Date: 2019/07/12

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK,FN
Sampler Initials: DJ

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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IMMEDIATE

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905 817 5700 Fax: 905 817 5779 Toll Free: 800 563 6266
CAM FCD-01191/7

CHAIN OF CUSTODY RECORD 62018

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)	
Company Name	Pinchin Ltd.	Company Name		Quotation #	
Contact Name	Tim McBride	Contact Name		P.O. #/ AFE#	
Address	957 Cambrian Heights Dr. Suite 203	Address		Project #	224078
				Site Location	Whitefish Lk. FN
Phone	Fax	Phone	Fax	Site #	
Email	tmcbride@pinchin.com	Email	~~[illegible]~~ Kmuir@pinchin.com	Sampled By	Dave Jones

Turnaround Time (TAT) Required

- [X] Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
- [ ] 1 Day
- [ ] 2 Days
- [ ] 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153
- [ ] Table 1
- [ ] Table 2
- [X] Table 3
- [ ] Table ____
- [ ] Res/Park
- [X] Ind/Comm
- [ ] Agri/ Other
- [ ] Med/ Fine
- [X] Coarse

FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations
- [ ] CCME
- [ ] MISA
- [ ] PWQO
- [ ] Other (Specify)
- [ ] REG 558 (MIN. 3 DAY TAT REQUIRED)
- [ ] Sanitary Sewer Bylaw
- [ ] Storm Sewer Bylaw

Region

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	[illegible]	HOLD- DO NOT ANALYZE
1	MW1 - Background Active	2019/07/05	1 PM	S	1				✓			✓	✓	
2	MW1 - Background Active 2	2019/07/05	2:30 PM	S	1				✓			✓	✓	
3														
4														
5														
6														
7														
8														
9														
10														

LABORATORY USE ONLY

CUSTODY SEAL Y / N Present	Intact	COOLER TEMPERATURES
Y	Y	2, 2, 2 °C
Y	Y	2/2/1 °C

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
Kathleen Muir	2019/07/05	3 PM	/ Bradley Frappier	2019/07/05	15:53
			DIPIKA SINGH	2019/07/06	09:00

Received in Sudbury

05-Jul-19 15:58

Antonella Brasil

B9I5674

MRK ENV-1232

COC-1004 (10/14) ENV ENG

Your Project #: 224078
Site Location: WHITEFISH LK.FN
Your C.O.C. #: 62016

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/17
Report #: R5801547
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9J0302
Received: 2019/07/10, 08:50

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Hot Water Extractable Boron	2	2019/07/12	2019/07/15	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum	2	N/A	2019/07/13		EPA 8260C m
Hexavalent Chromium in Soil by IC (1)	2	2019/07/13	2019/07/16	CAM SOP-00436	EPA 3060/7199 m
Strong Acid Leachable Metals by ICPMS	2	2019/07/12	2019/07/17	CAM SOP-00447	EPA 6020B m
Moisture	2	N/A	2019/07/11	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT	2	2019/07/15	2019/07/15	CAM SOP-00413	EPA 9045 D m
Volatile Organic Compounds in Soil	2	N/A	2019/07/12	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
(1) Soils are reported on a dry weight basis unless otherwise specified.

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Your Project #: 224078
Site Location: WHITEFISH LK.FN
Your C.O.C. #: 62016

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/17
Report #: R5801547
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9J0302
Received: 2019/07/10, 08:50

Encryption Key Antonella Brasil

Antonella Brasil
Senior Project Manager
17 Jul 2019 17:15:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: Antonella.Brasil@bvlabs.com
Phone# (905)817-5817

==

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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RESULTS OF ANALYSES OF SOIL

BV Labs ID		KFV767	KFV768		KFV768		
Sampling Date		2019/07/09 14:00	2019/07/09 12:00		2019/07/09 12:00		
COC Number		62016	62016		62016		
	UNITS	**MW3**	**MW4**	**QC Batch**	**MW4 Lab-Dup**	**RDL**	**QC Batch**
Inorganics							
Moisture	%	29	15	6224332	15	1.0	6224332
Available (CaCl2) pH	pH	5.16	6.11	6228065			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B9J0302
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		KFV767	KFV768			KFV768		
Sampling Date		2019/07/09 14:00	2019/07/09 12:00			2019/07/09 12:00		
COC Number		62016	62016			62016		
	UNITS	MW3	MW4	RDL	QC Batch	MW4 Lab-Dup	RDL	QC Batch
Inorganics								
Chromium (VI)	ug/g	<0.2	0.3	0.2	6227085			
Metals								
Hot Water Ext. Boron (B)	ug/g	0.58	0.077	0.050	6225698			
Acid Extractable Antimony (Sb)	ug/g	0.22	<0.20	0.20	6225549	<0.20	0.20	6225549
Acid Extractable Arsenic (As)	ug/g	3.3	1.3	1.0	6225549	1.7	1.0	6225549
Acid Extractable Barium (Ba)	ug/g	120	57	0.50	6225549	67	0.50	6225549
Acid Extractable Beryllium (Be)	ug/g	0.46	0.30	0.20	6225549	0.36	0.20	6225549
Acid Extractable Boron (B)	ug/g	<5.0	<5.0	5.0	6225549	<5.0	5.0	6225549
Acid Extractable Cadmium (Cd)	ug/g	0.54	<0.10	0.10	6225549	<0.10	0.10	6225549
Acid Extractable Chromium (Cr)	ug/g	45	32	1.0	6225549	38	1.0	6225549
Acid Extractable Cobalt (Co)	ug/g	9.3	8.3	0.10	6225549	9.6	0.10	6225549
Acid Extractable Copper (Cu)	ug/g	42	11	0.50	6225549	13	0.50	6225549
Acid Extractable Lead (Pb)	ug/g	23	4.0	1.0	6225549	4.6	1.0	6225549
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	<0.50	0.50	6225549	<0.50	0.50	6225549
Acid Extractable Nickel (Ni)	ug/g	67	18	0.50	6225549	20	0.50	6225549
Acid Extractable Selenium (Se)	ug/g	0.86	<0.50	0.50	6225549	<0.50	0.50	6225549
Acid Extractable Silver (Ag)	ug/g	<0.20	<0.20	0.20	6225549	<0.20	0.20	6225549
Acid Extractable Thallium (Tl)	ug/g	0.15	0.073	0.050	6225549	0.084	0.050	6225549
Acid Extractable Uranium (U)	ug/g	0.85	0.92	0.050	6225549	1.1	0.050	6225549
Acid Extractable Vanadium (V)	ug/g	34	28	5.0	6225549	34	5.0	6225549
Acid Extractable Zinc (Zn)	ug/g	68	33	5.0	6225549	38	5.0	6225549
Acid Extractable Mercury (Hg)	ug/g	0.10	0.070	0.050	6225549	0.061	0.050	6225549

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B9J0302
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KFV767	KFV768		
Sampling Date		2019/07/09 14:00	2019/07/09 12:00		
COC Number		62016	62016		
	UNITS	MW3	MW4	RDL	QC Batch
Calculated Parameters					
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	<0.050	0.050	6222683
Volatile Organics					
Acetone (2-Propanone)	ug/g	<0.50	<0.50	0.50	6224773
Benzene	ug/g	<0.020	<0.020	0.020	6224773
Bromodichloromethane	ug/g	<0.050	<0.050	0.050	6224773
Bromoform	ug/g	<0.050	<0.050	0.050	6224773
Bromomethane	ug/g	<0.050	<0.050	0.050	6224773
Carbon Tetrachloride	ug/g	<0.050	<0.050	0.050	6224773
Chlorobenzene	ug/g	<0.050	<0.050	0.050	6224773
Chloroform	ug/g	<0.050	<0.050	0.050	6224773
Dibromochloromethane	ug/g	<0.050	<0.050	0.050	6224773
1,2-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6224773
1,3-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6224773
1,4-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6224773
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	<0.050	0.050	6224773
1,1-Dichloroethane	ug/g	<0.050	<0.050	0.050	6224773
1,2-Dichloroethane	ug/g	<0.050	<0.050	0.050	6224773
1,1-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6224773
cis-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6224773
trans-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6224773
1,2-Dichloropropane	ug/g	<0.050	<0.050	0.050	6224773
cis-1,3-Dichloropropene	ug/g	<0.030	<0.030	0.030	6224773
trans-1,3-Dichloropropene	ug/g	<0.040	<0.040	0.040	6224773
Ethylbenzene	ug/g	<0.020	<0.020	0.020	6224773
Ethylene Dibromide	ug/g	<0.050	<0.050	0.050	6224773
Hexane	ug/g	<0.050	<0.050	0.050	6224773
Methylene Chloride(Dichloromethane)	ug/g	<0.050	<0.050	0.050	6224773
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	<0.50	0.50	6224773
Methyl Isobutyl Ketone	ug/g	<0.50	<0.50	0.50	6224773
Methyl t-butyl ether (MTBE)	ug/g	<0.050	<0.050	0.050	6224773
Styrene	ug/g	<0.050	<0.050	0.050	6224773
1,1,1,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6224773
1,1,2,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6224773

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KFV767	KFV768		
Sampling Date		2019/07/09 14:00	2019/07/09 12:00		
COC Number		62016	62016		
	UNITS	**MW3**	**MW4**	**RDL**	**QC Batch**
Tetrachloroethylene	ug/g	<0.050	<0.050	0.050	6224773
Toluene	ug/g	<0.020	<0.020	0.020	6224773
1,1,1-Trichloroethane	ug/g	<0.050	<0.050	0.050	6224773
1,1,2-Trichloroethane	ug/g	<0.050	<0.050	0.050	6224773
Trichloroethylene	ug/g	<0.050	<0.050	0.050	6224773
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	<0.050	0.050	6224773
Vinyl Chloride	ug/g	<0.020	<0.020	0.020	6224773
p+m-Xylene	ug/g	<0.020	<0.020	0.020	6224773
o-Xylene	ug/g	<0.020	<0.020	0.020	6224773
Total Xylenes	ug/g	<0.020	<0.020	0.020	6224773
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	100	100		6224773
D10-o-Xylene	%	105	124		6224773
D4-1,2-Dichloroethane	%	93	93		6224773
D8-Toluene	%	100	99		6224773

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: B9J0302
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

TEST SUMMARY

BV Labs ID: KFV767
Sample ID: MW3
Matrix: Soil

Collected: 2019/07/09
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6225698	2019/07/12	2019/07/15	Suban Kanapathippllai
1,3-Dichloropropene Sum	CALC	6222683	N/A	2019/07/13	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6227085	2019/07/13	2019/07/16	Lang Le
Strong Acid Leachable Metals by ICPMS	ICP/MS	6225549	2019/07/12	2019/07/17	Daniel Teclu
Moisture	BAL	6224332	N/A	2019/07/11	Gurpreet Kaur
pH CaCl2 EXTRACT	AT	6228065	2019/07/15	2019/07/15	Neil Dassanayake
Volatile Organic Compounds in Soil	GC/MS	6224773	N/A	2019/07/12	Chandni Khawas

BV Labs ID: KFV768
Sample ID: MW4
Matrix: Soil

Collected: 2019/07/09
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6225698	2019/07/12	2019/07/15	Suban Kanapathippllai
1,3-Dichloropropene Sum	CALC	6222683	N/A	2019/07/13	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6227085	2019/07/13	2019/07/16	Lang Le
Strong Acid Leachable Metals by ICPMS	ICP/MS	6225549	2019/07/12	2019/07/17	Daniel Teclu
Moisture	BAL	6224332	N/A	2019/07/11	Gurpreet Kaur
pH CaCl2 EXTRACT	AT	6228065	2019/07/15	2019/07/15	Neil Dassanayake
Volatile Organic Compounds in Soil	GC/MS	6224773	N/A	2019/07/12	Chandni Khawas

BV Labs ID: KFV768 Dup
Sample ID: MW4
Matrix: Soil

Collected: 2019/07/09
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	6225549	2019/07/12	2019/07/17	Daniel Teclu
Moisture	BAL	6224332	N/A	2019/07/11	Gurpreet Kaur

BV Labs Job #: B9J0302
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.3°C

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

QUALITY ASSURANCE REPORT

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6224773	4-Bromofluorobenzene	2019/07/12	104	60 - 140	104	60 - 140	101	%		
6224773	D10-o-Xylene	2019/07/12	112	60 - 130	92	60 - 130	92	%		
6224773	D4-1,2-Dichloroethane	2019/07/12	85	60 - 140	101	60 - 140	100	%		
6224773	D8-Toluene	2019/07/12	105	60 - 140	101	60 - 140	94	%		
6224332	Moisture	2019/07/11							3.3	20
6224773	1,1,1,2-Tetrachloroethane	2019/07/13	92	60 - 140	101	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,1-Trichloroethane	2019/07/13	87	60 - 140	95	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,2,2-Tetrachloroethane	2019/07/13	84	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,2-Trichloroethane	2019/07/13	85	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6224773	1,1-Dichloroethane	2019/07/13	81	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	1,1-Dichloroethylene	2019/07/13	93	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichlorobenzene	2019/07/13	87	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichloroethane	2019/07/13	82	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichloropropane	2019/07/13	78	60 - 140	88	60 - 130	<0.050	ug/g	NC	50
6224773	1,3-Dichlorobenzene	2019/07/13	93	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	1,4-Dichlorobenzene	2019/07/13	97	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	Acetone (2-Propanone)	2019/07/13	78	60 - 140	93	60 - 140	<0.50	ug/g	NC	50
6224773	Benzene	2019/07/13	85	60 - 140	94	60 - 130	<0.020	ug/g	4.0	50
6224773	Bromodichloromethane	2019/07/13	80	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	Bromoform	2019/07/13	90	60 - 140	106	60 - 130	<0.050	ug/g	NC	50
6224773	Bromomethane	2019/07/13	113	60 - 140	127	60 - 140	<0.050	ug/g	NC	50
6224773	Carbon Tetrachloride	2019/07/13	87	60 - 140	94	60 - 130	<0.050	ug/g	NC	50
6224773	Chlorobenzene	2019/07/13	88	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	Chloroform	2019/07/13	81	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	cis-1,2-Dichloroethylene	2019/07/13	80	60 - 140	90	60 - 130	<0.050	ug/g	NC	50
6224773	cis-1,3-Dichloropropene	2019/07/13	88	60 - 140	98	60 - 130	<0.030	ug/g	NC	50
6224773	Dibromochloromethane	2019/07/13	91	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	Dichlorodifluoromethane (FREON 12)	2019/07/13	85	60 - 140	91	60 - 140	<0.050	ug/g	NC	50
6224773	Ethylbenzene	2019/07/13	NC	60 - 140	91	60 - 130	<0.020	ug/g	4.6	50
6224773	Ethylene Dibromide	2019/07/13	88	60 - 140	101	60 - 130	<0.050	ug/g	NC	50
6224773	Hexane	2019/07/13	NC	60 - 140	99	60 - 130	<0.050	ug/g	2.7	50
6224773	Methyl Ethyl Ketone (2-Butanone)	2019/07/13	77	60 - 140	96	60 - 140	<0.50	ug/g	NC	50

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6224773	Methyl Isobutyl Ketone	2019/07/13	81	60 - 140	100	60 - 130	<0.50	ug/g	NC	50
6224773	Methyl t-butyl ether (MTBE)	2019/07/13	80	60 - 140	89	60 - 130	<0.050	ug/g	NC	50
6224773	Methylene Chloride(Dichloromethane)	2019/07/13	76	60 - 140	88	60 - 130	<0.050	ug/g	NC	50
6224773	o-Xylene	2019/07/13	96	60 - 140	94	60 - 130	<0.020	ug/g	5.0	50
6224773	p+m-Xylene	2019/07/13	NC	60 - 140	98	60 - 130	<0.020	ug/g	4.8	50
6224773	Styrene	2019/07/13	95	60 - 140	97	60 - 130	<0.050	ug/g	NC	50
6224773	Tetrachloroethylene	2019/07/13	90	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	Toluene	2019/07/13	89	60 - 140	90	60 - 130	<0.020	ug/g	4.7	50
6224773	Total Xylenes	2019/07/13					<0.020	ug/g	4.8	50
6224773	trans-1,2-Dichloroethylene	2019/07/13	87	60 - 140	95	60 - 130	<0.050	ug/g	NC	50
6224773	trans-1,3-Dichloropropene	2019/07/13	94	60 - 140	103	60 - 130	<0.040	ug/g	NC	50
6224773	Trichloroethylene	2019/07/13	90	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	Trichlorofluoromethane (FREON 11)	2019/07/13	96	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	Vinyl Chloride	2019/07/13	87	60 - 140	95	60 - 130	<0.020	ug/g	NC	50
6225549	Acid Extractable Antimony (Sb)	2019/07/17	87	75 - 125	102	80 - 120	<0.20	ug/g	NC	30
6225549	Acid Extractable Arsenic (As)	2019/07/17	99	75 - 125	102	80 - 120	<1.0	ug/g	27	30
6225549	Acid Extractable Barium (Ba)	2019/07/17	NC	75 - 125	97	80 - 120	<0.50	ug/g	16	30
6225549	Acid Extractable Beryllium (Be)	2019/07/17	95	75 - 125	94	80 - 120	<0.20	ug/g	19	30
6225549	Acid Extractable Boron (B)	2019/07/17	91	75 - 125	94	80 - 120	<5.0	ug/g	NC	30
6225549	Acid Extractable Cadmium (Cd)	2019/07/17	96	75 - 125	99	80 - 120	<0.10	ug/g	NC	30
6225549	Acid Extractable Chromium (Cr)	2019/07/17	NC	75 - 125	99	80 - 120	<1.0	ug/g	16	30
6225549	Acid Extractable Cobalt (Co)	2019/07/17	98	75 - 125	100	80 - 120	<0.10	ug/g	15	30
6225549	Acid Extractable Copper (Cu)	2019/07/17	96	75 - 125	100	80 - 120	<0.50	ug/g	15	30
6225549	Acid Extractable Lead (Pb)	2019/07/17	99	75 - 125	100	80 - 120	<1.0	ug/g	14	30
6225549	Acid Extractable Mercury (Hg)	2019/07/17	99	75 - 125	105	80 - 120	<0.050	ug/g	13	30
6225549	Acid Extractable Molybdenum (Mo)	2019/07/17	97	75 - 125	101	80 - 120	<0.50	ug/g	NC	30
6225549	Acid Extractable Nickel (Ni)	2019/07/17	100	75 - 125	101	80 - 120	<0.50	ug/g	12	30
6225549	Acid Extractable Selenium (Se)	2019/07/17	101	75 - 125	104	80 - 120	<0.50	ug/g	NC	30
6225549	Acid Extractable Silver (Ag)	2019/07/17	99	75 - 125	102	80 - 120	<0.20	ug/g	NC	30
6225549	Acid Extractable Thallium (Tl)	2019/07/17	95	75 - 125	101	80 - 120	<0.050	ug/g	15	30
6225549	Acid Extractable Uranium (U)	2019/07/17	100	75 - 125	101	80 - 120	<0.050	ug/g	17	30
6225549	Acid Extractable Vanadium (V)	2019/07/17	NC	75 - 125	102	80 - 120	<5.0	ug/g	17	30

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6225549	Acid Extractable Zinc (Zn)	2019/07/17	NC	75 - 125	101	80 - 120	<5.0	ug/g	12	30
6225698	Hot Water Ext. Boron (B)	2019/07/15	99	75 - 125	100	75 - 125	<0.050	ug/g	1.9	40
6227085	Chromium (VI)	2019/07/16	42 (1)	70 - 130	94	80 - 120	<0.2	ug/g	NC	35
6228065	Available (CaCl2) pH	2019/07/15			100	97 - 103			0.58	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) The matrix spike recovery was below the lower control limit. This may be due in part to the reducing environment of the sample. The matrix spike was reanalyzed to confirm result.

FUNDAMENTAL LABORATORY ACCEPTANCE GUIDELINE

BV Labs Job #:	B9J0302
Date Received:	2019/07/10
Your C.O.C. #:	62016
Your Project #:	224078
BV Labs Project Manager:	Antonella Brasil
Quote #:	A70927

Invoice To:
Pinchin Ltd
ATTN: Accounts Payable
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5
Client Contact:
Tim McBride

No discrepancies noted.

Report Comments

Received Date:	2019/07/10	**Time:**	08:50	**By:**	
Inspected Date:		**Time:**		**By:**	
FLAG Created Date:		**Time:**		**By:**	

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Eva P

CHARTERED
Eva Pranjic
CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 62016

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)	
Company Name:	Pinchin Ltd.	Company Name:		Quotation #:	
Contact Name:	Tim McBride	Contact Name:		P.O. #/ AFE#:	
Address:	951 Cambrian Heights Dr. Suite 203	Address:		Project #:	224078
				Site Location:	Whitefish Lk FN
Phone:	Fax:	Phone:	Fax:	Site #:	
Email:	tmcbride@pinchin.com	Email:	Kmuir@pinchin.com	Sampled By:	Dave Jones

Turnaround Time (TAT) Required

- [X] Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

- [ ] 1 Day
- [ ] 2 Days
- [ ] 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

- [ ] Table 1
- [ ] Res/Park
- [ ] Med/ Fine
- [ ] Table 2
- [X] Ind/Comm
- [ ] Coarse
- [ ] Table 3
- [ ] Agri/ Other
- [ ] Table ____

FOR RSC (PLEASE CIRCLE) Y / (N)

Other Regulations

- [ ] CCME
- [ ] Sanitary Sewer Bylaw
- [ ] MISA
- [ ] Storm Sewer Bylaw
- [ ] PWQO
- Region ____
- [ ] Other (Specify) ____
- [ ] REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / (N)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	pH							HOLD - DO NOT ANALYZE
1	MW3	July 9, 19	2:00PM		3				✓			✓	✓							
2	MW4	July 9, 19	12:00PM		3				✓			✓	✓							
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

REFER TO BACK OF COC

LABORATORY USE ONLY

CUSTODY SEAL Y / (N)		COOLER TEMPERATURES
Present	Intact	
N		6, 7, 6 °C
		1 / 1 / 1

COOLING MEDIA PRESENT: (Y) / N

COMMENTS

10-Jul-19 08:50
Antonella Brasil
B9J0302
SWE ENV-886

Received in Sudbury

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Kathleen Muir K. Muir	2019/07/10	8:30AM	Sudbury Frazier	2019/07/10	8:50	
			Sudbury	2019/07/	09:30	

COC-1004 (10/14) - ENV ENG

Your Project #: 224078
Site Location: WHITEFISH LK.FN
Your C.O.C. #: 127636

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/17
Report #: R5801363
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9J0417
Received: 2019/07/10, 14:40

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Hot Water Extractable Boron	3	2019/07/13	2019/07/15	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum	3	N/A	2019/07/16		EPA 8260C m
Hexavalent Chromium in Soil by IC (1)	3	2019/07/12	2019/07/16	CAM SOP-00436	EPA 3060/7199 m
Strong Acid Leachable Metals by ICPMS	3	2019/07/12	2019/07/17	CAM SOP-00447	EPA 6020B m
Moisture	3	N/A	2019/07/12	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT	3	2019/07/15	2019/07/15	CAM SOP-00413	EPA 9045 D m
Volatile Organic Compounds in Soil	3	N/A	2019/07/12	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
(1) Soils are reported on a dry weight basis unless otherwise specified.

Your Project #: 224078
Site Location: WHITEFISH LK.FN
Your C.O.C. #: 127636

Attention: Tim McBride

Pinchin Ltd
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5

Report Date: 2019/07/17
Report #: R5801363
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9J0417
Received: 2019/07/10, 14:40

Encryption Key

Antonella Brasil
Senior Project Manager
17 Jul 2019 16:23:06

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: Antonella.Brasil@bvlabs.com
Phone# (905)817-5817

==

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BUREAU VERITAS

BV Labs Job #: B9J0417
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KFW417		KFW417		KFW418	KFW419		
Sampling Date		2019/07/10 10:00		2019/07/10 10:00		2019/07/10 11:00	2019/07/10 12:00		
COC Number		127636		127636		127636	127636		
	UNITS	BH1	QC Batch	BH1 Lab-Dup	QC Batch	BH2	BH3	RDL	QC Batch
Inorganics									
Moisture	%	14	6224770	14	6224770	14	16	1.0	6224770
Available (CaCl2) pH	pH	5.55	6228065			5.55	5.32		6228065

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B9J0417
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		KFW417			KFW417			KFW418	KFW419		
Sampling Date		2019/07/10 10:00			2019/07/10 10:00			2019/07/10 11:00	2019/07/10 12:00		
COC Number		127636			127636			127636	127636		
	UNITS	BH1	RDL	QC Batch	BH1 Lab-Dup	RDL	QC Batch	BH2	BH3	RDL	QC Batch
Inorganics											
Chromium (VI)	ug/g	<0.2	0.2	6224630				<0.2	<0.2	0.2	6224630
Metals											
Hot Water Ext. Boron (B)	ug/g	<0.050	0.050	6226900				0.11	0.074	0.050	6226900
Acid Extractable Antimony (Sb)	ug/g	<0.20	0.20	6226049	<0.20	0.20	6226049	<0.20	<0.20	0.20	6226049
Acid Extractable Arsenic (As)	ug/g	2.1	1.0	6226049	2.1	1.0	6226049	2.1	1.9	1.0	6226049
Acid Extractable Barium (Ba)	ug/g	35	0.50	6226049	36	0.50	6226049	27	27	0.50	6226049
Acid Extractable Beryllium (Be)	ug/g	<0.20	0.20	6226049	<0.20	0.20	6226049	<0.20	<0.20	0.20	6226049
Acid Extractable Boron (B)	ug/g	<5.0	5.0	6226049	<5.0	5.0	6226049	<5.0	<5.0	5.0	6226049
Acid Extractable Cadmium (Cd)	ug/g	<0.10	0.10	6226049	<0.10	0.10	6226049	<0.10	<0.10	0.10	6226049
Acid Extractable Chromium (Cr)	ug/g	23	1.0	6226049	23	1.0	6226049	20	18	1.0	6226049
Acid Extractable Cobalt (Co)	ug/g	5.7	0.10	6226049	5.8	0.10	6226049	5.1	5.2	0.10	6226049
Acid Extractable Copper (Cu)	ug/g	16	0.50	6226049	16	0.50	6226049	19	15	0.50	6226049
Acid Extractable Lead (Pb)	ug/g	3.9	1.0	6226049	3.9	1.0	6226049	2.9	2.8	1.0	6226049
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.50	6226049	<0.50	0.50	6226049	<0.50	<0.50	0.50	6226049
Acid Extractable Nickel (Ni)	ug/g	15	0.50	6226049	15	0.50	6226049	13	12	0.50	6226049
Acid Extractable Selenium (Se)	ug/g	<0.50	0.50	6226049	<0.50	0.50	6226049	<0.50	<0.50	0.50	6226049
Acid Extractable Silver (Ag)	ug/g	<0.20	0.20	6226049	<0.20	0.20	6226049	<0.20	<0.20	0.20	6226049
Acid Extractable Thallium (Tl)	ug/g	<0.050	0.050	6226049	<0.050	0.050	6226049	<0.050	<0.050	0.050	6226049
Acid Extractable Uranium (U)	ug/g	0.56	0.050	6226049	0.55	0.050	6226049	0.67	0.41	0.050	6226049
Acid Extractable Vanadium (V)	ug/g	22	5.0	6226049	23	5.0	6226049	21	21	5.0	6226049
Acid Extractable Zinc (Zn)	ug/g	32	5.0	6226049	32	5.0	6226049	16	13	5.0	6226049
Acid Extractable Mercury (Hg)	ug/g	<0.050	0.050	6226049	<0.050	0.050	6226049	<0.050	<0.050	0.050	6226049

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www bvlabs com

BV Labs Job #: B9J0417
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KFW417	KFW418	KFW419		
Sampling Date		2019/07/10 10:00	2019/07/10 11:00	2019/07/10 12:00		
COC Number		127636	127636	127636		
	UNITS	**BH1**	**BH2**	**BH3**	**RDL**	**QC Batch**
Calculated Parameters						
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	<0.050	<0.050	0.050	6222683
Volatile Organics						
Acetone (2-Propanone)	ug/g	<0.50	<0.50	<0.50	0.50	6224773
Benzene	ug/g	<0.020	<0.020	<0.020	0.020	6224773
Bromodichloromethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Bromoform	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Bromomethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Carbon Tetrachloride	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Chlorobenzene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Chloroform	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Dibromochloromethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,2-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,3-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,4-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,1-Dichloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,2-Dichloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,1-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
cis-1,2-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
trans-1,2-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,2-Dichloropropane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
cis-1,3-Dichloropropene	ug/g	<0.030	<0.030	<0.030	0.030	6224773
trans-1,3-Dichloropropene	ug/g	<0.040	<0.040	<0.040	0.040	6224773
Ethylbenzene	ug/g	<0.020	<0.020	<0.020	0.020	6224773
Ethylene Dibromide	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Hexane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Methylene Chloride(Dichloromethane)	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	<0.50	<0.50	0.50	6224773
Methyl Isobutyl Ketone	ug/g	<0.50	<0.50	<0.50	0.50	6224773
Methyl t-butyl ether (MTBE)	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Styrene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,1,1,2-Tetrachloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,1,2,2-Tetrachloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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VOLATILE ORGANICS BY GC/MS (SOIL)

BV Labs ID		KFW417	KFW418	KFW419		
Sampling Date		2019/07/10 10:00	2019/07/10 11:00	2019/07/10 12:00		
COC Number		127636	127636	127636		
	UNITS	**BH1**	**BH2**	**BH3**	**RDL**	**QC Batch**
Tetrachloroethylene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Toluene	ug/g	<0.020	<0.020	<0.020	0.020	6224773
1,1,1-Trichloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
1,1,2-Trichloroethane	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Trichloroethylene	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	<0.050	<0.050	0.050	6224773
Vinyl Chloride	ug/g	<0.020	<0.020	<0.020	0.020	6224773
p+m-Xylene	ug/g	<0.020	<0.020	<0.020	0.020	6224773
o-Xylene	ug/g	<0.020	<0.020	<0.020	0.020	6224773
Total Xylenes	ug/g	<0.020	<0.020	<0.020	0.020	6224773
Surrogate Recovery (%)						
4-Bromofluorobenzene	%	98	100	100		6224773
D10-o-Xylene	%	111	117	109		6224773
D4-1,2-Dichloroethane	%	93	94	94		6224773
D8-Toluene	%	99	100	100		6224773

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BUREAU VERITAS

BV Labs Job #: B9J0417
Report Date: 2019/07/17

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

TEST SUMMARY

BV Labs ID: KFW417
Sample ID: BH1
Matrix: Soil

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6226900	2019/07/13	2019/07/15	Suban Kanapathippllai
1,3-Dichloropropene Sum	CALC	6222683	N/A	2019/07/16	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6224630	2019/07/12	2019/07/16	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6226049	2019/07/12	2019/07/17	Viviana Canzonieri
Moisture	BAL	6224770	N/A	2019/07/12	Amitoj Singh Uppal
pH CaCl2 EXTRACT	AT	6228065	2019/07/15	2019/07/15	Neil Dassanayake
Volatile Organic Compounds in Soil	GC/MS	6224773	N/A	2019/07/12	Chandni Khawas

BV Labs ID: KFW417 Dup
Sample ID: BH1
Matrix: Soil

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	6226049	2019/07/12	2019/07/17	Viviana Canzonieri
Moisture	BAL	6224770	N/A	2019/07/12	Amitoj Singh Uppal

BV Labs ID: KFW418
Sample ID: BH2
Matrix: Soil

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6226900	2019/07/13	2019/07/15	Suban Kanapathippllai
1,3-Dichloropropene Sum	CALC	6222683	N/A	2019/07/16	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6224630	2019/07/12	2019/07/16	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6226049	2019/07/12	2019/07/17	Viviana Canzonieri
Moisture	BAL	6224770	N/A	2019/07/12	Amitoj Singh Uppal
pH CaCl2 EXTRACT	AT	6228065	2019/07/15	2019/07/15	Neil Dassanayake
Volatile Organic Compounds in Soil	GC/MS	6224773	N/A	2019/07/12	Chandni Khawas

BV Labs ID: KFW419
Sample ID: BH3
Matrix: Soil

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6226900	2019/07/13	2019/07/15	Suban Kanapathippllai
1,3-Dichloropropene Sum	CALC	6222683	N/A	2019/07/16	Automated Statchk
Hexavalent Chromium in Soil by IC	IC/SPEC	6224630	2019/07/12	2019/07/16	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6226049	2019/07/12	2019/07/17	Viviana Canzonieri
Moisture	BAL	6224770	N/A	2019/07/12	Amitoj Singh Uppal
pH CaCl2 EXTRACT	AT	6228065	2019/07/15	2019/07/15	Neil Dassanayake
Volatile Organic Compounds in Soil	GC/MS	6224773	N/A	2019/07/12	Chandni Khawas

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	17.0°C

Results relate only to the items tested.

BV Labs Job #: B9J0417
Report Date: 2019/07/17

QUALITY ASSURANCE REPORT

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6224773	4-Bromofluorobenzene	2019/07/12	104	60 - 140	104	60 - 140	101	%		
6224773	D10-o-Xylene	2019/07/12	112	60 - 130	92	60 - 130	92	%		
6224773	D4-1,2-Dichloroethane	2019/07/12	85	60 - 140	101	60 - 140	100	%		
6224773	D8-Toluene	2019/07/12	105	60 - 140	101	60 - 140	94	%		
6224630	Chromium (VI)	2019/07/16	81	70 - 130	91	80 - 120	<0.2	ug/g	NC	35
6224770	Moisture	2019/07/12							4.3	20
6224773	1,1,1,2-Tetrachloroethane	2019/07/13	92	60 - 140	101	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,1-Trichloroethane	2019/07/13	87	60 - 140	95	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,2,2-Tetrachloroethane	2019/07/13	84	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	1,1,2-Trichloroethane	2019/07/13	85	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6224773	1,1-Dichloroethane	2019/07/13	81	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	1,1-Dichloroethylene	2019/07/13	93	60 - 140	99	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichlorobenzene	2019/07/13	87	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichloroethane	2019/07/13	82	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	1,2-Dichloropropane	2019/07/13	78	60 - 140	88	60 - 130	<0.050	ug/g	NC	50
6224773	1,3-Dichlorobenzene	2019/07/13	93	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	1,4-Dichlorobenzene	2019/07/13	97	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	Acetone (2-Propanone)	2019/07/13	78	60 - 140	93	60 - 140	<0.50	ug/g	NC	50
6224773	Benzene	2019/07/13	85	60 - 140	94	60 - 130	<0.020	ug/g	4.0	50
6224773	Bromodichloromethane	2019/07/13	80	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	Bromoform	2019/07/13	90	60 - 140	106	60 - 130	<0.050	ug/g	NC	50
6224773	Bromomethane	2019/07/13	113	60 - 140	127	60 - 140	<0.050	ug/g	NC	50
6224773	Carbon Tetrachloride	2019/07/13	87	60 - 140	94	60 - 130	<0.050	ug/g	NC	50
6224773	Chlorobenzene	2019/07/13	88	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	Chloroform	2019/07/13	81	60 - 140	91	60 - 130	<0.050	ug/g	NC	50
6224773	cis-1,2-Dichloroethylene	2019/07/13	80	60 - 140	90	60 - 130	<0.050	ug/g	NC	50
6224773	cis-1,3-Dichloropropene	2019/07/13	88	60 - 140	98	60 - 130	<0.030	ug/g	NC	50
6224773	Dibromochloromethane	2019/07/13	91	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	Dichlorodifluoromethane (FREON 12)	2019/07/13	85	60 - 140	91	60 - 140	<0.050	ug/g	NC	50
6224773	Ethylbenzene	2019/07/13	NC	60 - 140	91	60 - 130	<0.020	ug/g	4.6	50
6224773	Ethylene Dibromide	2019/07/13	88	60 - 140	101	60 - 130	<0.050	ug/g	NC	50
6224773	Hexane	2019/07/13	NC	60 - 140	99	60 - 130	<0.050	ug/g	2.7	50

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QUALITY ASSURANCE REPORT(CONT'D)

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6224773	Methyl Ethyl Ketone (2-Butanone)	2019/07/13	77	60 - 140	96	60 - 140	<0.50	ug/g	NC	50
6224773	Methyl Isobutyl Ketone	2019/07/13	81	60 - 140	100	60 - 130	<0.50	ug/g	NC	50
6224773	Methyl t-butyl ether (MTBE)	2019/07/13	80	60 - 140	89	60 - 130	<0.050	ug/g	NC	50
6224773	Methylene Chloride(Dichloromethane)	2019/07/13	76	60 - 140	88	60 - 130	<0.050	ug/g	NC	50
6224773	o-Xylene	2019/07/13	96	60 - 140	94	60 - 130	<0.020	ug/g	5.0	50
6224773	p+m-Xylene	2019/07/13	NC	60 - 140	98	60 - 130	<0.020	ug/g	4.8	50
6224773	Styrene	2019/07/13	95	60 - 140	97	60 - 130	<0.050	ug/g	NC	50
6224773	Tetrachloroethylene	2019/07/13	90	60 - 140	93	60 - 130	<0.050	ug/g	NC	50
6224773	Toluene	2019/07/13	89	60 - 140	90	60 - 130	<0.020	ug/g	4.7	50
6224773	Total Xylenes	2019/07/13					<0.020	ug/g	4.8	50
6224773	trans-1,2-Dichloroethylene	2019/07/13	87	60 - 140	95	60 - 130	<0.050	ug/g	NC	50
6224773	trans-1,3-Dichloropropene	2019/07/13	94	60 - 140	103	60 - 130	<0.040	ug/g	NC	50
6224773	Trichloroethylene	2019/07/13	90	60 - 140	98	60 - 130	<0.050	ug/g	NC	50
6224773	Trichlorofluoromethane (FREON 11)	2019/07/13	96	60 - 140	103	60 - 130	<0.050	ug/g	NC	50
6224773	Vinyl Chloride	2019/07/13	87	60 - 140	95	60 - 130	<0.020	ug/g	NC	50
6226049	Acid Extractable Antimony (Sb)	2019/07/17	86	75 - 125	103	80 - 120	<0.20	ug/g	NC	30
6226049	Acid Extractable Arsenic (As)	2019/07/17	96	75 - 125	100	80 - 120	<1.0	ug/g	2.6	30
6226049	Acid Extractable Barium (Ba)	2019/07/17	NC	75 - 125	95	80 - 120	<0.50	ug/g	2.9	30
6226049	Acid Extractable Beryllium (Be)	2019/07/17	92	75 - 125	94	80 - 120	<0.20	ug/g	NC	30
6226049	Acid Extractable Boron (B)	2019/07/17	90	75 - 125	95	80 - 120	<5.0	ug/g	NC	30
6226049	Acid Extractable Cadmium (Cd)	2019/07/17	95	75 - 125	99	80 - 120	<0.10	ug/g	NC	30
6226049	Acid Extractable Chromium (Cr)	2019/07/17	96	75 - 125	101	80 - 120	<1.0	ug/g	1.5	30
6226049	Acid Extractable Cobalt (Co)	2019/07/17	96	75 - 125	102	80 - 120	<0.10	ug/g	2.8	30
6226049	Acid Extractable Copper (Cu)	2019/07/17	94	75 - 125	100	80 - 120	<0.50	ug/g	1.6	30
6226049	Acid Extractable Lead (Pb)	2019/07/17	93	75 - 125	103	80 - 120	<1.0	ug/g	0.76	30
6226049	Acid Extractable Mercury (Hg)	2019/07/17	98	75 - 125	110	80 - 120	<0.050	ug/g	NC	30
6226049	Acid Extractable Molybdenum (Mo)	2019/07/17	95	75 - 125	102	80 - 120	<0.50	ug/g	NC	30
6226049	Acid Extractable Nickel (Ni)	2019/07/17	95	75 - 125	102	80 - 120	<0.50	ug/g	3.7	30
6226049	Acid Extractable Selenium (Se)	2019/07/17	96	75 - 125	103	80 - 120	<0.50	ug/g	NC	30
6226049	Acid Extractable Silver (Ag)	2019/07/17	96	75 - 125	102	80 - 120	<0.20	ug/g	NC	30
6226049	Acid Extractable Thallium (Tl)	2019/07/17	94	75 - 125	102	80 - 120	<0.050	ug/g	NC	30
6226049	Acid Extractable Uranium (U)	2019/07/17	96	75 - 125	104	80 - 120	<0.050	ug/g	3.1	30

BV Labs Job #: B9J0417
Report Date: 2019/07/17

QUALITY ASSURANCE REPORT(CONT'D)

Pinchin Ltd
Client Project #: 224078
Site Location: WHITEFISH LK.FN
Sampler Initials: DJ

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6226049	Acid Extractable Vanadium (V)	2019/07/17	95	75 - 125	103	80 - 120	<5.0	ug/g	2.6	30
6226049	Acid Extractable Zinc (Zn)	2019/07/17	NC	75 - 125	100	80 - 120	<5.0	ug/g	1.2	30
6226900	Hot Water Ext. Boron (B)	2019/07/15	103	75 - 125	103	75 - 125	<0.050	ug/g	3.7	40
6228065	Available (CaCl2) pH	2019/07/15			100	97 - 103			0.58	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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BUREAU VERITAS

FUNDAMENTAL LABORATORY ACCEPTANCE GUIDELINE

BV Labs Job #:	B9J0417
Date Received:	2019/07/10
Your C.O.C. #:	127636
Your Project #:	224078
BV Labs Project Manager:	Antonella Brasil
Quote #:	A70927

Invoice To:
Pinchin Ltd
ATTN: Accounts Payable
957 Cambrian Heights Drive
Suite 203
Sudbury, ON
CANADA P3C 5S5
Client Contact:
Tim McBride

No discrepancies noted.

Report Comments

Received Date:	2019/07/10	**Time:**	14:40	**By:**	
Inspected Date:		**Time:**		**By:**	
FLAG Created Date:		**Time:**		**By:**	

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Eva Pranjic CHARTERED CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/4

CHAIN OF CUSTODY RECORD 127636

Page ___ of ___

Invoice Information

Company Name: Pinchin
Contact Name: Tim McBride
Address: 957 Cambrian Htr. Drive. Suite 203
Phone: Fax:
Email: tmcbride@pinchin.com

Report Information (if differs from invoice)

Company Name:
Contact Name:
Address:
Phone: Fax:
Email: Kmurr@pinchin.com

Project Information (where applicable)

Quotation #:
P.O. #/ AFE#:
Project #: 224078
Site Location: Whitefish Lk. FN
Site #:
Site Location Province:
Sampled By: Dave Jones

Turnaround Time (TAT) Required

[X] Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
[ ] 1 Day [ ] 2 Days [ ] 3-4 Days

Date Required:
Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

[ ] Table 1 [ ] Res/Park [ ] Med/ Fine
[ ] Table 2 [X] Ind/Comm [ ] Coarse
[ ] Table 3 [ ] Agri/ Other
[ ] Table ___
FOR RSC (PLEASE CIRCLE) Y (N)

Other Regulations

[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] MISA [ ] Storm Sewer Bylaw
[ ] PWQO Region ______
[ ] Other (Specify) ______
[ ] REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: (Y) / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PH							HOLD- DO NOT ANALYZE
1	BH1	2019/07/10	10:00	Soil	3				X			X	X							
2	BH2	2019/07/10	11:00	Soil	3				X			X	X							
3	BH3	2019/07/10	12:00	Soil	3				X			X	X							
4																				
5																				
6																				
7																				
8																				
9																				
10																				

LABORATORY USE ONLY

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COC-1004 (01/19)

APPENDIX V

Standard Operating Procedures

SOP – EDR008 – REV005 – MONITORING WELL SAMPLING

Title:	Monitoring Well Sampling
Practice:	EDR
First Effective Date:	November 8, 2013
Version:	005
Version Date:	January 3, 2018
Author:	Robert MacKenzie
Authorized by:	Robert MacKenzie
Signature:	Rob MacKenzie

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MEMBER OF
THE PINCHIN GROUP

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MEMBER OF THE PINCHIN GROUP

1.0 VERSION HISTORY

Version	Date	Summary of Changes	Author
Original	November 08, 2013	N/A	RM
001	September 25, 2015	Incorporated procedures specific to Pinchin West into SOP	RM
002	February 9, 2016	Revised overall procedure to be consistent with well development SOP/Added reference to revised well development field forms	RM
003	April 29, 2016	Updated Section 4.0	RM
004	April 28, 2017	Removed reference to Pinchin West	RM
005	January 3, 2018	Changed “submersible” to “centrifugal” throughout	RM

2.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the standard procedures for groundwater monitoring well purging and sampling, and provides a description of the equipment required and field methods.

Note that this SOP pertains to monitoring well sampling using the “well volume” purging procedure. Groundwater monitoring well purging and sampling using low flow procedures is described in SOP-EDR023.

3.0 OVERVIEW

Groundwater sampling involves two main steps: well purging followed by sample collection. All groundwater monitoring wells must be purged prior to groundwater sampling to remove groundwater that may have been chemically altered while residing in the well so that groundwater samples representative of actual groundwater quality within the formation intersected by the well screen can be obtained.

Monitoring well sampling should not be completed until at least 24 hours have elapsed following monitoring well development to allow subsurface conditions to equilibrate. Any deviation from this procedure must be discussed with the Project Manager before proceeding.

4.0 DISTRIBUTION

This is an on-line document. Paper copies are valid only on the day they are printed. Refer to the author if you are in any doubt about the accuracy of this document.

This SOP will be distributed to all Pinchin staff and others as follows:

- Posted to the SOP section of the Environmental Due Diligence and Remediation (EDR) Practice Line on the Pinchin Orchard; and
- Distributed to senior staff at Le Groupe Gesfor Poirier and Pinchin LeBlanc for distribution as appropriate.

5.0 PROCEDURE

5.1 Equipment and Supplies

5.1.1 Documents and Information Gathering

- A copy of the proposal or work plan;
- Monitoring well construction details (borehole logs, well construction summary table from a previous report or well installation field notes);
- A copy of this SOP;
- A site-specific Health and Safety Plan (as per the project requirements); and
- Client or site representative's contact details.

5.1.2 Well Purging and Sampling Equipment

- Inertial pump (e.g., Waterra tubing and foot valve) (Optional depending on jurisdiction);
- Peristaltic pump (Optional depending on the parameters being sampled);
- Centrifugal or bladder pump (Optional depending on jurisdiction and well depth);
- Disposable bailer (Optional);
- Graduated pail (to contain purge water and permit the volume of groundwater purged to be tracked);
- Pails or drums for purge water storage prior to disposal;
- Well keys (if wells are locked);
- Tools to open monitoring well (T-bar, socket set, Allen keys, etc.);
- Interface probe;
- Equipment cleaning supplies (see SOP-EDR009);
- Disposable latex or nitrile gloves; and
- Field forms.

5.2 Purging Procedures

The well purging procedure employed will be determined by the hydraulic conductivity of the formation in which the groundwater monitoring well is installed. For this SOP, a high yield well is defined as a well that cannot be purged to dryness when pumping continuously at a rate of up to 2 litres per minute (L/min) and a low yield well is defined as a well that can be purged to dryness when pumping continuously at a rate of 2 L/min or less. This threshold represents a "normal" pumping rate when hand pumping with an inertial pump.

5.2.1 Purging of High Yield Wells

The procedure for purging a high yield monitoring well is as follows:

1. Decontaminate all non-dedicated monitoring and sampling equipment that will be used, including the interface probe and centrifugal or bladder pump (if used), in accordance with the procedures described in SOP-EDR009;
2. Review the well construction details provided in the borehole logs, previous field notes or well construction summary table from a previous report. Determine the well depth, well stick up, screen length, depth to top of sand pack and diameter of the borehole annulus. If the well depth is unavailable, measure it with the interface probe;
3. Measure the initial water level (i.e., static water level) from the reference point on the well (which should be marked at the top of the well pipe) with an interface probe. If measurable free-phase product is present on the water table, record the depth to the top of the free-phase product and the depth to the free-phase product/water boundary (i.e., water level), and discuss this with the Project Manager before proceeding further;
4. Calculate the well volume. **Note that for the purpose of this SOP, there are two definitions of well volume depending on the province in which the project is being conducted.** For Ontario and Manitoba, the well volume is defined as the volume of water within the wetted length of the well pipe (well pipe volume) plus the volume of water within the wetted length of the sand pack (sand pack volume). For British Columbia, Alberta and Saskatchewan, the well volume is defined as the volume of water within the wetted length of the well pipe (well pipe volume) only.

   The volume of water in the well pipe is calculated as follows:

   Well Pipe Volume (litres) = $h_w \times \pi r_w^2 \times$ 1,000 litres per cubic metre (L/m^3)

   Where $\pi = 3.14$

   h_w = the height of the water column in the monitoring well in metres (wetted length)

   r_w = the radius of the monitoring well in metres (i.e., half the interior diameter of the well)

The volume of the sand pack in the monitoring well is calculated as follows:

Sand Pack Volume (litres) = h_w x [(0.3 π r_b^2 x 1,000 L/m^3) – (0.3 π r_w^2 x 1,000 L/m^3)]

Where 0.3 = the assumed porosity of the sand pack

h_w = the height of the water column in the monitoring well in metres (wetted length)

π = 3.14

r_b = the radius of the borehole annulus in metres

r_w = the radius of the monitoring well in metres

For Ontario and Manitoba projects, the following table provides well volumes in litres/metre for typical well installations:

Borehole Annulus Diameter (Inches/Metres)	Well Interior Diameter (Inches)	Well Pipe Volume (Litres/Metre)*	Well Volume (Litres/Metre)*
4/0.1	1.25	0.8	2.9
	1.5	1.1	3.2
	2	2.0	3.8
6/0.15	1.25	0.8	5.9
	1.5	1.1	6.1
	2	2.0	6.7
8.25/0.21	1.5	1.1	11.2
	2	2.0	11.8
10.25/0.26	1.5	1.1	16.7
	2	2.0	17.3

* Litres to be removed per metre of standing water in the well (wetted length).

If the borehole annulus and well interior diameters match one of those listed above, to determine the volume of one well volume simply multiply the number in the last column of the table by the wetted length in the well. For example, if a 2-inch diameter well installed in a 8.25-inch diameter borehole has 2.2 metres of standing water, one well volume equals 26.0 litres (2.2 metres x 11.8 litres/metre).

Note that the above well volume calculations apply only to wells where the water level in the well is below the top of the sand pack. If the water level is above the top of the sand pack, then the well volume is the volume of water in the sand pack and well pipe within the sand pack interval, plus the volume of water in the well pipe (i.e., well pipe volume) above the top of the sand pack. For example, assume a 2-inch diameter well has been installed in a 8.25-inch diameter borehole to a depth of 6.0 metres below ground surface (mbgs), with a 3.05 metre long screen. The sand pack extends from 6.0 mbgs to 2.5 mbgs and the water level is at 1.85 mbgs. One well volume equals ([6.0 metres – 2.5 metres] x 11.8 litres/metre) + ([2.5 metres – 1.85 metres] x 2.0 litres/metre) or 42.6 litres.

For British Columbia, Alberta and Saskatchewan projects, the well volume is calculated using the conversion factor listed in the third column of the above table. For example, if there are 2.5 metres of standing water in a 1.5-inch diameter well, one well volume equals 2.75 litres (2.5 metres x 1.1 litres/metre);

5. Lower the pump intake into the well until it is approximately 0.3 metres above the bottom of the well. Remove half a well volume while pumping at a rate of approximately 1 to 2 L/min. Record the approximate purge volume, pump intake depth and pertinent visual/olfactory observations (e.g., sheen, odour, free-phase product, sediment content, clarity, colour, etc.);
6. Move the pump intake upward to the middle of the water column (or middle of the screened interval if the water level in the well is above the top of the screen). Remove half a well volume (for a cumulative total of 1 well volume) while pumping at a rate of approximately 1 to 2 L/min. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations;
7. Move the pump intake upward to near the top of the screened interval (or near the top of the water column if the water level is currently below the top of the screen). Remove half a well volume (for a cumulative total of 1.5 well volumes) while pumping at a rate of approximately 1 to 2 L/min. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations.
   Note that if the wetted length is short within a well (e.g., 1.5 metres or less), there will not be enough separation between pump intake depths to warrant pumping from three depths (i.e., near the bottom, middle and top of the water column). In this case, pumping from two depths (i.e., near the bottom and top of the water column) is sufficient;
8. Repeat steps 5 through 7 until a minimum of 3 well volumes in total have been removed. If the purge water contains high sediment content after the removal of 3 well volumes, well purging should continue by removing additional well volumes until the sediment content visibly decreases. If the purge water continues to have high sediment content after the removal of 2 additional well volumes (i.e., 5 well volumes in total), contact the Project Manager to discuss whether well purging should continue; and

9. Proceed with groundwater sample collection (see below).

Note that the use of a bailer to purge a high yield well with a wetted interval greater than 2 metres is not recommended given that the depth from which groundwater is removed is difficult to control.

5.2.2 Purging of Low Yield Wells

The procedure for purging a low yield monitoring well is as follows:

1. Decontaminate all non-dedicated monitoring and sampling equipment that will be used, including the interface probe and centrifugal or bladder pump (if used), in accordance with the procedures described in SOP-EDR009;
2. Review the well construction details provided in the borehole logs, previous field notes or well construction summary table from a previous report. Determine the well depth, well stick up, screen length, depth to top of sand pack and diameter of the borehole annulus. If the well depth is unavailable, measure it with the interface probe;
3. Measure the initial water level (i.e., static water level) from the reference point on the well (which should be marked at the top of the well pipe) with an interface probe. If measurable free-phase product is present on the water table, record the depth to the top of the free-phase product and the depth to the free-phase product/water boundary (i.e., water level), and discuss this with the Project Manager before proceeding further;
4. Position the pump intake at the bottom of the well. Purge the well to dryness at a rate of between approximately 1 and 2 litres L/min. At the conclusion of purging, drain the pump tubing if possible. Record the approximate purge volume;
5. After allowing sufficient time for the well to recover, proceed with sample collection (see below). Note that wherever possible, the well should be allowed to recover to at least 90% recovery before proceeding with sample collection. However, if recovery to this level requires more than one hour to complete, it is better to sample the well as soon as it recovers sufficiently to permit sampling, especially if samples are being collected for volatile parameters such as volatile organic compounds (VOCs) and petroleum hydrocarbons (PHCs) (F1); and
6. Record the water levels, time of water level measurements and well status (e.g., well recovery incomplete, 90% recovery target met) on the field form to document the well recovery. Purging of wells at the end of a day and returning to the site the following day to collect samples is not permitted unless the well recovery is so poor that this amount of time is needed for there to be sufficient recovery to permit sample collection.

Note that bailers can be used in lieu of a pump to purge a low yield well provided that the well yield is low enough to permit the draining of all of the groundwater in the well with the bailer.

5.3 Well Purging Record

Well purging prior to sampling is to be documented through the completion in full of the following field forms located in the Pinchin Orchard:

- EDR-GW-Well Sampling-Low Yield Well; or
- EDR-GW-Well Sampling-High Yield Well.

Any deviations from this SOP along with the rationale for these deviations must be recorded on the forms.

5.4 Sample Collection

5.4.1 General Considerations

Inertial pumps are generally suitable for all sample collection for due diligence projects. However, the motion of the inertial pump in the water column of a well, even when pumping at a low rate, can create turbulence in the well that can suspend sediment already in the well or draw it in from the formation. Sediment captured in a sample can often result in positive bias to the analytical results, especially for the parameters PHCs (F3 and F4) and polycyclic aromatic hydrocarbons (PAHs), resulting in "false positives" that are not representative of actual groundwater quality. Sampling for these parameters following low flow purging and sampling procedures (SOP-EDR023) is an acceptable option to minimize potential sediment bias but because it is more expensive and time consuming than "conventional" sampling, it is typically not completed for due diligence projects. In lieu of low flow purging and sampling, a peristaltic pump, centrifugal pump or bladder pump is to be used as a "grab sampler" when sampling for PHCs (F2-F4) and PAHs.

In Ontario and Manitoba, or where otherwise prohibited by provincial guidance documents, peristaltic pumps must not be used to collect samples for analysis of volatile parameters, namely VOCs and PHCs (F1). As such, if the suite of parameters to be sampled at a given well includes VOCs and/or PHCs (F1), a "hybrid" sampling procedure is to be followed, in which samples for VOCs, PHCs (F1), PCBs and/or metals analysis are to be collected using an inertial pump and samples for PHCs (F2-F4) and PAHs analysis are to be collected using a peristaltic pump. Alternatively, the entire suite of parameters can be collected using a centrifugal or bladder pump.

The following table summarizes the pump types, parameters that can be sampled using each pump and how the well volume is determined for each province:

Jurisdiction	Pump Type	Parameters	Well Volume
BC	Inertial Pump	All Parameters	Well Pipe Volume
	Peristaltic Pump	All Parameters	Well Pipe Volume

Jurisdiction	**Pump Type**	**Parameters**	**Well Volume**
Alberta/Saskatchewan	Inertial Pump	All Parameters Except PHCs (F2) and PAHs	Well Pipe Volume
	Peristaltic Pump	PHCs (F2) and PAHs	Well Pipe Volume
Manitoba/Ontario	Inertial Pump	All Parameters Except PHCs (F2-F4) and PAHs	Well Pipe Volume + Casing Volume
	Peristaltic Pump	PHCs (F2-F4) and PAHs	
All Provinces	Centrifugal Pump	All Parameters	As Per Above
All Provinces	Bladder Pump	All Parameters	As Per Above

Bailers should not be used for sample collection unless there is no other option (e.g., when there is minimal groundwater in a well). They can be used as a substitute for an inertial pump but may bias concentrations of volatile parameters low and concentrations of PHCs (F2-F4) and PAHs high. The use of a bailer for groundwater sample collection must be approved by the Project Manager.

There is a common misconception that using a peristaltic pump, centrifugal pump or bladder pump and sampling at a low pumping rate is "low flow sampling". Sampling in this manner is essentially "grab sampling" using a device other than an inertial pump and is not "low flow sampling". Only if groundwater sampling was completed in accordance with SOP-EDR023 can the sampling be referred to as "low flow sampling".

5.4.2 Sampling of High and Low Yield Wells

The procedure for collecting groundwater samples from a high or low yield monitoring well is as follows:

1. Label the sample containers with the sample identifier, project number and date and time of sample collection. The sample containers for each well are be filled in the following order:
   - Volatiles parameters (e.g., VOCs, PHCs (F1));
   - Semi-volatile parameters (e.g., PHCs (F2-F4), PAHs); and
   - Non-volatile parameters (e.g., inorganic parameters, metals).

   There is an exception to the above sample collection order when using the "hybrid" sampling method. In this case, the semi-volatile parameters (PHCs (F2-F4) and/or PAHs) are to be sampled first using the peristaltic pump, centrifugal pump or bladder pump, followed by sampling volatile parameters and then non-volatile parameters using the inertial pump;

2. Position the pump intake at the approximate middle of the screened interval (or middle of the water column if the water level is below the top of the screen). At the discretion of the Project Manager, the pump intake may be positioned near the top of the water column if light non-aqueous phase liquids (LNAPLs) are being investigated (e.g., gasoline, fuel oil) and at the bottom of the well when dense non-aqueous phase liquids (DNAPLs) (e.g., chlorinated solvents) are being investigated. For a low yield well when the tubing was (or could) not be drained at the conclusion of purging, or when a high yield well is not sampled immediately after purging, pump sufficient water from the tubing before initiating sample collection at a rate of approximately 0.5 L/min to remove any water that was left over in the tubing following purging;
3. When sampling for volatile parameters (i.e., VOCs and PHCs (F1)), pump at a rate of approximately 0.5 L/min. When using an inertial pump, hold the pump vertical while pumping to minimize agitation and possible contaminant volatilization. During volatile parameter sampling, the tubing of the inertial pump must not contain air bubbles. If air bubbles are present, continue pumping until there are no air bubbles in the tubing. Once the tubing is full and free of air bubbles, carefully pour the groundwater from the tubing into the sample vials until they are filled to be headspace-free. When using a peristaltic pump (BC only), centrifugal pump or bladder pump for volatile parameter sampling, the samples can be collected by pumping directly into the sample containers until they are headspace-free. Once filled and capped, check each vial for air bubbles by turning it upside down. If bubbles are present in a vial, reopen it and add additional groundwater until there are no remaining bubbles;
4. When sampling for semi-volatile parameters, pump at a rate of between 0.5 and 1 L/min. The samples can be collected by pumping directly into the sample containers;
5. When sampling for non-volatile parameters, pump at a rate of between 0.5 and 1 L/min. The samples can be collected by pumping directly into the sample containers;
6. Samples collected for dissolved metals analysis are to be filtered in the field using dedicated, disposable 0.45 micron in-line filters or marked to be filtered by the laboratory, except for samples collected in Ontario for methyl mercury analysis which are not to be filtered. Field filtering must occur before samples for metals analysis are preserved. Prior to filling the first sample container using a new filter, the filter is to be “primed” by flushing a volume of water equal to twice the capacity of the filter through the filter. Samples for other parameters are not to be filtered in the field. In situations where field filtering cannot be completed, such as when sampling with a bailer, samples for metals analysis

are to be collected in sample containers without preservatives and the analytical laboratory is to be instructed on the Chain-of-Custody to filter and preserve the samples upon receipt;

7. When collecting samples in containers that are pre-charged with preservatives, care must be taken not to overfill the containers as some of the preservative may be lost which will result in the sample not being properly preserved. Also, sample containers for metals analysis typically have a fill line marked on the container and the container must not be filled to above this line as this will cause dilution of the preservative and the sample may not be properly preserved;
8. Record the parameters sampled for, the purging and sampling equipment used, whether samples for metals analysis were field filtered, and the time and date of sample collection in the field forms; and
9. Immediately following collection, place each sample container in a cooler containing ice bags or ice packs.

5.5 Additional Considerations for O. Reg. 153/04 Phase Two ESA Compliance

Groundwater sampling conducted for a Phase Two ESA completed in accordance Ontario Regulation 153/04 must be completed when well yields permit using the low flow purging and sampling methods provided in SOP-EDR023 unless authorized by the Qualified Person responsible for the Phase Two ESA.

6.0 TRAINING

The Practice Leader is responsible for identifying the initial training needs of EDR staff and ensuring that staff are trained and competent before undertaking work assignments.

All trained personnel are responsible for identifying coaching or re-training needs (if they are uncomfortable with work assignments that have been assigned).

The careful application of *Health & Safety Training* by each employee is an integral part of all activities and is assumed as part of this SOP.

7.0 MAINTENANCE OF SOP

1 Year.

8.0 REFERENCES

Association of Professional Geoscientists of Ontario, "*Guidance for Environmental Site Assessments under Ontario Regulation 153/04 (as amended)",* April 2011.

9.0 APPENDICES

None.

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Template: Master SOP Template – February 2014

PINCHIN

SOP – EDR017 – REV006 – MONITORING WELL DEVELOPMENT

Title:	Monitoring Well Development
Practice:	EDR
First Effective Date:	November 23, 2010
Version:	006
Version Date:	January 3, 2018
Author:	Paresh Patel and Robert MacKenzie
Authorized by:	Robert MacKenzie
Signature:	

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1.0 VERSION HISTORY

Version	Date	Summary of Changes	Author
Original	November 23, 2010	N/A	PDP
001	June 15, 2013	Streamlined background section/Focused procedure on tasks that can be completed by Pinchin personnel/Provided step-by-step summary of field procedure	RLM
002	January 22, 2015	Incorporated procedures specific to Pinchin West into SOP	RLM
003	February 9, 2016	Revised overall procedure to include initial determination of well yield/Added reference to revised well development field forms/Provided guidance on assessing field parameter stabilization when developing wells where water or air were used during drilling	RLM
004	April 29, 2016	Updated Section 4.0	RLM
005	April 28, 2017	Removed references to Pinchin West	RLM
006	January 3, 2018	Modified Section 3.0 to allow well development to occur immediately after well installation under certain circumstances.	RLM

2.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the standard procedures for groundwater monitoring well development and provides a description of the equipment required and field methods.

All groundwater monitoring wells are to be developed following installation prior to groundwater sampling or the completion of hydraulic conductivity testing. In addition, previously installed groundwater monitoring wells that have not been purged in over one year should be redeveloped prior to additional sampling or hydraulic conductivity testing if there is evidence of sediment impacting the monitoring well (e.g., the depth to bottom of well measurement indicates sediment accumulation) or at the discretion of the Project Manager.

This SOP pertains to monitoring well development that can be undertaken by Pinchin personnel. Monitoring well development completed by drilling rigs is beyond the scope of this SOP.

3.0 OVERVIEW

The main objective of groundwater monitoring well development is to ensure that groundwater sampled from a well is representative of the groundwater in the formation adjacent to the well and that hydraulic conductivity testing provides data representative of the hydraulic characteristics of the adjacent formation.

The specific goals of well development include the following:

- Rectifying the clogging or smearing of formation materials that may have occurred during drilling of the borehole;
- Retrieving lost drilling fluids;
- Improving well efficiency (i.e., the hydraulic connection between the sand pack and the formation);
- Restoring groundwater properties that may have been altered during the drilling process (e.g., volatilization of volatile parameters due to frictional heating during auger advancement or use of air rotary drilling methods); and
- Grading the filter pack to effectively trap fine particles that may otherwise interfere with water quality analysis.

Monitoring well development should not be completed until at least 24 hours have elapsed following monitoring well installation to permit enough time for the well seal to set up, unless both of the following conditions are met:

- The well seal is entirely above the water table; and
- Surface runoff (e.g., from heavy rainfall or snow melt) is not occurring at the well location at the time of development.

Any deviation from this procedure must be approved by the Project Manager before proceeding.

4.0 DISTRIBUTION

This is an on-line document. Paper copies are valid only on the day they are printed. Refer to the author if you are in any doubt about the accuracy of this document.

This SOP will be distributed to all Pinchin staff and others as follows:

- Posted to the SOP section of the Environmental Due Diligence and Remediation (EDR) Practice Line on the Pinchin Orchard; and
- Distributed to senior staff at Le Groupe Gesfor Poirier and Pinchin LeBlanc for distribution as appropriate.

5.0 PROCEDURE

5.1 Equipment and Supplies

- Inertial pump (e.g., Waterra tubing and foot valve);
- Surge block for use with an inertial pump (Optional);
- Submersible pump (including pump controller and power supply) (Optional);
- Disposable bailer (Optional);
- Graduated pail (to contain purge water and permit the volume of groundwater purged to be tracked);
- Pails or drums for purge water storage prior to disposal;
- Well keys (if wells are locked);
- Tools to open monitoring well (T-bar, socket set, Allen keys, etc.);
- Interface probe;
- Equipment cleaning supplies (see SOP-EDR009);
- Field parameter measurement equipment (see SOP-EDR016) (Optional);
- Disposable nitrile gloves; and
- Field forms.

Pinchin typically employs inertial pumps or bailers for well development because they can be dedicated to each well. However, the use of submersible pumps is a viable alternative for developing deep wells with high well volumes at the discretion of the Project Manager.

5.2 Procedures

The well development procedures employed will be determined by the hydraulic conductivity of the formation in which the groundwater monitoring well is installed. For this SOP, a high yield well is defined as a well that cannot be purged to dryness when pumping continuously at a rate of up to 2 litres per minute (L/min) and a low yield well is defined as a well that can be purged to dryness when pumping continuously at a rate of up to 2 L/min or less. This threshold represents a “normal” pumping rate when hand pumping with an inertial pump.

The initial stage of well development (Stage 1) will apply to all wells and will involve the removal of up to one well volume, followed by an evaluation of the well yield. The procedures followed for Stage 2 of well development will be contingent on whether the well is determined to be a low yield or high yield well.

5.2.1 Well Development for Low and High Yield Wells - Stage 1

The initial procedure for developing a low yield or high yield monitoring well is as follows:

1. Decontaminate all non-dedicated monitoring and pumping equipment that will be used, including the interface probe and submersible pump (if used), in accordance with the procedures described in SOP-EDR009;
2. Review the well construction details provided in the borehole log, previous field notes or well construction summary table from a previous report. Determine the well depth, well stick up, screen length, depth to the top of the sand pack and diameter of the borehole annulus. If the well depth is unavailable, measure it with the interface probe;
3. Measure the initial water level (i.e., static water level) from the reference point on the well (which should be marked at the top of the well pipe) with an interface probe. If measurable free-phase product is present on the water table, record the depth to the top of the free-phase product and the depth to the free-phase product/water boundary (i.e., water level), and discuss this with the Project Manager before proceeding further;
4. Calculate the well volume. **Note that for the purpose of this SOP, there are two definitions of well volume depending on the province in which the project is being conducted.** For Ontario and Manitoba, the well volume is defined as the volume of water within the wetted length of the well pipe (well pipe volume) plus the volume of water within the wetted length of the sand pack (sand pack volume). For British Columbia, Alberta and Saskatchewan, the well volume is defined as the volume of water within the wetted length of the well pipe (well pipe volume) only.

   The volume of water in the well pipe is calculated as follows:

   Well Pipe Volume (litres) = h_w x π r_w^2 x 1,000 litres per cubic metre (L/m^3)

   Where π = 3.14

   h_w = the height of the water column in the monitoring well in metres (wetted length)

   r_w = the radius of the monitoring well in metres (i.e., half the interior diameter of the well)

   The volume of the sand pack in the monitoring well is calculated as follows:

   Sand Pack Volume (litres) = h_w x [(0.3 π r_b^2 x 1,000 L/m^3) – (0.3 π r_w^2 x 1,000 L/m^3)]

   Where 0.3 = the assumed porosity of the sand pack

h_w = the height of the water column in the monitoring well in metres (wetted length)

$\pi = 3.14$

r_b = the radius of the borehole annulus in metres

r_w = the radius of the monitoring well in metres

For Ontario and Manitoba projects, the following table provides well volumes in litres/metre for typical well installations:

Borehole Annulus Diameter (Inches/Metres)	Well Interior Diameter (Inches)	Well Pipe Volume (Litres/Metre)*	Well Volume (Litres/Metre)*
4/0.1	1.25	0.8	2.9
	1.5	1.1	3.2
	2	2.0	3.8
6/0.15	1.25	0.8	5.9
	1.5	1.1	6.1
	2	2.0	6.7
8.25/0.21	1.5	1.1	11.2
	2	2.0	11.8
10.25/0.26	1.5	1.1	16.7
	2	2.0	17.3

* Litres to be removed per metre of standing water in the well (wetted length).

If the borehole annulus and well interior diameters match one of those listed above, to determine the volume of one well volume simply multiply the number in the last column of the table by the wetted length in the well. For example, if a 2-inch diameter well installed in a 8.25-inch diameter borehole has 2.2 metres of standing water, one well volume equals 26.0 litres (2.2 metres x 11.8 litres/metre).

Note that the above well volume calculations apply only to wells where the water level in the well is below the top of the sand pack. If the water level is above the top of the sand pack, then the well volume is the volume of water in the sand pack and well pipe within the sand pack interval, plus the volume of water in the well pipe (i.e., well pipe volume) above the top of the sand pack.

For example, assume a 2-inch diameter well has been installed in a 8.25-inch diameter borehole to a depth of 6.0 metres below ground surface (mbgs), with a 3.05 metre long screen. The sand pack extends from 6.0 mbgs to 2.5 mbgs and the water level is at 1.85 mbgs. One well volume equals ([6.0 metres – 2.5 metres] x 11.8 litres/metre) + ([2.5 metres – 1.85 metres] x 2.0 litres/metre) or 42.6 litres.

For British Columbia, Alberta and Saskatchewan projects, the well volume is calculated using the conversion factor listed in the third column of the above table. For example, if there are 2.5 metres of standing water in a 1.5-inch diameter well, one well volume equals 2.75 litres (2.5 metres x 1.1 litres/metre);

5. Lower the pump into the well until the pump intake is approximately 0.3 metres above the bottom of the well. Remove half a well volume while pumping at a rate of approximately 1 to 2 L/min. Measure the depth to water after the half a well volume is removed. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations (e.g., sheen, odour, free-phase product, sediment content, clarity, colour, etc.); and
6. Move the pump intake upward to the middle of the water column (or middle of the screened interval if the static water level in the well is above the top of the screen). Remove half a well volume (for a cumulative total of 1 well volume) or purge until dry while pumping at a rate of approximately 1 to 2 L/min, whichever occurs first. Measure the depth to water after the half a well volume is removed unless dry. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations. Note that if suction is broken (indicating that drawdown to the pump intake depth has occurred), move the pump intake to the bottom of the well and continue purging.

After completing Step 6, review the water level data to assess whether the well is a low yield or high yield well. If the well is purged dry or close to dryness, or significant drawdown has occurred, then the well is a low yield well. If little or no drawdown has occurred then the well is a high yield well. Some judgement will be required by field personnel when classifying the well yield if moderate drawdown has occurred during removal of the first well volume.

5.2.2 Well Development for High Yield Wells - Stage 2

The procedure for the second stage of developing a high yield monitoring well is as follows:

1. Move the pump intake upward to near the top of the screened interval (or near the top of the water column if the water level is currently below the top of the screen). Remove half a well volume (for a cumulative total of 1.5 well volumes) while pumping at the maximum practical rate that is greater than 2 L/min. Record the approximate purge volume, pump

intake depth and any pertinent visual/olfactory observations (e.g., sheen, odour, free-phase product, sediment content, clarity, colour, etc.);

2. Note that if the wetted length is short within a well (e.g., 1.5 metres or less), there will not be enough separation between pump intake depths to warrant pumping from three depths (i.e., near the bottom, middle and top of the water column). In this case, pumping from two depths (i.e., near the bottom and top of the water column) is sufficient;
3. Lower the pump intake until it is approximately 0.3 metres above the bottom of the well. Remove half a well volume (for a cumulative total of 2 well volumes) while pumping at the maximum practical rate that is greater than 2 L/min. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations;
4. Move the pump intake upward to the middle of the water column (or middle of the screened interval if the water level in the well is above the top of the screen). Remove half a well volume (for a cumulative total of 2.5 well volumes) while pumping at the maximum practical rate that is greater than 2 L/min. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations;
5. Move the pump intake upward to near the top of the screened interval (or near the top of the water column if the water level is currently below the top of the screen). Remove half a well volume (for a cumulative total of 3 well volumes) while pumping at the maximum practical rate that is greater than 2 L/min. Record the approximate purge volume, pump intake depth and any pertinent visual/olfactory observations;
6. If the purge water contains high sediment content after the removal of 3 well volumes, well development should continue by removing additional well volumes following the same procedure as above until the sediment content visibly decreases. If the purge water continues to have high sediment content after the removal of 2 additional well volumes (i.e., 5 well volumes in total), contact the Project Manager to discuss whether well development should continue. A cap of 10 well volumes removed is considered sufficient for high yield well development regardless of sediment content; and
7. Record the water level at the conclusion of well development.

Note that at the discretion of the Project Manager, when developing a monitoring well using an inertial pump, a surge block can be attached to the foot valve before completing Step 1 (i.e., the first time groundwater is pumped from near the top of the screened interval or water column) and then leaving it on the foot valve for the remainder of well development. A surge block is used to increase the turbulence created by pumping and enhance the removal of fine-grained material from the sand pack.

Note that the use of a bailer to develop a high yield well with a wetted interval greater than 2 metres is not recommended given that the depth from which groundwater is removed is difficult to control. However, a bailer can be used as a substitute for a surge block by raising and lowering it through the screened interval for approximately 5 to 10 minutes before the start of Step 1.

5.2.3 Well Development for Low Yield Wells - Stage 2

The procedure for the second stage of developing a low yield monitoring well is as follows:

1. Position the pump intake at the bottom of the well and purge the well to dryness if it was not purged to dryness during completion of Stage 1 at the maximum practical rate that is greater than 2 L/min. Allow sufficient time for the well to recover to at least 90% of the initial static water level or allow the well to recover for a period of time designated by the Project Manager; and
2. Repeat Step 1 until the well has been purged to dryness a minimum of 3 times. An exception to this is that if recovery is slow, and especially if sediment content is low, repeat purging (i.e., purging the well to dryness more than once) may not be necessary and the need for additional purging is to be discussed with the Project Manager. If the purge water contains high sediment content after purging to dryness 3 times, well development should continue by purging the well to dryness until the sediment content visibly decreases. If the purge water continues to have high sediment content after purging the well to dryness 2 additional times (i.e., purging the well to dryness 5 times in total), contact the Project Manager to discuss whether well development should continue. A cap of purging a well to dryness 10 times is considered sufficient for low yield well development regardless of sediment content.

As per the procedure for high yield well development, a surge block can be attached to the foot valve to increase the effectiveness of the pumping action. If a surge block is used, pumping should commence at the top of the water column in the well (instead of near the bottom of the well as described above) with the pump intake progressively lowered as the water level in the well decreases.

Note that bailers can be used in lieu of an inertial pump for the development of a low yield well. The turbulence created in a well by the act of dropping a bailer into it and then removing it full of groundwater can be effective in removing fine-grained material from the sand pack. If a bailer is left in a well, it should be “hung” above the water table to facilitate future water level monitoring.

5.2.4 Removal of Water Lost During Well Installation

When water has been used during well installation (e.g., for bedrock coring, to control heaving sands), the total volume of water required to be purged from a well during development will be equal to 3 times the estimated volume of water lost during drilling plus the volume of water that would normally be removed during well development.

For example, for a high yield well where 25 litres of water were lost during drilling and the well volume is 10 litres, the minimum amount of water to be purged during development is 105 litres (i.e., 3 times the volume of water lost during drilling [75 litres] plus a minimum of 3 well volumes [30 litres]).

For a low yield well, the well will need to be purged to dryness enough times to remove a volume equivalent to 3 times the volume of water lost during drilling plus the volume of water that would normally be removed during well development.

As an alternative to removing 3 times the volume of water lost during drilling, field parameter stabilization during well development can be used to assess whether sufficient water has been removed. For example, the conductivity of drill water (which is usually tap water) is typically much lower than groundwater, and conductivity measurements can act as a guide during development as to whether the water being removed is formation groundwater or drill water.

For assessing field parameter stability when developing a high yield well, field parameter measurements of pH, conductivity, temperature and oxidation-reduction potential are to be made after every half well volume is removed and stability is considered achieved if the field parameters are all within ±10% over 3 consecutive readings. Note that a minimum of 3 well volumes must be removed even if field parameter stabilization is achieved prior to the removal of 3 well volumes to comply with the minimum well purging requirements of this SOP (i.e., removal of a minimum of 3 well volumes from a high yield well).

For assessing field parameter stability when developing a low yield well, field parameter measurements of pH, conductivity, temperature and oxidation-reduction potential are to be made once each time a well is purged to dryness, approximately halfway through purging. For example, if based on the current water level it is estimated that 10 litres will be removed before a well is purged to dryness, the field parameters are to be measured after 5 litres have been removed. Stability is considered achieved if the field parameters are all within ±10% over 3 consecutive readings. After stabilization is achieved, continue to purge the well to dryness a final time at which point development is complete.

A second alternative would be to allow sufficient time for the drill water to dissipate into the formation. The appropriate amount of time will depend on the amount of water lost to the formation and the formation characteristics, but will be a minimum of one week. A Senior Project

Manager or Senior Technical Reviewer will be responsible for determining the suitability of this approach and the required length of time. At the discretion of the Senior Project Manager or Senior Technical Reviewer, field parameter measurements may be made during pre-sampling purging to assess whether the drill water has dissipated by the time of sampling.

Note that it can be difficult to estimate the amount of water lost during drilling. If the driller's water tank is accessible, measure the water levels in the water tank before and after drilling the well and then estimate the volume of water used during drilling using the water tank dimensions and subtract this volume from the volume of water recovered at the end of drilling from this volume to estimate the volume of water lost. If this is not possible, ask the driller to estimate the approximate volume of water lost during drilling.

For some well installations, determining even an approximate volume of water lost during drilling is not possible. In this situation, field parameter stabilization should be used as a guide in deciding how much water to remove during well development.

5.2.5 Development of Monitoring Wells Installed Using Air Rotary Drilling Methods

When developing a monitoring well installed using an air rotary drilling procedure, field parameter stabilization must be used to assess whether sufficient water has been removed and the field parameters measured must include dissolved oxygen. This is particularly important when the contaminants of concern at a site include volatile organic compounds (VOCs) as the use of compressed air during the drilling process can result in sparging of VOCs from the groundwater, resulting in groundwater samples that are biased low with respect to VOC concentrations.

The well development procedure is the same as described in Section 5.2.4, except that the field parameters measured are to include pH, conductivity, temperature, oxidation-reduction potential and dissolved oxygen. The criterion for determining field parameter stabilization for dissolved oxygen is ±10% over 3 consecutive readings or 3 consecutive readings with concentrations less than 0.5 milligrams per litre.

5.2.6 Assessing Field Parameter Stabilization

When determining whether field parameter stabilization has occurred over 3 consecutive readings (except for dissolved oxygen when using the less than 0.5 milligrams per litre over 3 consecutive readings criterion), the following procedure is to be followed:

1. For each parameter, use the first of the 3 readings and calculate 10% of this reading; and
2. The range that the next 2 readings must be within is ± 10% of the first reading.

For example, if the temperature of the first of 3 consecutive readings is 10º C, the next 2 readings must fall between 9 and 11 º C for temperature to be considered stable.

5.3 Well Development Record

Well development is to be documented through the completion in full of the following field forms located in the Pinchin Orchard:

- EDR-GW-Well Development-S1-Low/High Yield Well (completed for Stage 1 for both low and high yield wells);
- EDR-GW-Well Development-S2-Low Yield Well (completed for Stage 2 for low yield wells); and/or
- EDR-GW-Well Development-S2-High Yield Well (completed for Stage 2 for high yield wells).

Any deviations from this SOP along with the rationale for these deviations must be recorded on the EDR-GW-Well Development-S1-Low/High Yield Well form.

5.4 Additional Considerations for O. Reg. 153/04 Phase Two ESA Compliance

When developing a low yield well, the well must be purged to dryness a minimum of 3 times regardless of the recovery time unless reduced purging is authorized by the Qualified Person responsible for the Phase Two ESA.

6.0 TRAINING

The Practice Leader is responsible for identifying the training needs of EDR staff and ensuring that staff are trained and competent before undertaking work assignments.

All trained personnel are responsible for identifying coaching or re-training needs (if they are uncomfortable with work assignments that have been assigned).

The careful application of *Health & Safety Training* by each employee is an integral part of all activities and is assumed as part of this SOP.

7.0 MAINTENANCE OF SOP

1 Year.

8.0 REFERENCES

Association of Professional Geoscientists of Ontario, "*Guidance for Environmental Site Assessments under Ontario Regulation 153/04 (as amended)",* April 2011.

9.0 APPENDICES

None.

APPENDIX VI

Ontario Well Records

Ontario Ministry of the Environment, Conservation and Parks

Well Tag No. *(Place Sticker and/or Print Below)* A111225

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☐ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Craig Atikameksheng Anishnawbek First Nations	Baker		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1786 Chief Sway P.O Box 226	Noh Swean	ON	N0A1M0	5194456040

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
25 Reserve Rd.	White Fish	X	X

County/District/Municipality	City/Town/Village	Province	Postal Code
	Naughton	Ontario	P3E4M1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	513741	6487222	X	

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Sand	Gravle, Boulders	Large Boulders	0	7.5Ft.
Grey	Clay	Silt	Soft.	7.5Ft.	15Ft.
Grey	Silt	Sand	Stiff	15Ft.	18Ft.
Grey	Till	Sand/gravle	Hard	18Ft.	20Ft.

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	12Ft.	Hole plug	6 bags
12	20Ft.	#3 Silica Sand	6 bags

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify ____

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☒ Boring ☐ Air percussion ☐ Other, specify ____ ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify ____ ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☒ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
2.067	P.V.C	.154	0	13Ft.

Status of Well

☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☒ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2"	P.V.C	40	13	20Ft.

Map of Well Location

Please provide a map below following instructions on the back.

See Attached + Log

Water Details

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☒ Untested ☐ Other, specify

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Water found at Depth (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
15	20	8"

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Marathon Drilling	7659

Business Address (Street Number/Name)	Municipality
6847 Hiram DR.	Greely

Province	Postal Code	Business E-mail Address
ON	K4P1A2	kgilmour@marathonwellsground.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
7054190248	Kyle Gilmour

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
41019	Kyle Gilmour	20200116

Comments:

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered Y Y Y Y M M D D

Date Work Completed Y Y Y Y M M D D

Ministry Use Only

Audit No. Z325078

Received

0506E (2018/12) **Ministry's Copy**

Ontario Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A244456

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Graig	Baker		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1786 Chielsway	Ohswean	ON	N0A1M0	5194450040

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Reserve Rd.	Naughton		

County/District/Municipality	City/Town/Village	Province	Postal Code
Reserve	WhiteFish	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	487222	5137416		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Black	Top Soil	Sand	Organic	0	2Ft.
Grey	Clay	Silt	StiFF	2	10Ft.
Grey	Sand	Silt	Fine	10	14Ft.
Grey	Sand	Silt	Course	14	20Ft.
Grey	Sand	Granle		20	25Ft.

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	13Ft.	Hole plug	7 bags
13	25Ft.	#3 Silica Sand	6 bags

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify ____

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☑ Boring ☐ Digging
☐ Air percussion
☐ Other, specify ____

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify ____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
2.067	P.V.C	.144	0	15Ft.

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☑ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify ____
☐ Other, specify ____

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2"	P.V.C	40	15	25

Map of Well Location

Please provide a map below following instructions on the back.

See Attached

Water Details

Water found at Depth ____ (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify ____
Water found at Depth ____ (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify ____
Water found at Depth ____ (m/ft) ☐ Gas — Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify ____

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	25	8"

Well Contractor and Well Technician Information

Business Name of Well Contractor: Marathon Drilling
Well Contractor's Licence No.: 7659
Business Address (Street Number/Name): 6847 Hi Ram DR.
Municipality:
Province: ON
Postal Code: K4P1A2
Business E-mail Address: kgilmow@marathonunderground.com
Bus. Telephone No. (inc. area code): 7059140298
Name of Well Technician (Last Name, First Name): Kyle Gilmow
Well Technician's Licence No.: 4009
Signature of Technician and/or Contractor:
Date Submitted: 20200116

Comments:

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered Y Y Y Y M M D D

Date Work Completed Y Y Y Y M M D D

Ministry Use Only
Audit No. Z325079
Received

Ontario

Ministry of the Environment, Conservation and Parks

Well Record for Well Cluster – Part 1 of 3

(Only for Multiple Test Holes or Dewatering Wells)

Regulation 903 Ontario Water Resources Act

All measurements recorded in: ☐ Metric ☑ Imperial

Follow instructions on the front and back of this form. Print or Type

Well Tag No. of Deepest Well: (Print Well Tag No.) A244456

Well No. on Drawing of Deepest Well:

☐ Dewatering wells
☑ Test holes
No. of wells reported ____

Page ____ of ____

Well Cluster Location Information

Address of Well Location (Street Number(s)/Name(s), RR, if available)	Lot(s)	Concession(s)	Geographic Township	County/District/Upper Tier Municipality
Ojibway Rd / Reserve Rd			First Nations	

City, Town, Village or Hamlet	Province	GPS Unit Make	Model	Unit Mode of Operation
White Fish	Ontario	Garmin	20X	☐ Undifferentiated ☐ Averaged ☐ Differentiated, specify:

Mandatory Attachments/Additional Information

☒ Land Owner Consent Form must be attached.

☒ Detailed Drawing of All Well Locations must be attached.

I, the person constructing the well, will promptly submit to the Director, on request, any additional information in my custody or control related to any well in the well cluster that I have constructed.

Signature of Technician/Contractor ____ Date (yyyy/mm/dd) ____

Well Details

Well # on Drawing	UTM Zone	Easting	Northing	Hole Depth (m/ft)	Hole Diameter (cm/in)	Method of Construction	Casing Material; Diameter (cm/in)	Casing From	Casing To	Screen Interval From	Screen Interval To	Annular Space From	Annular Space To	Annular Material	Overburden/Bedrock or Abandonment Filing Material Intervals (m/ft)	Static Water Level (m/ft)	Date of Completion (yyyy/mm/dd)
4	17	512698	475712	8.5	4"	Coring	1½"	0	25"	2.5	8.5	2'	85"	Sand	Holeplug 3/8	0	
5	17	475712	512698	8.0	4"	Coring	1½"	0	3Ft						Holeplug 3/8		
3	17	475678	512698	8.0	4"	Coring	1½"	0	3Ft.	3	8Ft.	3	8	Sand	Hole plug 3/8	.5	

Well Contractor and Well Technician Information

Business Name of Well Contractor	Business Address (Street Number/Name, RR)	Municipality	Province
Marathon Drilling	6847 Hiram DR.	Greely	ON

Postal Code	Bus. Telephone No.	Well Contractor's Licence No.	Business E-mail Address
K4P 1A2	705-919-0298		Kgilmour@marathonunderground.com

Name of Well Technician (First Name, Last Name)	Well Technician's Licence No.	Signature of Well Technician	Date Submitted (yyyy/mm/dd)
Kyle Gilmour	T-4009	[signature]	2020/01/15

Date First Well in Cluster Constructed or Abandoned (yyyy/mm/dd):

Date Last Well in Cluster Completed (yyyy/mm/dd):

Well Abandonment

Person Abandoning the Wells:

Name ____ (Print or Type) - See instruction 11 on the back of this form

Ministry Use Only

Date Received (yyyy/mm/dd):

Audit No. C 47571

Comments:

Ministry's Copy

Appendix III Detailed Cost Tables

ALTERNATIVE 1: Do Nothing
Class 'D' Construction Cost Estimate

2019 - 2024

	ITEM	Quantity	Unit	Unit Price	Amount
A	**Insurance / Mob and Demob**	100%	l.s.	$ 244,000	$ 244,000
				Subtotal	**$ 244,000**
D	**Decommission of Main Landfill Site**				
1	Clearing (cut tree line back)	100%	l.s.	$ 3,300	$ 3,300
2	Final Cover: Site Grading & Clay Fill	20,800	m3	$ 28	$ 582,400
3	Topsoil & Seeding	5,000	m3	$ 22	$ 110,000
4	Swing Gate	1	ea.	$ 2,200	$ 2,200
				Subtotal	**$ 697,900**
E	**Decommission Abandoned Disposal Site**				
1	Clearing	100%	l.s.	$ 1,660	$ 1,660
3	Final Cover: Site Grading & Clay Fill	2,000	m3	$ 28	$ 56,000
4	Topsoil & Seeding	500	m3	$ 22	$ 11,000
5	Swing Gate	1	ea.	$ 2,430	$ 2,430
				Subtotal	**$ 71,090**
				Total Construction Cost	**$ 1,012,990**
				10% Contigency	**$ 101,299**
				ESTIMATED TOTAL AMOUNT	**$ 1,114,289**

Alternative 1: Do Nothing

Labour Costs

Item	Description	Unit	Quantity	Price	Amount
1	Staffing & Equipment				$40,679
3	Cover Materials	tons	445	5	$2,225
4	Environmental Monitoring Program	l.s.			$10,600
5	Annual Report	l.s.			$5,000
6	Litter Control Fencing	l.s.			$300
7	Closure Fund	l.s.			$2,500
8	Post Closure Fund	l.s.			$400
9	General Site Mtc - Bldg, service, leachate system				$2,100
	Total				**$63,804**
	Administration Allowance (10%)				$6,400
	TOTAL LABOUR COST				**$70,204**

20 Year Life Cycle Cost Estimates

Interest: 5.0% Escalation: 2.0%

Annual O&M Cost: $70,204

Year	Capital Item	Cost	PV Factor	PV Cost
1	Construction	$1,114,289	1.000	$1,184,493
2			0.971	$68,198
3			0.944	$66,249
4			0.917	$64,356
5			0.891	$62,518
Total				**$1,445,814**

ALTERNATIVE 4: NEW LANDFILL DEVELOPMENT (No Diversion)
Class 'D' Construction Cost Estimate

PHASE 1: 2019 - 2029

	ITEM	Quantity	Unit	Unit Price	Amount
A	**Insurance / Mob and Demob**	100%	l.s.	$ 244,000	$ 244,000
				Subtotal	**$ 244,000**
B	**Environmental Protection**				
1	Siltation Control Fencing	1,000	m	$ 44	$ 44,000
2	Straw Bale Retention Barriers	10	ea.	$ 550	$ 5,500
3	Rock Check Dams	4	ea.	$ 830	$ 3,320
4	Sedimentation Pond	100%	l.s.	$ 38,650	$ 38,650
				Subtotal	**$ 91,470**
C	**Site Works**				
1	Strip topsoil	1,100	m3	$ 6	$ 6,600
2	Clear and Grub	100%	l.s.	$ 11,000	$ 11,000
3	Import Fill for Phase 1 Waste Fill Area	27,000	m3	$ 28	$ 756,000
4	Berm Construction	2,600	m3	$ 33	$ 85,800
5	Driveway	10,000	m2	$ 33	$ 330,000
6	Drainage Swale Construction	700	m	$ 28	$ 19,600
7	Road Upgrades				
	.1 Upgrade existing gravel road	2,600	m	$ 303	$ 787,800
	.2 Construct new gravel road	1,700	m	$ 276	$ 469,200
8	Perimeter Fencing	700	m	$ 155	$ 108,500
9	Precast Concrete Segregation Depots	100%	l.s.	$ 66,275	$ 66,275
				Subtotal	**$ 2,640,775**
D	**Decommission of Main Landfill Site**				
1	Clearing (cut tree line back)	100%	l.s.	$ 3,300	$ 3,300
2	Final Cover: Site Grading & Clay Fill	20,800	m3	$ 28	$ 582,400
3	Topsoil & Seeding	5,000	m3	$ 22	$ 110,000
4	Swing Gate	1	ea.	$ 2,200	$ 2,200
				Subtotal	**$ 697,900**
E	**Decommission Abandoned Disposal Site**				
1	Clearing	100%	l.s.	$ 1,660	$ 1,660
3	Final Cover: Site Grading & Clay Fill	2,000	m3	$ 28	$ 56,000
4	Topsoil & Seeding	500	m3	$ 22	$ 11,000
5	Swing Gate	1	ea.	$ 2,430	$ 2,430
				Subtotal	**$ 71,090**
				Total Phase 1 Construction Cost	**$ 3,745,235**
				10% Contigency	**$ 374,524**
				PHASE 1 ESTIMATED TOTAL AMOUNT	**$ 4,119,759**

PHASE 2: 2029- 2039

	ITEM	Quantity	Unit	Unit Price	Amount
A	**Insurance / Mob and Demob**	100%	l.s.	$ 41,750	$ 41,750
				Subtotal	**$ 41,750**
B	**Environmental Protection**				
1	Siltation Control Fencing	700	m	$ 50	$ 35,000
2	Straw Bale Retention Barriers	10	ea.	$ 550	$ 5,500
3	Rock Check Dams	2	ea.	$ 860	$ 1,720
				Subtotal	**$ 42,220**
C	**Site Works**				
1	Strip topsoil	1,300	m3	$ 9	$ 11,700
2	Clear and Grub	100%	l.s.	$ 16,570	$ 16,570
3	Import Fill for Phase 2 Waste Fill Area	32,000	m3	$ 28	$ 896,000
4	Berm Construction	2,700	m3	$ 33	$ 89,100
				Subtotal	**$ 1,013,370**
				Total Phase 1 Construction Cost	**$ 1,097,340**
				10% Contigency	**$ 109,734**
				PHASE 1 ESTIMATED TOTAL AMOUNT	**$ 1,207,074**

TOTAL 20 YEAR ESTIMATED CONSTRUCTION COST $ 5,326,833

Alternative 4: New Landfill (without Diversion)

Labour Costs

Item	Description	Unit	Quantity	Price	Amount
1	Staffing & Equipment				$40,679
3	Cover Materials	tons	445	5	$2,225
4	Environmental Monitoring Program	l.s.			$10,600
5	Annual Report	l.s.			$5,000
6	Litter Control Fencing	l.s.			$300
7	Closure Fund	l.s.			$2,500
8	Post Closure Fund	l.s.			$400
9	General Site Mtc - Bldg, service, leachate system				$2,100
	Total				**$63,804**
	Administration Allowance (10%)				$6,400
	TOTAL LABOUR COST				**$70,204**

20 Year Life Cycle Cost Estimates

Interest 5.0% Escalation 2.0%

Annual O&M Cost: $70,204

Year	Capital Item	Cost	PV Factor	PV Cost
1	Construction	$4,119,759	1.000	$4,189,962
2			0.971	$68,198
3			0.944	$66,249
4			0.917	$64,356
5			0.891	$62,518
6			0.865	$60,731
7			0.840	$58,996
8			0.816	$57,311
9			0.793	$55,673
10		$1,207,074	0.770	$1,261,157
11			0.748	$52,537
12			0.727	$51,036
13			0.706	$49,578
14			0.686	$48,162
15			0.666	$46,786
16			0.647	$45,449
17			0.629	$44,150
18			0.611	$42,889
19			0.593	$41,663
20			0.577	$40,473
Total				**$6,407,875**

ALTERNATIVE 5: NEW LANDFILL DEVELOPMENT (With Diversion)
Class 'D' Construction Cost Estimate

PHASE 1: 2019 - 2029

	ITEM	Quantity	Unit	Unit Price	Amount
A	**Insurance / Mob and Demob**	100%	l.s.	$ 244,000	$ 244,000
				Subtotal	**$ 244,000**
B	**Environmental Protection**				
1	Siltation Control Fencing	820	m	$ 44	$ 36,080
2	Straw Bale Retention Barriers	10	ea.	$ 550	$ 5,500
3	Rock Check Dams	4	ea.	$ 830	$ 3,320
4	Sedimentation Pond	100%	l.s.	$ 38,650	$ 38,650
				Subtotal	**$ 83,550**
C	**Site Works**				
1	Strip topsoil	900	m3	$ 6	$ 5,400
2	Clear and Grub	100%	l.s.	$ 11,000	$ 11,000
3	Import Fill for Phase 1 Waste Fill Area	22,150	m3	$ 28	$ 620,200
4	Berm Construction	2,150	m3	$ 33	$ 70,950
5	Driveway	10,000	m2	$ 33	$ 330,000
6	Drainage Swale Construction	700	m	$ 28	$ 19,600
7	Road Upgrades				
	.1 Upgrade existing gravel road	2,600	m	$ 303	$ 787,800
	.2 Construct new gravel road	1,700	m	$ 276	$ 469,200
8	Perimeter Fencing	575	m	$ 155	$ 89,125
9	Precast Concrete Segregation Depots	100%	l.s.	$ 66,275	$ 66,275
				Subtotal	**$ 2,469,550**
D	**Decommission of Main Landfill Site**				
1	Clearing (cut tree line back)	100%	l.s.	$ 3,300	$ 3,300
2	Final Cover: Site Grading & Clay Fill	20,800	m3	$ 28	$ 582,400
3	Topsoil & Seeding	5,000	m3	$ 22	$ 110,000
4	Swing Gate	1	ea.	$ 2,200	$ 2,200
				Subtotal	**$ 697,900**
E	**Decommission Abandoned Disposal Site**				
1	Clearing	100%	l.s.	$ 1,660	$ 1,660
3	Final Cover: Site Grading & Clay Fill	2,000	m3	$ 28	$ 56,000
4	Topsoil & Seeding	500	m3	$ 22	$ 11,000
5	Swing Gate	1	ea.	$ 2,430	$ 2,430
				Subtotal	**$ 71,090**
				Total Phase 1 Construction Cost	**$ 3,566,090**
				10% Contigency	**$ 356,609**
				PHASE 1 ESTIMATED TOTAL AMOUNT	**$ 3,922,699**

PHASE 2: 2029- 2039

	ITEM	Quantity	Unit	Unit Price	Amount
A	**Insurance / Mob and Demob**	100%	l.s.	$ 41,750	$ 41,750
				Subtotal	**$ 41,750**
B	**Environmental Protection**				
1	Siltation Control Fencing	700	m	$ 50	$ 35,000
2	Straw Bale Retention Barriers	10	ea.	$ 550	$ 5,500
3	Rock Check Dams	2	ea.	$ 860	$ 1,720
				Subtotal	**$ 42,220**
C	**Site Works**				
1	Strip topsoil	1,300	m3	$ 9	$ 11,700
2	Clear and Grub	100%	l.s.	$ 16,570	$ 16,570
3	Import Fill for Phase 2 Waste Fill Area	32,000	m3	$ 28	$ 896,000
4	Berm Construction	2,700	m3	$ 33	$ 89,100
				Subtotal	**$ 1,013,370**
				Total Phase 1 Construction Cost	**$ 1,097,340**
				10% Contigency	**$ 109,734**
				PHASE 1 ESTIMATED TOTAL AMOUNT	**$ 1,207,074**

TOTAL 20 YEAR ESTIMATED CONSTRUCTION COST $ 5,129,773

Alternative 5: New Landfill (with Diversion)

Labour Costs

Item	Description	Unit	Quantity	Price	Amount
1	Staffing & Equipment(Diversion Included)				$85,679
3	Cover Materials	tons	445	5	$2,225
4	Environmental Monitoring Program	l.s.			$10,600
5	Annual Report	l.s.			$5,000
6	Litter Control Fencing	l.s.			$300
7	Closure Fund	l.s.			$2,500
8	Post Closure Fund	l.s.			$400
9	General Site Mtc - Bldg, service, leachate system				$2,100
	Total				**$108,804**
	Administration Allowance (10%)				$10,900
	TOTAL LABOUR COST				**$119,704**

20 Year Life Cycle Cost Estimates

Interest 5.0% Escalation 2.0%

Annual O&M Cost: $119,704

Year	Capital Item	Cost		PV Factor	PV Cost
1	Construction	$3,922,699	$5,796	1.000	$4,048,199
2			$5,911	0.971	$122,026
3			$6,028	0.944	$118,650
4			$6,148	0.917	$115,369
5			$6,269	0.891	$112,181
6			$6,393	0.865	$109,084
7			$6,520	0.840	$106,073
8			$6,649	0.816	$103,148
9			$6,781	0.793	$100,305
10		$1,207,074	$6,915	0.770	$1,304,617
11			$7,052	0.748	$94,858
12			$7,192	0.727	$92,250
13			$7,334	0.706	$89,714
14			$7,479	0.686	$87,251
15			$7,627	0.666	$84,857
16			$7,778	0.647	$82,530
17			$7,932	0.629	$80,269
18			$8,089	0.611	$78,071
19			$8,250	0.593	$75,936
20			$8,410	0.577	$73,859
Total					**$7,079,246**

Alternative 6: Off-Reserve Landfill (with Diversion) & On-Reserve Transport
Class 'D' Construction Cost Estimate

Capital Costs

Item	Description	Unit	Quantity	Price	Amount
Rolloff Station Phase 1					
1	Rolloff Bins	ea.	3	$ 6,500	$ 19,500
2	Rolloff Bins Covers	ea.	3	$ 17,000	$ 51,000
3	Concrete Pads	m^2	110	$ 200	$ 22,000
4	Retaining wall	blocks	100	$ 170	$ 17,000
5	Site Preparation	l.s.	100%	$ 10,000	$ 10,000
6	Strip topsoil	m^3	290	$ 6	$ 1,740
7	Access Road - Based 1.5 km, 8 m wide, 150 mm gravel	m^2	520	$ 330	$ 171,600
8	Fencing and Gate	m	225	$ 140	$ 31,500
9	Garage and signage	l.s.	100%	$ 80,000	$ 80,000
10	Rolloff Bin Truck	ea.	1	$ 220,000	$ 220,000
11	Garbage Collection Truck	ea.	1	$ 180,000	$ 180,000
Environmental Protection					
12	Siltation Control Fencing	m	155	$ 44	$ 6,820
13	Straw Bale Retention Barriers	ea.	3	$ 550	$ 1,650
14	Rock Check Dams	ea.	1	$ 830	$ 830
15	Sedimentation Pond	l.s.	100%	$ 8,000	$ 8,000
16	Landfill Decommissioning	l.s.	100%	$ 768,990	$ 768,990
	Total				**$ 1,590,630**
	Contingency Allowance (10%)				$ 159,063
	TOTAL CAPITAL COST				**$ 1,749,693**

Labour Costs

Item	Description	Unit	Hrs/wk	Quantity	Price	Amount
1	Transfer Station Bin Mtn and Painting					$6,000
2	Staff and site maintenance	hrs	40	2080	$15	$31,200
3	Site Maintenance (snow removal, etc)	l.s.		100%	$5,000	$5,000
4	Truck Maintenance	l.s.		100%	$15,000	$15,000
	Total					**$57,200**
	Administration Allowance (10%)					$5,800
	TOTAL CAPITAL COST					**$63,000**

20 Year Life Cycle Cost Estimates

Interest: 5.0% Escalation 2.0%

Annual O&M Cost: $63,000

Year	Capital Item	Cost	Resident Incr	PV Factor	PV Cost
1	Construction	$1,929,693	$59,694	1.000	$2,052,387
2			$61,976	0.971	$121,405
3			$64,297	0.944	$120,127
4	New Bin	$23,500	$66,658	0.917	$142,359
5			$69,061	0.891	$117,603
6			$71,504	0.865	$116,357
7			$73,990	0.840	$115,121
8			$76,518	0.816	$113,896
9	New Bin	$24,000	$79,090	0.793	$136,681
10			$82,292	0.770	$111,928
11	Truck Replacement	$220,000	$85,418	0.748	$331,070
12			$88,599	0.727	$110,208
13			$91,834	0.706	$109,344
14	New Bin	$24,000	$95,125	0.686	$132,478
15			$98,473	0.666	$107,610
16			$101,879	0.647	$106,740
17			$105,342	0.629	$105,868
18	New Bin	$24,000	$108,865	0.611	$128,996
19			$113,090	0.593	$104,503
20			$117,243	0.577	$103,912
Total					**$4,488,593**

Alternative 6: Off-Reserve Landfill (with Diversion) & On-Reserve Transport
Class 'D' Construction Cost Estimate

Capital Costs

Item	Description	Unit	Quantity	Price	Amount
Rolloff Station Phase 1					
1	Rolloff Bins	ea.	3	$ 6,500	$ 19,500
2	Rolloff Bins Covers	ea.	3	$ 17,000	$ 51,000
3	Concrete Pads	m^2	110	$ 200	$ 22,000
4	Retaining wall	blocks	100	$ 170	$ 17,000
5	Site Preparation	l.s.	100%	$ 10,000	$ 10,000
6	Strip topsoil	m^3	290	$ 6	$ 1,740
7	Access Road - Based 1.5 km, 8 m wide, 150 mm gravel	m^2	520	$ 330	$ 171,600
8	Fencing and Gate	m	225	$ 140	$ 31,500
9	Garage and signage	l.s.	100%	$ 80,000	$ 80,000
10	Rolloff Bin Truck	ea.	1	$ 220,000	$ 220,000
Environmental Protection					
12	Siltation Control Fencing	m	155	$ 44	$ 6,820
13	Straw Bale Retention Barriers	ea.	3	$ 550	$ 1,650
14	Rock Check Dams	ea.	1	$ 830	$ 830
15	Sedimentation Pond	l.s.	100%	$ 8,000	$ 8,000
16	Landfill Decommissioning	l.s.	100%	$ 768,990	$ 768,990
	Total				**$ 1,410,630**
	Contingency Allowance (10%)				$ 141,063
	TOTAL CAPITAL COST				**$ 1,551,693**

Labour Costs

Item	Description	Unit	Hrs/wk	Quantity	Price	Amount
1	Transfer Station Bin Mtn and Painting					$6,000
2	Staff and site maintenance	hrs	40	2080	$15	$31,200
3	Site Maintenance (snow removal, etc)	l.s.		100%	$5,000	$5,000
4	Truck Maintenance	l.s.		100%	$15,000	$15,000
	Total					**$57,200**
	Administration Allowance (10%)					$5,800
	TOTAL CAPITAL COST					**$63,000**

20 Year Life Cycle Cost Estimates

Interest: 5.0% Escalation 2.0%

Annual O&M Cost: $63,000

Year	Capital Iter	Cost	Resident Incr	PV Factor	PV Cost
1	Constructic	$1,731,693	$28,494	1.000	$1,823,187
2			$28,527	0.971	$88,912
3			$65,732	0.944	$121,481
4	New Bin	$23,500	$57,992	0.917	$134,415
5			$61,183	0.891	$110,587
6			$62,042	0.865	$108,171
7			$62,900	0.840	$105,801
8			$63,776	0.816	$103,494
9	New Bin	$24,000	$67,151	0.793	$127,213
10			$68,274	0.770	$101,130
11	Truck Repl:	$220,000	$69,334	0.748	$319,033
12			$72,677	0.727	$98,634
13			$73,836	0.706	$96,634
14	New Bin	$24,000	$75,010	0.686	$118,679
15			$78,528	0.666	$94,318
16			$79,871	0.647	$92,493
17			$81,218	0.629	$90,697
18	New Bin	$24,000	$85,069	0.611	$114,459
19			$86,674	0.593	$88,826
20			$88,357	0.577	$87,259
Total					**$4,025,421**

Appendix IV Meeting Minutes and Stakeholders Input

Minutes Issued: March 29, 2019 Ref. No.: 38062

INITIATION MEETING 1 RECORD

PROJECT:	Solid Waste Management and Landfill Assessment
CLIENT:	Atikameksheng Anishnawbek
CLIENT REFERENCE NO.:	38062
LOCATION:	Atikameksheng Anishnawbek Administration Office
DATE:	March 18, 2019

In attendance for meeting / site visit:

Darin Migwans	Atikameksheng Anishnawbek, Public Works Manager
Bea Rodh	North Shore Tribal Council, Waste Management Coodinator
Steve Reddin	First Nations Engineering Services Ltd.
John Haaland	First Nations Engineering Services Ltd.

Item	Follow up
1) Introductions a) Stephen Reddin completed introduction to meeting, identified himself to be representative as acting project manager until Joanna returns to work in April.	
2) Engineering agreement a) Electronic copies submitted to Atikameksheng Anishnawbek. Darin was happy with the electronic submission requirements. b) Darin had paper copies on hand, FNESL signed 4 copies of agreement (1 to be returned to FNESL) which will be presented to Council for approval.	**Atikameksheng**
3) Correspondence & Main Contacts; main correspondence will be directed to: a) Atikameksheng Anishnawbek i. Darin Migwans – Public Works Manager ii. Arvind Sharma – Director of Infrastructure & Planning iii. Brendan Huston – Director of Operations b) North Shore Tribal Council (NSTC) i. Bea Rodh – Waste Management Coordinator c) ISC i. Philip Stringer d) FNESL i. Stephen Reddin ii. Joanna Recollet iii. John Haaland	**Info Only**
4) Review Presentation – Comments on Methodology a) Atikameksheng Existing Landfill; i. Recycling pickup is completed on Fridays by a private contractor and deposits at City of Greater Sudbury's (CGS) recycling center. Garbage collection is performed every Monday by band operations. (Refer to Site Visit notes for further details) Atikameksheng community has had an attendant at the landfill for about 1.5 years, picture presented in the TOR is a historical picture and does not represent current practices of waste segregation. Bea to provide FNESL with current pictures. (non winter	**Received by FNESL (03/19/2019)**

Item	Follow up
season)	
ii. Stream and Fly Lake located *"downstream"* of current landfill section which are a concern for leachate contamination.	
iii. There is strong community support for better solid waste practices.	
iv. Installation of clear signage at landfill has improved public education and waste segregation efforts. A gate was installed at the landfill, there was insufficient funding to fence off landfill property.	
v. Atikameksheng has regulated landfill usage to on reserve resident band members only. Still having issues of after hours dumping, off reserve citizens attempting to use landfill, as well as community center trash bin filled during evenings and weekends.	
b) Study Objectives	
i. Placement and security of a new transfer station is ideal due to the issue of after hours dumping by members and non-members.	
ii. Darin noted that Atikameksheng has communicated with CGS's Environmental Division regarding the development of a Municipal Service Agreement. Letter was drafted and submitted to city, it has been approved by Operations and City Council. Proposal is currently with MOE to complete assessment of the CGS landfill to accept solid waste from First Nation. Timeline of 1 to 10 years was mentioned, it should be noted that MOE fees for amendment to Certificate of Approval (CofA) may be incurred.	
iii. Darin to provide FNESL with correspondence with City, Steve asked if it would be okay for FNESL to contact the city in regard to Municipal Agreement, all approved. Darin to provide name and number of CGS contact person. FNESL shall correspond with CGS contact.	**Atikameksheng** **FNESL**
c) Review of Background Information	
i. NSTC and Atikameksheng to provide FNESL with available reports and studies pertaining to the first nation and existing solid waste management. ACRS, Comprehensive Community Plan, plus others available	**Atikameksheng/ NSTC**
ii. Waste Management Practices Meeting, Joanna to address with community upon return.	**FNESL - Joanna**
iii. A topographical survey was noted as a provisional item within the proposal. NSTC and/or Atikameksheng will provide FNESL with existing site plans if they are available.	**Atikameksheng/ NSTC**
iv. It was noted that Pinchin Ltd. will be completing the landfill assessment portion of this study. Open discussion about waste composition deposited within landfill between all in attendance, potential to utilize landfill attendant to create log of composition deposited. Direction from the community and NSTC required to incorporate this portion to the study.	**NSTC / Atikameksheng**
d) Waste Reduction and Waste Diversion Programs	
i. Darin mentioned that further education programs for community would be beneficial, previous programs had positive reception from the community, a refresher would help reassure good household practices for solid waste disposal.	
ii. Backyard composting is not commonly practiced, only a handful of houses may perform backyard composting, Bea mentioned a community composting effort may have better reception from members.	
iii. It was noted that Cambrian College performed a *"Composting Report"* for Atikameksheng. Bea will provide to FNESL for review.	**NSTC**
iv. The community is currently working with the CGS for recyclables collection, which transports recycled good to a processing facility for	

Item	Follow up
separation. e) Example Evaluation Matrix requires community input for criteria as it is an important process to ensure desired goals are achieved within this study.	
5) Site Visit a. Darin noted that Atikameksheng utilized Walden's landfill site scale to complete a 9 week study in order to determine loading on landfill by community pickup. Average disposal at the dump was determined to be 1.2 tonnes deposited per week. b. Trash bin is used for daily disposal by band members who drive personal garbage to landfill. The attendant prefers members to deposit garbage within the bin provided and encourages people to separate recyclables accordingly. i. No separation for wood products. ii. Separate bin for scrap metal. iii. Large blue bin for recycled goods. (ex. Cardboard, cans, glass and plastics)	

Copies of these minutes of meeting are to be issued to all those in attendance.

End of Meeting Minutes.

Any errors/omissions/deletions to these minutes of meeting are to be directed to the writer, John Haaland, First Nations Engineering Services Ltd.

ATIKAMEKSHENG ANISHNAWBEK SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT

MARCH 18, 2019

FIRST NATIONS ENGINEERING SERVICES LTD.

1

PROJECT INITIATION MEETING

AGENDA

- INTRODUCTIONS
- ENGINEERING AGREEMENT
- STAKEHOLDER LIST
- REVIEW PRESENTATION OF METHODOLOGY
- CLOSING REMARKS
- NEXT MEETING

2

ATIKAMEKSHENG EXISTING LANDFILL

- Proximity to residences is an issue
- Attracts wildlife close to community
- Community favors a closure due to inadequacies as a waste system
- Landfill site accepted all solid waste without separation/segregation

3

STUDY OBJECTIVES

- **Establish remaining life of existing landfill**
- **Provide alternatives and recommendations for the following:**

1. *Future operation plans* for existing landfill.
2. Possible need to *close and cap previous landfill site*
3. *Recycling Options*
4. Comparison Analysis between:

New Transfer Station and options for entering a *Municipal Service Agreement*

VS.

Direct Drive option for *local pick-up by Municipality*

5. Funding needs and sources
6. *Final Waste Management Plan*

4

METHODOLOGY

1. **REVIEW OF BACKGROUND INFORMATION**
   Review and Summarize existing reports
   Waste Quantity and Waste Composition Projections
2. **SITE REVIEW**
   Topographical Survey
   Landfill Assessment
3. **ASSESSMENT OF THE CURRENT WASTE MANAGEMENT SYSTEM**
4. **FUTURE WASTE MANAGEMENT SYSTEM OPTIONS**
   Options Analysis and Recommended Approach
   Example Evaluation Matrix
5. **FINAL REPORT - SOLID WASTE MANAGEMENT PLANNING STUDY**
   Recommendation & Cost Estimate
   Design Approval Request
   Project Description

5

1. REVIEW OF BACKGROUND INFORMATION

1. **BACKGROUND DATA COLLECTION AND REVIEW INFORMATION**
   Review of all available existing material related to this project
   - Asset Condition Reporting System and other assessment reports;
   - Community Plan, Land Use Plan, Site plans, Design Plans;
   - Record drawings, aerial photos, legal surveys of existing and proposed sites;
   - Waste Composition Projections, (WDO Gap Data from ISC)

   Previous Studies
   - 1997 Phase II EII – Henderson Paddon Environmental Inc.
   - 2002 Waste Management Plan Study – Neegan-Burnside
   - 2003 Waste Management Plan Final – Neegan-Burnside

   Generation and Composition of Ontario's First Nation's waste stream:
   WDO Gap Data – Ontario First Nations Technical Services Corporations
2. **WASTE MANAGEMENT PRACTICES MEETING**
   Discuss current waste management practices including:
   - Budget and operations;
   - Collection and disposal;
   - Current recycling efforts;
   - Waste generators within the community

6

2. SITE REVIEW

1. **TOPOGRAPHICAL SURVEY – Provisional**
2. **LANDFILL ASSESSMENT – Pinchin LTD**
   A. *Landfill Assessment Investigations Report* will document monitoring activities and provide characterization of current environmental status of the site, including:
   - Groundwater flow;
   - Groundwater quality characterization
   - Leachate water quality characterization
   - Contaminant migration analysis; and
   - Surface water quality characterization

   B. *Waste Capacity Assessment Report*

7

3. ASSESSMENT OF THE CURRENT WASTE MANAGEMENT SYSTEM

1. **Assessment completed once landfill capacity determined**
2. **Assessment to focus on functionality to meet community needs over 20 year planning period. Works will include:**
   - Define each component of Waste Management System, including past and present operational records
   - System flexibility to accommodate future programs and diversion of new materials
   - Define opportunities for enhancement of existing system
   - Analyze current operations and maintenance budget
   - Analyze resources required to support existing system

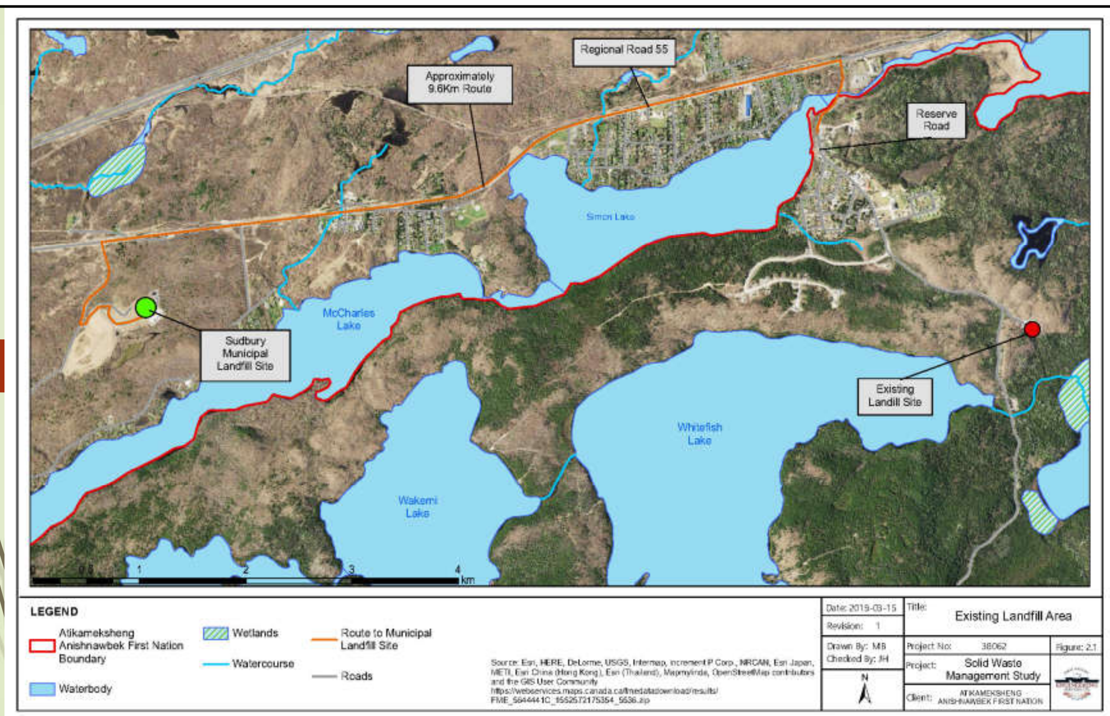
8

4. FUTURE WASTE MANAGEMENT SYSTEM OPTIONS

1. **WASTE REDUCTION AND WASTE DIVERSION PROGRAMS**
2. **WASTE COLLECTION AND WASTE TRANSFER**
3. **WASTE DISPOSAL**

- *Note: Solid waste disposal and recycling will consider all options within 100km of the community. Refer to next slide for example of nearby Municipal Waste Facility*

9



10

4.1 WASTE REDUCTION AND WASTE DIVERSION PROGRAMS

1. Blue Box Recycling – roadside pickup or drop off bins
2. Used Tires
3. Waste Electronics
4. Management of Household Hazardous Wastes
5. Scrap Metal
6. Used Oil
7. Backyard Composting

11

4.2 WASTE COLLECTION AND WASTE TRANSFER

1. Curbside vs. depot drop-off opportunities
2. Waste and recyclables collection frequencies
3. Pay-as-you-throw opportunities and other fee-for-service programs
4. Single stream recyclables vs. multi-stream recyclable collection
5. Transfer station opportunities for long-haul applications using private contractors
6. Potential partnerships with surrounding communities

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4.3 WASTE DISPOSAL

1. Recyclable material processing facilities and facility components
2. Separation at-source vs. separation at a processing facility
3. Conventional landfill disposal alternatives
4. Alternative waste processing technologies (ie. Mechanical, biological, thermal and chemical processing)
5. Processing residuals management
6. Waste and/or recyclables export opportunities
7. Disposal at adjacent municipalities

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EXAMPLE EVALUATION MATRIX

ALTERNATIVE EVALUATION

The comparison chart below is an example of evaluation techniques applied during the selection process.

Table X.Y: Evaluation Matrix - Process Alternatives

Item	Criteria	Criteria Weight	Alternative 1: Expand Existing Landfill Site	Score 1-10	Weighted Score	Alternative 2: New Landfill Site	Score 1-10	Weighted Score
1	Capital Cost – Class D	10		10	100		5	50
2	O&M	10		8	80		8	80
3	Capping and Closure	10		8	80		10	100
4	Footprint Size & Future Expansion Requirements	5		2	10		10	50
5	Security – Fencing and gated access	7		8	56		10	70
6	Occupational Health & Safety for Operator Access & Maintenance Activities	7		8	56		10	70
7	Access to Facility	10		10	100		2	20
8	Lifecycle	10		1	10		10	100
9	Zoning, Setback and Community Acceptance	10		6	60		10	100
	Weighted Totals	**79**			**552**			**640**
			Score Divided by Total of Criteria Weight		**6.99**			**8.10**

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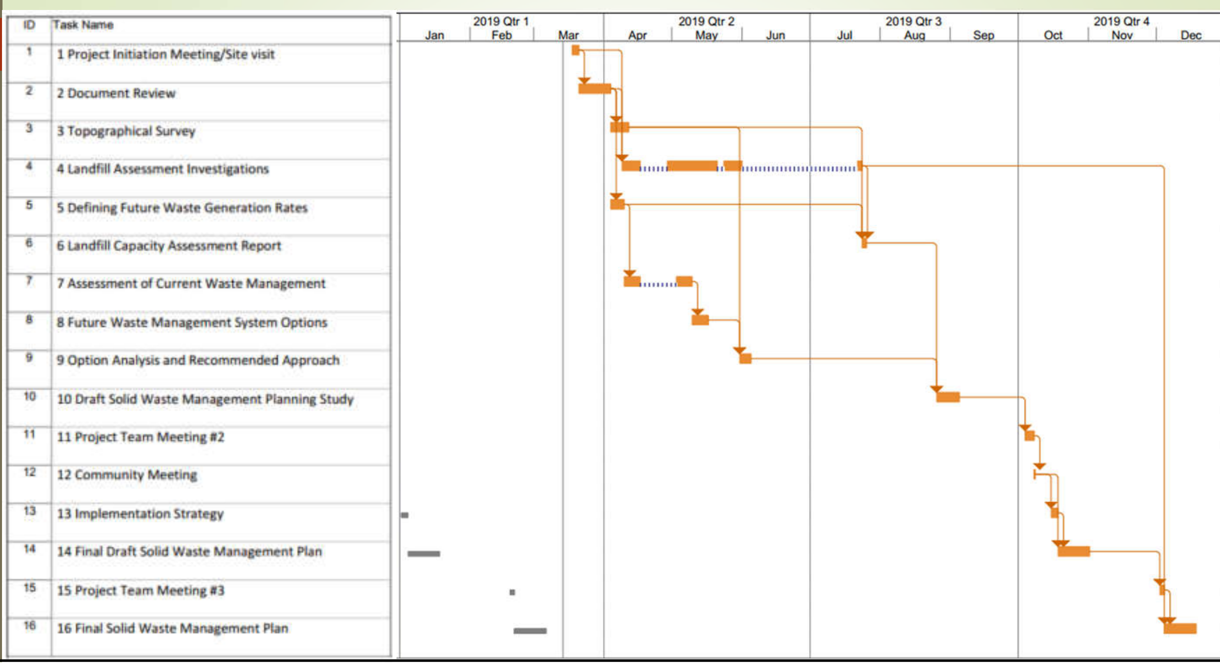
5. FINAL REPORT – SOLID WASTE MANAGEMENT PLANNING STUDY

1. A management summary of the study
2. Brief Historical Background of the First Nation
3. Discussions of options and alternatives
4. Conclusions and Recommendations
5. Costing information

15

PROJECT SCHEDULE



16

PROJECT MEETING #2

- **PRESENTATION OF DRAFT REPORT**
  Including lifecycle costing results and ranked alternatives
- **PROJECT TEAM FEEDBACK**
  Comments regarding alternatives examined
  Suggestions to improve alternatives
- **REVIEW DRAFT EVALUATION MATRICES**
  Confirm agreeance with weighting and values assigned to each category
- **COMMUNITY MEETING #1**

17

THANK YOU, MIIGWETCH!

QUESTIONS / COMMENTS

18

FIRST NATIONS ENGINEERING SERVICES LTD.

Minutes Issued: December 17, 2019 Ref. No.: 38062

PROJECT TEAM MEETING #2 MINUTES – DRAFT REPORT REVIEW

PROJECT:	Solid Waste Management and Landfill Assessment
CLIENT:	Atikameksheng Anishnawbek
CLIENT REFERENCE NO.:	38062
LOCATION:	Atikameksheng Anishnawbek Administration Office
DATE:	December 10, 2019

In attendance for meeting / site visit:

Darin Migwans	Atikameksheng Anishnawbek, Public Works Manager
Phillip Stringer	Indigenous Services Canada
Joanna Recollet	First Nations Engineering Services Ltd.
John Haaland	First Nations Engineering Services Ltd.

Item	Follow up
1) Introductions	
a) Joanna Recollet completed introduction to meeting, identified herself and project team present	
b) Community input is required prior acceptance of Draft Report by ISC.	
c) ISC and Community representatives agree that the sharing of Draft Report to city of Sudbury is acceptable to refine alternatives.	
2) Draft Report Presentation Review	
a) Presentation slide show is attached and was reviewed with meeting participants.	
b) Refine alternative presentation, provide class D costings, remove reference for "Class C" estimates.	**FNESL**
c) Presented a community population of 483 total. Atikameksheng in agreeance with population moving forwards.	
d) Recent CPS report provided for Atikameksheng community has an approved growth rate. Project team would like a comparison completed with the 1.98% utilized by FNESL. Darin to provide CPS report to FNESL.	**Atikameksheng/ FNESL**
e) FNESL confirmed required buffers limits are used in new landfill size estimates.	
f) Confirmed with Darin; Community's public works department currently completes garbage collection.	
g) Phillip notes that ISC funds MTSA programs at 100% (potentially 80%) of Tipping Fees and 80% (potentially 100%) of Transportation Fees for garbage disposal. To be confirmed.	**ISC**
h) Estimates for waste disposal at a City of Sudbury landfill, provide costing for transportation by 3rd party contractor vs. community owned and operated transportation service (Provide employment opportunity for first nation).	**FNESL**
i) Project Team approved Class D estimates can be used for obtaining approved funding.	**FNESL**
j) Darin is satisfied with current recycling MTSA with the City of Greater Sudbury and would prefer to continue. Phillip notes preference for First Nation operated collection.	

Item	Follow up
k) Community requires direction for disposal of hazardous waste (used oil), Green Cart/Composting programs. ISC noted funding for Green Bin programs and education programs is available. FNESL to confirm if Sudbury requires the use of green bins provided by their solid waste division.	**FNESL**
l) Day transportation is currently working with Darin to sign onto tire stewardship for used tire disposal (Note: this is a free service and no charges to First Nation's should be involved.)	**Atikameksheng/ FNESL**
m) Education Programs are strongly recommended for the community. FNESL and Darin to work together and plan a education program on recycling for community members. Darin noted that participation from members can be improved.	
n) Previously reported new landfill location selected on community property had a close split for member preference. ~51%vs49%. Current position is to establish MTSA and dispose off reserve.	**FNESL**
o) Confirm solid waste generation rates used in report with OFTNC updated values.	**FNESL**
3) Next Steps;	
a) Updated schedule discussed, no issues with completion date extending to end of Feb 2020	
b) Community meetings scheduled for Dec 17 1pm and 5pm.	
c) Reviewed comments provided by ISC along with FNESL responses, see attached.	
i) ISC agrees with 1.98% population growth rate	
ii) FNESL will explain calculations more thoroughly where required.	**FNESL**
iii) ISC fine with Pinchin responses, but requested that a comparison of CCME standards be included, since these are federal.	**FNESL**

Copies of these minutes of meeting are to be issued to all those in attendance.

End of Meeting Minutes.

Any errors/omissions/deletions to these minutes of meeting are to be directed to the writer, John Haaland, First Nations Engineering Services Ltd.

December 5, 2019

Ref.#38062
Response Dec 5

Atikameksheng Anishnawbek
25 Reserve Rd.
Naughton, ON, P0M 1M0

Attn: Darin Migwans, Public Works Manager
Re: **Response to ISC Review of Draft Solid Waste Management Plan and Landfill Assessment**

Dear Darin,
We are forwarding our response to ISC's comments received on December 4, 2019 regarding the above project. ISC comments are bolded and response follows each comment.
COMMENTS:
Was community engagement ever completed? What were the results of this engagement? Please include in the final report.
As per the proposal and schedule of tasks, the community meeting is to take place after the Project Team has reviewed the draft report. Community input will be incorporated into the Final Draft Report and their input will be considered in the evaluation of alternatives.

Please include this area on the map in the appendices. Also were the cottagers included in the waste analysis? Please provide details. (Referring to 43.5 acres of land for leasing purposes)
We will confirm with the First Nation, whether they want this area included in the mapping and request mapping of the boundary. It is understood the cottagers dispose of their waste at a nearby transfer station. Including the cottagers in the waste analysis was not part of the scope. FNESL can provide an estimated fee to incorporate the cottagers into the waste analysis.

Here it states, 2km but on page 4 section 2.0 it states 1.5. We need to be consistent with the distance in the report.
FNESL will revise the 2 km to 1.5km.

Was this observed? What is this based on? "Composting collection is not provided to the community and only a "handful" of residents may practice backyard composting."
This would be verbal information provided by the First Nation. FNESL shall reconfirm during the community presentation.

The laws the community developed under FNLM should be included in this report. If there are none, this should be explained. If there are, what are they and how is it

working? How can it be improved? "Burning of any waste within reserve boundaries is strictly prohibited."
It is understood that no laws have been formally enacted. However, FNESL will confirm with the First Nation.

Change "at each" to "in all".
FNESL will change.

Please show this trend on the above figure. (referring to Historical Population trend)
After 2010, the off-reserve population growth shows a slight increase in slope, which is assumed to be a result of Bill C-3.

On-reserve populations has been continually declining as per table 4 on page 9, even with the increased economic development. Therefore, an AAGR of 1.65% should be used for calculation instead of 1.98%. Please adjust the calculation to reflect this.
The statement of the on-reserve population is continually declining is incorrect. The Historical Population graph shows an upward slope from 1988 to 2018, with a slight dip from 1994 to 1995, and returning back to normal in 1997. The growth rate in table 4 declines from 1998 base year to a 2008 base year. FNESL recommends a growth rate of 1.98% be utilized since it is based on 20 years of data. As explained in the report, a 1.5% growth rate was used in the previous Plan and this rate fell short of predicting actual growth on-reserve. The First Nation is close to completing a Business Park, which is expected to result in members returning to the community. With an anticipated spike in on-reserve population, an AAGR of 1.65% would not be in the best interest of the First Nation's plan.

Is this per person? Please clarify as the weight does not make sense when looking at the projection.
FNESL will explain this more within the report. The weight breakdown is 2.5 kg of waste separated into different items and determines a percentage of that item. The percentage is then applied to the total waste volume projected for the next 20 years.

Please describe how you arrived at using this number. "This estimate will use 8% for scrap metal waste…"
FNESL shall clarify that this is an assumption. Since there are 2 references referred to, FNESL is assuming 8% which falls between 2% and 21% will make up the scrap metal portion of Atikameksheng's 20-year waste generation.

Please include the total estimate within each option given below for the reader
If this is referring to cost estimates, these are provided in section 5.3 Waste Disposal Alternative. Section 5.1 to 5.2 provide a background on the alternatives and description of assumptions used in Section 5.3.

How did you arrive at this number? "For this study, the cost of recycling is estimated to be approximately $325/tonne."

FNESL will remove this assumption, since actual operation and maintenance costs were provided by the First Nation.

This alternative also needs to examine using the transfer station down the road at the Walden small vehicle transfer station, including class D estimates for this. This also needs to be included in the assessment table on page 37.
With permission from the First Nation, FNESL would prefer to discuss the alternatives with the City of Greater Sudbury and work out the logistics of where waste should be hauled to and refine any associated costs.

A discussion on the comparisons should be provided here. After comparison, the recommended option should be presented and given a reason as to why, taking into account all available data collected during the assessment.
Yes, this will be completed in the next submission.

In regard to ISC's comments on the Landfill Assessment portion, Pinchin Environmental has responded in the table below:

Comment	Response
Section 2.0 – "What are the SOPs? Include a brief description of them"	Copies of the Pinchin groundwater sampling SOPs will be provided as an appendix of the report.
Section 2.1 – Include the well records within the appendices.	Copies of the O. Reg. 903 Well Records for the newly installed wells will be provided as an appendix of the report.
Section 2.4 – "What were the well volumes purged? Please include these in the appendix in a table"	The well purge volumes will be added as a table in an appendix of the report.
Section 3.5.2 **AND** Section 3.14.11 – "Please include an outline of the suspected CAZ for the active landfill in the maps provided"	An estimated CAZ boundary will be added to the figures for the active landfill site.
Section 3.8 – Make note that although SW2 and SW3 exceed the PWQO for phenols, they did not exceed the CWQG for this parameter.	This sentence will be edited accordingly to identify that observation.
Section 3.14.6 – "What is the current slope of the landfill"	The current slope of the active face at the active landfill will be determined from the 2019 topographic survey and will be included in this

	section.
Section 3.14.11 – What are the measures that will be undertaken if gulls at the site become problematic?	A brief description of what measures could be taken will be include within this same bullet point.
Appendix I (Figures) – "Please include a figure outlining the extent of contamination within both the landfills for reference."	An additional figure will be included, showing text boxes with a list of parameters that have exceeded the Guideline B-7 criteria for each well to show the extent of the contamination.
Several comments indicating that the federal guidelines (O. Reg 347 or CCME) should be used for comparison of groundwater and surface water quality as well as soil quality. An additional comment indicating that the recommendations for which parameters to test for during the next event should follow O.Reg. 347 rather than Column 1 through 4 in the MECP Landfill Standards.	o The O. Reg 347 Table 4 concentrations would not be applicable for comparison to groundwater, surface water and soil quality at the landfill site since the O. Reg 347 concentrations are only used for waste classification based on water that has undergone a certain procedure (i.e., TCLP – toxicity characteristic leaching procedure). o The provincial guidelines were used because they are more stringent in comparison to the federal guidelines, which allows for a more conservative assessment of the water and soil quality. o The drinking water guidelines are applicable for the landfill site due to the possibility that someone could drill a drinking water well in the vicinity of the Site. This would be the highest potential concern for water use at the Site.

We hope this meets your requirements and look forward to advancing this project. If you require any further clarification, do not hesitate to contact our office.

Yours truly,
FIRST NATIONS ENGINEERING SERVICES LTD.

Joanna Recollet, P.Eng., PMP
Project Manager

c.c. Arvind Sharma, Director of Infrastructure
Bea Rodh, NSTC Waste Management Coordinator
Philip Stringer, Indigenous Services Canada
Tim McBride, Pinchin Ltd.

ATIKAMEKSHENG ANISHNAWBEK SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT

December 10, 2019

FIRST NATIONS ENGINEERING SERVICES LTD.

PINCHIN

ATIKAMEKSHENG ANISHNAWBEK

FIRST NATIONS ENGINEERING SERVICES LTD.

1

DRAFT REPORT REVIEW MEETING

AGENDA

- SUMMARY OF DRAFT REPORT
- REVIEW OF COMMENTS
- NEXT MEETING
- SCHEDULE

2

SUMMARY OF DRAFT REPORT

- INTRODUCTIONS
- LANDFILL ASSESSMENT
- POPULATION PROJECTIONS
- WASTE GENERATION
- WASTE MANAGEMENT OPTIONS

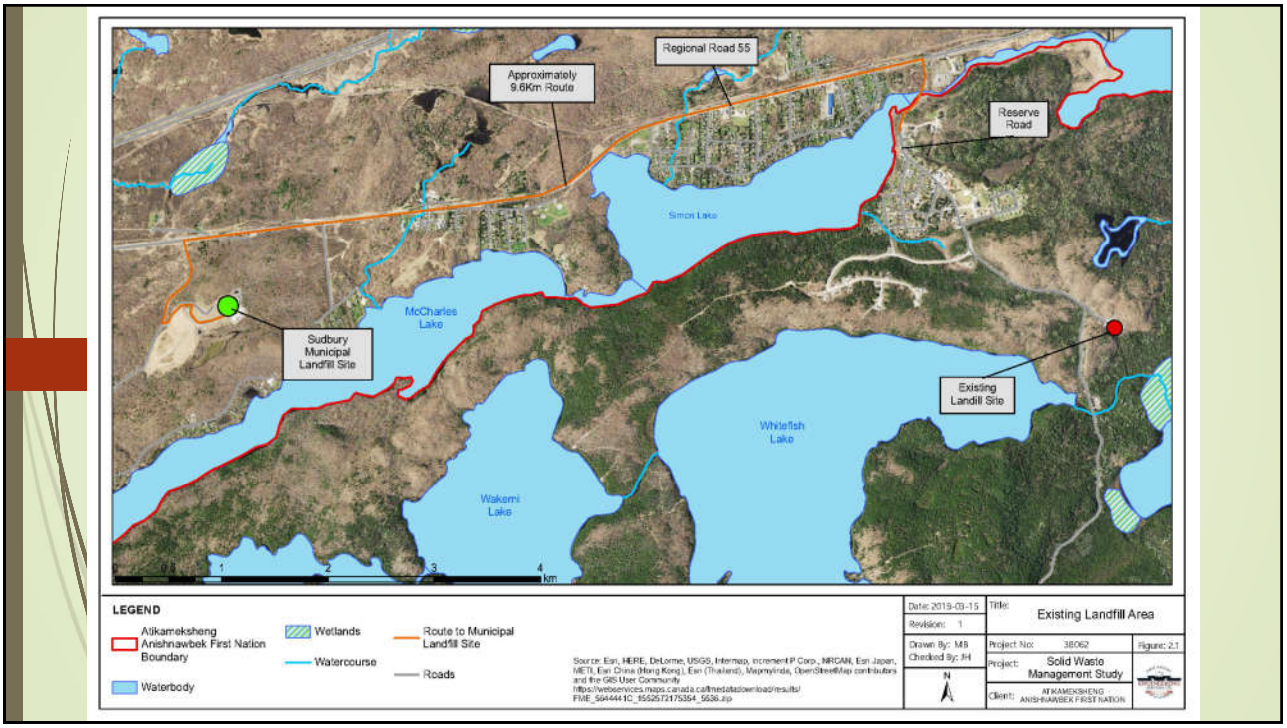
3

INTRODUCTION

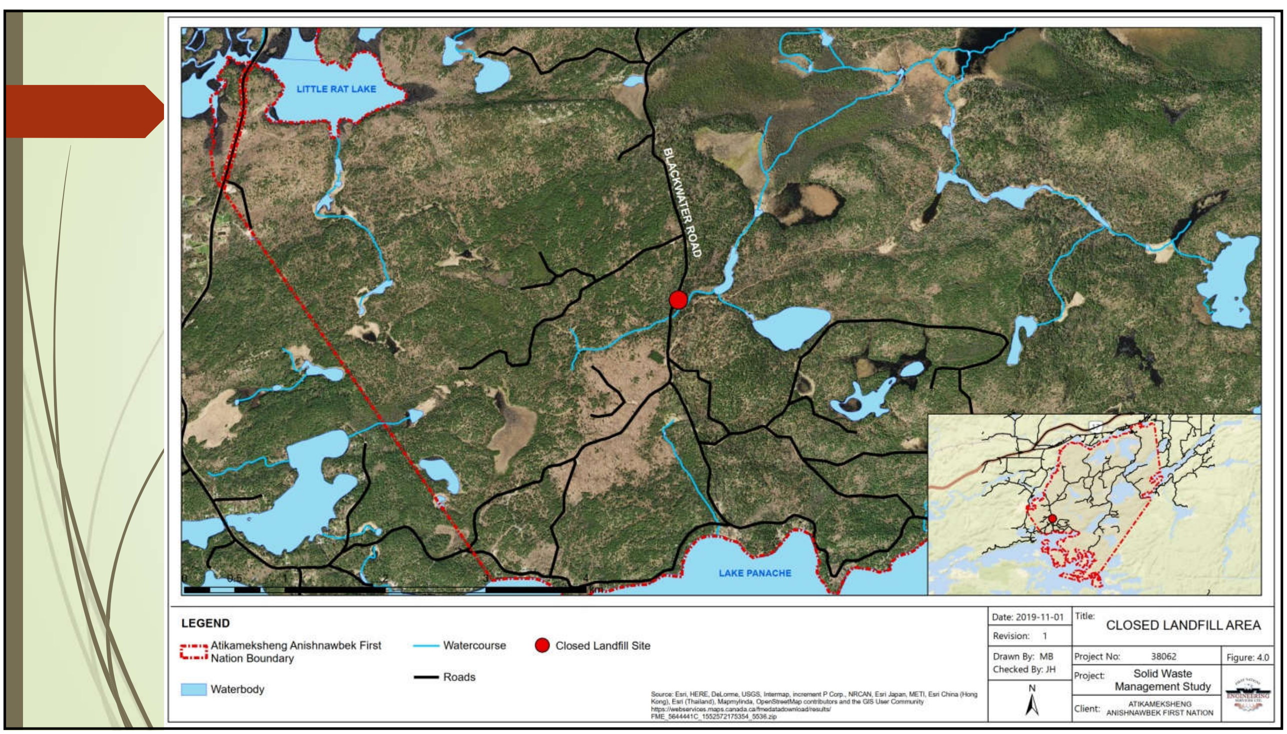
Study Objectives:

- Assessment of the existing landfill site and the abandoned landfill site at Penage, along Blackwater Rd.
- Project a 20-year population and its waste generation
- Determine the remaining life of the existing landfill
- Alternatives / recommendations provided for:
  - Future operational plans for the landfill site including on-going health & safety, security, final capping, closure and long-term monitoring;
  - Possible need to close and cap the previous land fill sites,
  - Recycling options,
- Comparison Analysis between:
  - establishing new Transfer Station, and options for entering a Municipal Service Agreement, or
  - Direct Drive option for local pick-up by local Municipality.
- Funding needs and sources;
- Provide a final Waste Management Plan based on community consultations

4


Regional Road 55
Approximately 9.6Km Route
Reserve Road
Simon Lake
McCharles Lake
Sudbury Municipal Landfill Site
Existing Landfill Site
Whitefish Lake
Wakemi Lake
km
LEGEND
Atikameksheng Anishnawbek First Nation Boundary
Waterbody
Wetlands
Watercourse
Route to Municipal Landfill Site
Roads
Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmyindia, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/
FME_5644410_1552572175354_5536.zip
Date: 2019-03-15
Revision: 1
Drawn By: MB
Checked By: JH
N
Title: Existing Landfill Area
Project No: 38062
Figure: 2.1
Project: Solid Waste Management Study
Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

5

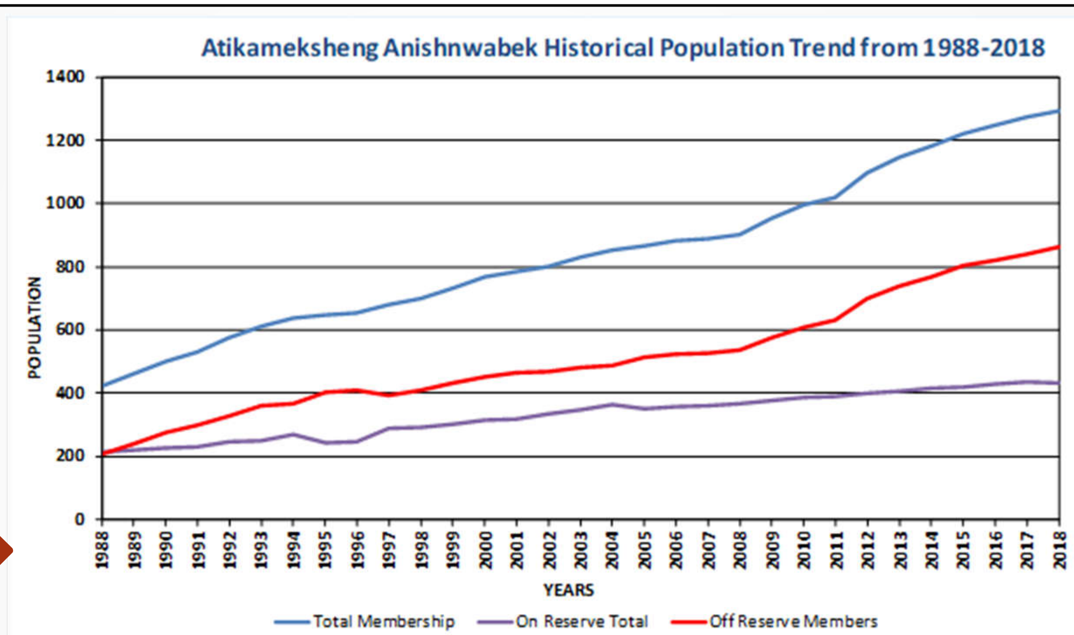

LITTLE RAT LAKE
BLACKWATER ROAD
LAKE PANACHE
LEGEND
Atikameksheng Anishnawbek First Nation Boundary
Waterbody
Watercourse
Roads
Closed Landfill Site
Source: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmylnda, OpenStreetMap contributors and the GIS User Community
https://webservices.maps.canada.ca/fmedatadownload/results/
FME_5644441C_1552572175354_5536.zip
Date: 2019-11-01
Revision: 1
Drawn By: MB
Checked By: JH
N
Title: CLOSED LANDFILL AREA
Project No: 38062
Figure: 4.0
Project: Solid Waste Management Study
Client: ATIKAMEKSHENG ANISHNAWBEK FIRST NATION

6

LANDFILL ASSESSMENT

- Pinchin Ltd completed an assessment of the existing Landfill and the abandoned landfill site.
- Hydrogeological assessment was completed at both sites and assessed for historical volumes of waste and estimated capacity remaining.
- Groundwater sampling results at both sites were not considered a significant environmental concern. It is noted this is one sampling event and regular monitoring is recommended.
- Surface water samples in the vicinity of the active site were sampled, with no exceedances except for phenols. However the phenols are not attributed to the landfill.
- An elevation survey estimated the active site had a total volume of 54,750 m^3 buried, and the closed site had approximately 2,100m^3.
- Based on the topography and recommended final slopes it is estimated that the active site has a remaining capacity of 10,000m^3.

7



POPULATION PROJECTIONS

8

POPULATION PROJECTIONS

Adjusted base population to include non-members living on-reserve and children not yet registered, total on-reserve population is 483.

Based on historical growth, the following average annual growth rates were calculated and compared:

	Total Population	On-Reserve	Off-Reserve
AAGR Base Year 1988	3.79	2.35	4.89
AAGR Base Year 1998	3.12	1.98	3.80
AAGR Base Year 2008	3.66	1.65	4.85

An AAGR of 1.98% is recommended, which projects a 20 year on-reserve population of 715. The following table summarizes the projection:

	Baseline	5th Year	10th Year	15th Year	20th Year	50th Year
Year:	2019	2024	2029	2034	2039	2068
Population:	483	533	588	648	715	1262

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WASTE GENERATION ESTIMATE

Several waste generation rates were considered and are listed below:

Source	Generation Rate	Year
Ontario First Nations	1.67 kg/cap/day	1997
AANDC	1.50 kg/cap/day	2002
Atikameksheng Anishnawbek First Nation	1.81 kg/cap/day	2003
Statistics Canada - Canada	2.00 kg/cap/day	2010
Statistics Canada - Ontario	1.92 kg/cap/day	2010

A waste generation rate of 1.81 Kg/cap/day was used to estimate the 20 year waste generation.

$$Volume\ \left({}^{m^3}/_{yr}\right) = Population\ \times \frac{Generation\ Rate\ (kg/yr/cap)}{Waste\ Density\ (kg/m^3)}$$

The above calculation was used to project a 20 year volume of waste of 80,471.7 m^3. Based on this volume it is estimated a total area of 32.7 acres of landfill would be required.

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WASTE COMPOSITION

- Solid Waste Management Strategy Planning Manual (1997) prepared for Ontario First Nations.

- Table 9 from the report categorizes the composition into waste items that can be diverted and its estimated that 87% could potentially be diverted from landfilling

Waste Items	Volume (m^3)
Organics	9,657
Recyclables (fibre, cardboard, plastic, metal, etc.)	39,431
Automobiles	8,691
Snowmobiles	3,380
Appliances	1,448
Furniture	966
Tires	483
Building Materials	2,897
Household Hazardous Waste	3,380
Maximum Potential Volume of Waste to be Diverted:	70,332
Percentage of Diverted Waste:	87%

**Estimates assume 100% community participation*

Total 20 Year Waste Generation		80,472 m^3		
Waste Item		Weight (kg)	Percentage	Projections (m^3)
Organics	Vegetable	0.075	3.0%	2,414
	Processed Foods	0.12	4.8%	3,863
	Meat/Parts	0.06	2.4%	1,931
	Other Organic	0.045	1.8%	1,448
	Total Organic	**0.3**	**12.0%**	**9,657**
Fibres	News/Flyers	0.24	9.6%	7,725
	White	0.24	9.6%	7,725
	Other Fibre	0.55	22.0%	17,704
	Total Fibre	**1.03**	**41.2%**	**33,154**
Containers	Steel	0.075	3.0%	2,414
	Aluminum	0.015	0.6%	483
	Wood	0.06	2.4%	1,931
	Plastic	0.09	3.6%	2,897
	Other	0.015	0.6%	483
	Total Containers	**0.255**	**10.2%**	**8,208**
Other Household Goods	Plastic Film	0.03	1.2%	966
	Foil	0.015	0.6%	483
	Diapers	0.06	2.4%	1,931
	Paper Towels	0.015	0.6%	483
	Other	0.03	1.2%	966
	Total other households	**0.15**	**6.0%**	**4,828**
Miscellaneous Bulk	Clothing	0.03	1.2%	966
	Automobiles	0.27	10.8%	8,691
	Snowmobiles	0.105	4.2%	3,380
	Appliances	0.045	1.8%	1,448
	Furniture	0.03	1.2%	966
	Tires	0.015	0.6%	483
	Building Materials	0.09	3.6%	2,897
	Other	0.075	3.0%	2,414
	Total Miscallaneous	**0.66**	**26.4%**	**21,245**
HH Hazardous Waste	Batteries	0.015	0.6%	483
	Paint	0.03	1.2%	966
	Cleaners	0.015	0.6%	483
	Other	0.045	1.8%	1,448
	Total HHW	**0.105**	**4.2%**	**3,380**
Total weight		**2.5**	100.0%	80,472

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Diversion Programs

Discussion on the changes to current recycling/diversion programs is included in Section 4.5 of the draft report.

Estimated diversion potential including:

Types of Diversion	**Volume Diverted (m^3)**
Recycling	27,360
Composting	30,579
Scrap Metals	6,438
Electronic Waste	1,609
Tires	483
Construction & Demolition Materials	2,897
Hazardous Household Wastes	3,380
Total	72,746

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WASTE MANAGEMENT OPTIONS

Waste Transportation & Collection Operations

- Individual Disposal
- Collection Services are made Mandatory
  - Via Public Works
  - Via Contract Out

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Waste Diversion & Disposal Alternatives

CGS currently implements the following:

- **Blue Box** – cardboard, all paper, glass, cartons, plastic (#1,2,4,5 and 6), plastic bags, aluminum, empty paint cans, aerosol cans and egg cartons.
- **Green Cart** – paper coffee cups, paper bags, tissue paper, paper towels, paper takeout containers, all food waste
- **Leaf and Yard** – garden plants, straw, garden trimmings, grass clippings, branches
- **Household Hazardous Waste Depot** – batteries, fluorescent lights, syringes, propane/helium tanks, unused/expired medications
- **Garbage** – a one bag limit is currently being practiced.

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- It is assumed, at minimum that Atikameksheng will continue to implement their Blue Box program and that 38% of their waste will be diverted.
- The following table provides a summary of waste volume accumulated each year, potential volume of recyclables and total landfill capacity required to dispose of waste
- Capacity of existing landfill will be reached by 2024

Year	Volume (m^3)	Recyclables (38%)	Landfill Volume (m^3)
2020	3,318.6	1261.0	2,057.5
2021	6,702.8	2547.1	4,155.7
2022	10,154.1	3858.5	6,295.5
2023	13,673.7	5196.0	8,477.7
2024	17,263.0	6559.9	10,703.0
2025	20,923.3	7950.9	12,972.5
2026	24,656.2	9369.3	15,286.8
2027	28,462.9	10815.9	17,647.0
2028	32,345.0	12291.1	20,053.9
2029	36,304.0	13795.5	22,508.5
2030	40,341.4	15329.7	25,011.7
2031	44,458.7	16894.3	27,564.4
2032	48,657.5	18489.9	30,167.7
2033	52,939.5	20117.0	32,822.5
2034	57,306.2	21776.4	35,529.9
2035	61,759.5	23468.6	38,290.9
2036	66,300.9	25194.3	41,106.5
2037	70,932.2	26954.2	43,977.9
2038	75,655.2	28749.0	46,906.2
2039	80,471.7	30579.2	49,892.4

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Waste Disposal Alternatives

The following alternatives were considered within the draft report:

- Alternative 1 – Do Nothing
- Alternative 2 – Thermal Technology (Waste Incineration)
- Alternative 3 – Waste To Energy
- Alternative 4 – New Landfilling Site (with diversion)
- Alternative 5 – New Landfilling Site (without diversion)
- Alternative 2-5b – Waste Import
- Alternative 6 – Haul Off-Reserve to an Existing Landfill Site

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The following alternatives were considered within the draft report:

- Alternative 1 – Do Nothing
  - Not recommended as it does not meet the 20 year needs of the community, since existing site will reach its capacity well before

Item	Amount
Capital Cost	$180,000
Annual Operation & Maintenance	$101,282
20 Year Life Cycle Cost	$1,445,814

- Alternative 2 – Thermal Technology (Waste Incineration)
  - The waste generation rates for the community are too low to support this option (100 tonnes/day required, FN estimate to produce 4 tonnes/day)
- Alternative 3 – Waste To Energy
  - Not enough waste is produced to support this

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- Alternative 4 – New Landfilling Site (with diversion)
  - Assumes previously recommended site is developed
  - Assumes 38% diversion and new landfill area of 26.7 acres required

Item	Amount
Capital Cost	$3,922,699
Annual Operation & Maintenance	$101,282 to $119,704
20 Year Life Cycle Cost	$7,079,246

- Alternative 5 – New Landfilling Site (without diversion)
  - Assumes no diversion and 32.7 acres of land required.

Item	Amount
Capital Cost	$4,119,759
Annual Operation & Maintenance	$70,204
20 Year Life Cycle Cost	$6,407,875

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- Alternative 2-5b – Waste Import
  - Involves the acceptance of waste from neighboring communities to make the above alternatives feasible.
  - It is suspected that First Nation members would not approve this within their territory.
- Alternative 6 – Haul Off-Reserve to an Existing Landfill Site
  - Includes the development of a waste transfer station
  - Hauling of waste to final disposal site
  - Input and confirmation from CGS is recommended to refine this option.

Item	Amount
Capital Cost	$1,749,693
Annual Operation & Maintenance	$57,200 to $63,000
20 Year Life Cycle Cost	$4,488,593

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COMMENTS ON DRAFT REPORT

PROJECT MEETING #3

- **PRESENTATION OF FINAL DRAFT REPORT**
  Including lifecycle costing results and ranked alternatives
- **PROJECT TEAM and COMMUNITY MEMBER FEEDBACK**
  Comments regarding alternatives examined
  Suggestions to improve alternatives
- **REVIEW DRAFT EVALUATION MATRICES**
  Confirm agreeance with weighting and values assigned to each category

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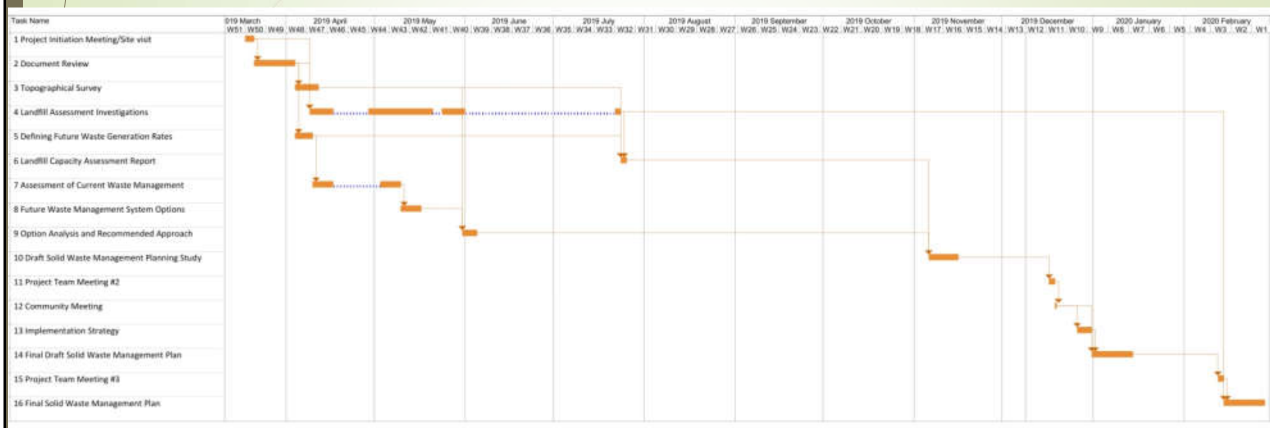
PROJECT SCHEDULE



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THANK YOU, MIIGWETCH!

QUESTIONS / COMMENTS

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December 18, 2019

ATIKAMEKSHENG ANISHNAWBEK

SWMP AND LANDFILL ASSESSMENT

Community Meeting #1 – Draft Report Presentation

The community meeting was held at the Atikameksheng Anishnawbek Administration Office on December 17, 2018 at 1pm and at 5pm. Those in attendance were as follows:

Session 1pm:	
Darin Migwans	Atikameksheng – Public Works Manager
Philip Stringer	Indigenous Services Canada (ISC) – Environment Officer
Bea Rodhs	North Shore Tribal Council (NTSC) – Waste Coordinator
Joanna Recollet	First Nations Engineering Services (FNESL) – Project Manager
William Ranson	Atikameksheng staff member
John Vallely	Atikameksheng staff member
Session 5pm:	
Darin Migwans	Atik – Public Works Manager
Bea Rodhs	NSTC – Waste Coordinator
Joanna Recollet	FNESL – Project Manager
Vivian Naponse	community member
Robert Paishegwon	community member

Item		Follow Up
1	**Community Meeting:** Joanna presented the attached power point presentation and took questions during the presentation. The following was noted at first session: • Discussion on improving First Nation participation in recycling program took place. Ultimately more education is recommended. It was suggested this could take place via workshops, children science camp, or newsletter. • In regard to hauling off reserve, if the alternative analysis demonstrates that a third party contractor costs more than the First Nation providing this service, ISC would consider directing funding to the First Nation. The following was noted at second session: • Members would like to see Public Works to initiate the monitoring program. • FNESL was directed to get more community consultation, since these session did not have a great turn out. FNESL to return in January to attend Elder's Luncheon and Coffee with the Director. Darin to coordinate and confirm. • Members would like to ensure Chief and Council are informed of the study. • Members do not support the idea of a survey going out to community.	

- It was noted that the previous SWMP, had recommended the closure of the existing landfill back in 2003 and nothing was done. This should be explained in the report and it should be ensured that any recommendations in this updated report be followed through with.

2	**Next Steps** Further community consultation will take place before proceeding with the Final Draft Report.

Copies of these Minutes of Meeting have been distributed to all those listed in attendance. If any errors/additions/deletions/omissions from these minutes of meeting, please contact the writer.

X

Joanna Recollet
FNESL Project Manager

ATIKAMEKSHENG ANISHNAWBEK SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT

Community Presentation

December 17, 2019

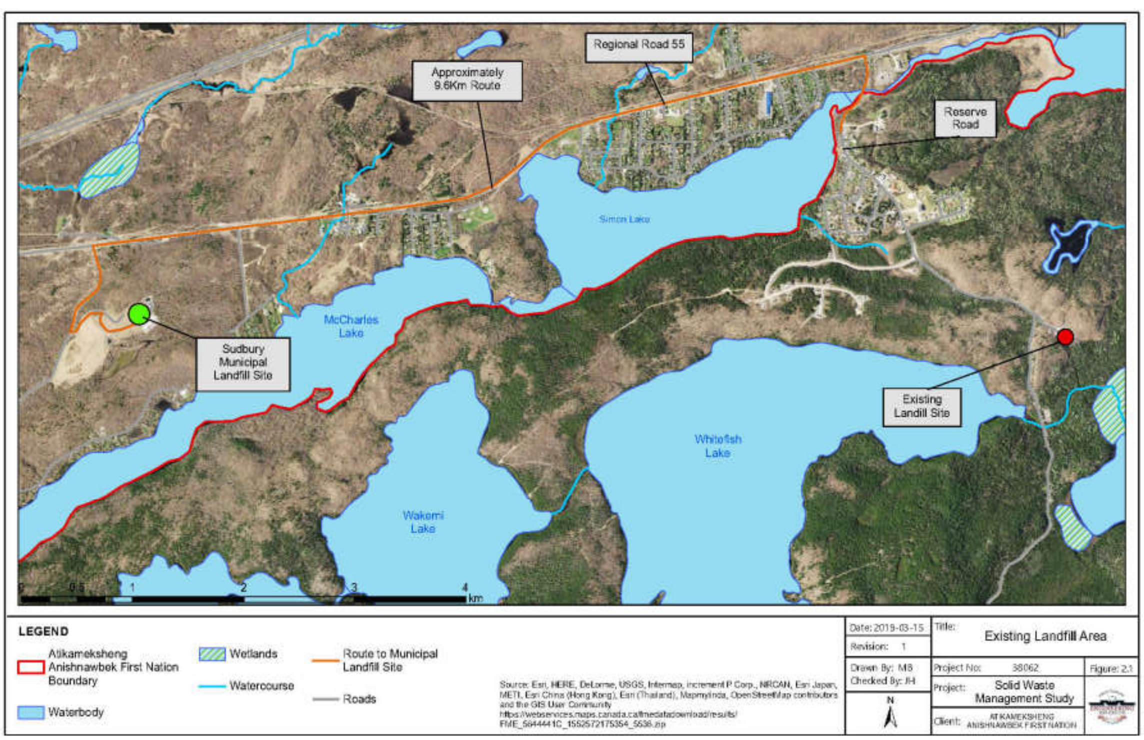
FIRST NATIONS ENGINEERING SERVICES LTD.

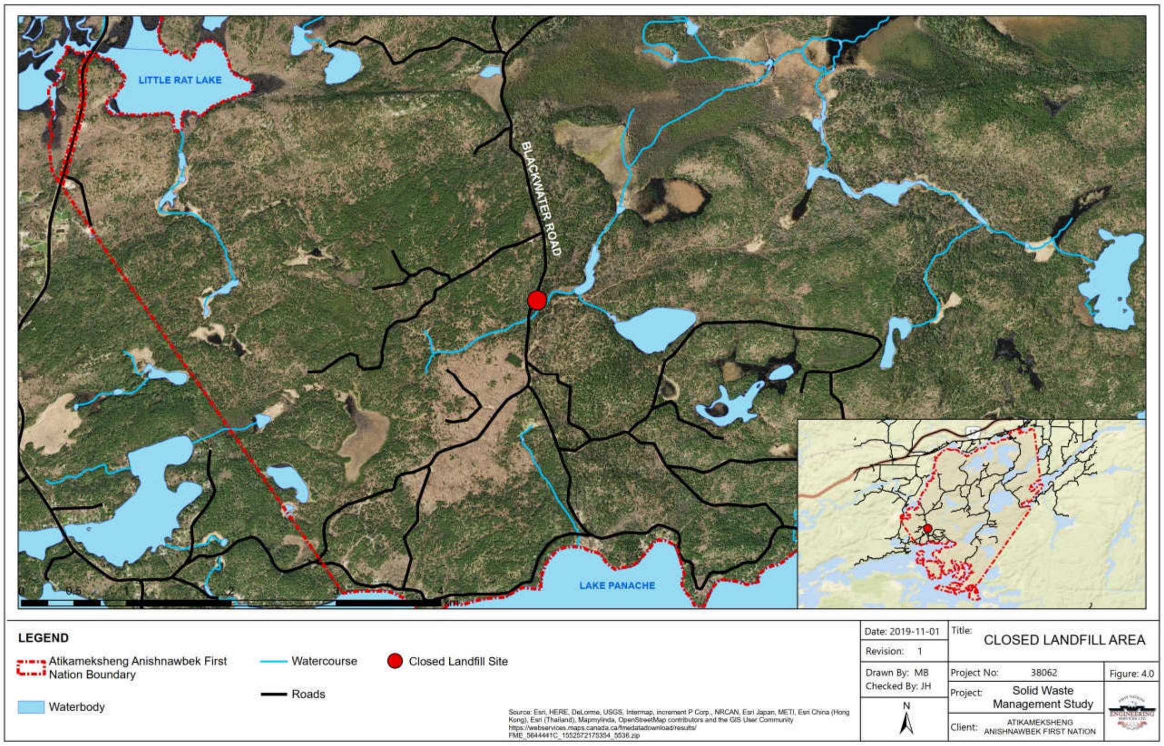
SUMMARY OF DRAFT REPORT

- PROJECT OBJECTIVES
- LANDFILL ASSESSMENT
- POPULATION PROJECTIONS
- WASTE GENERATION
- WASTE MANAGEMENT OPTIONS

STUDY OBJECTIVES

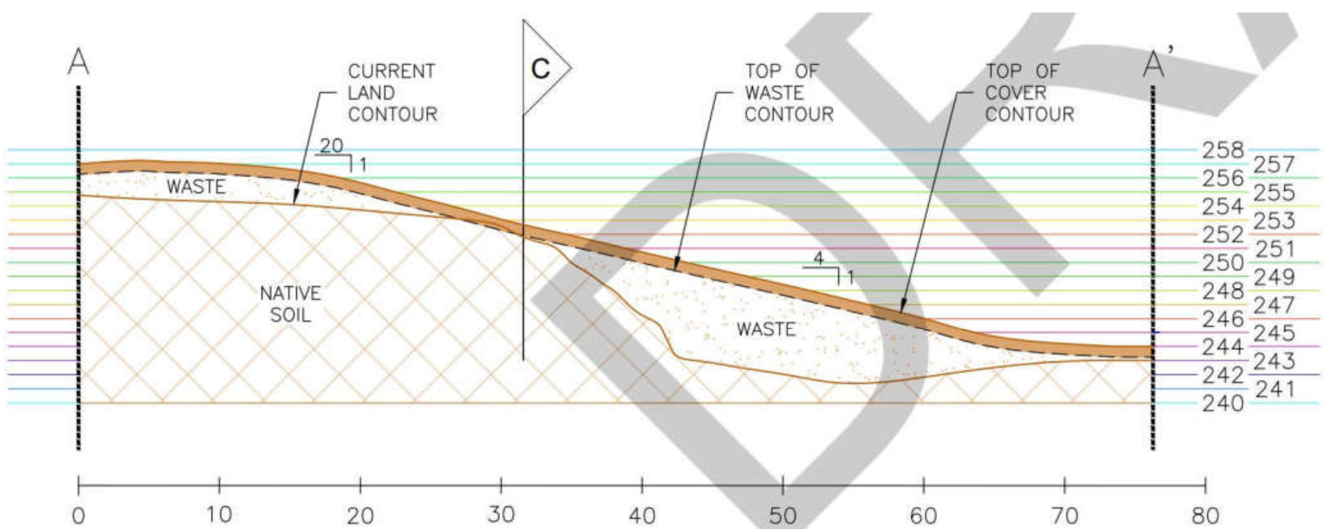
- Assessment of the existing landfill site and the abandoned landfill site at Penage, along Blackwater Rd.
- Project a 20-year population and its waste generation
- Determine the remaining life of the existing landfill
- Alternatives / recommendations provided for:
  - Future operational plans for the landfill site including on-going health & safety, security, final capping, closure and long-term monitoring;
  - Possible need to close and cap the previous land fill sites,
  - Recycling options,
- Comparison Analysis between:
  - establishing new Transfer Station, and options for entering a Municipal Service Agreement, or
  - Direct Drive option for local pick-up by local Municipality.
- Funding needs and sources;
- Provide a final Waste Management Plan based on community consultations





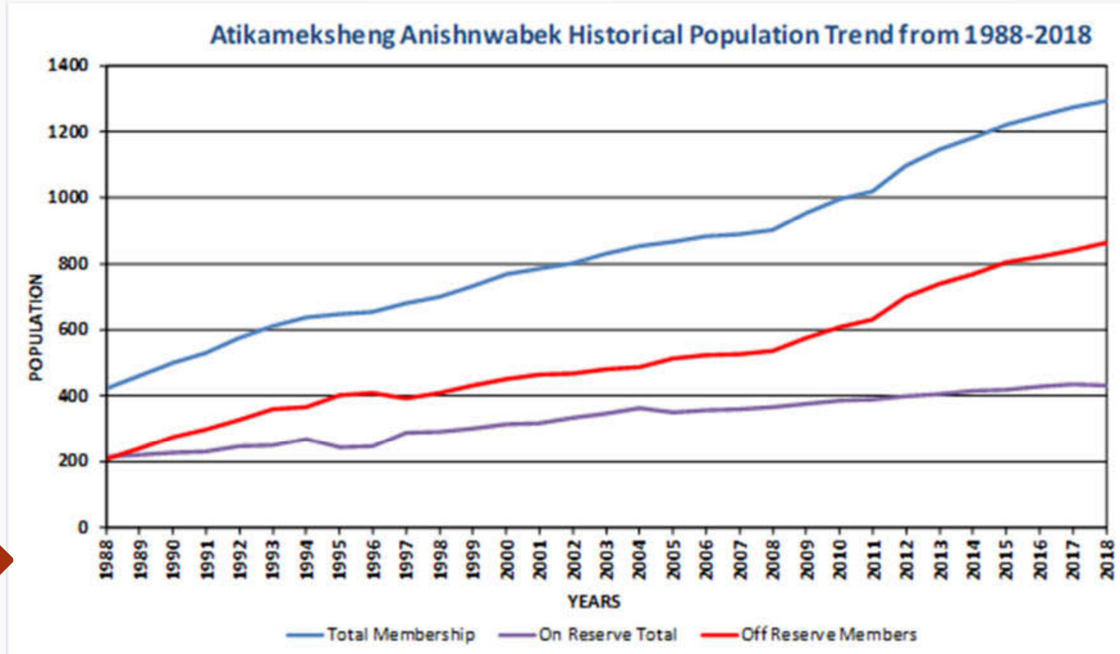
LANDFILL ASSESSMENT

- Pinchin Ltd completed an assessment of the existing Landfill and the abandoned landfill site.
- Hydrogeological assessment was completed at both sites and assessed for historical volumes of waste and estimated capacity remaining.
- Groundwater sampling results at both sites were not considered a significant environmental concern. It is noted this is one sampling event and regular monitoring is recommended.
- Surface water samples in the vicinity of the active site were sampled, with no exceedances except for phenols. However the phenols are not attributed to the landfill.
- An elevation survey estimated the active site had a total volume of 54,750 m^3 buried, and the closed site had approximately 2,100m^3.
- Based on the topography and recommended final slopes it is estimated that the active site has a remaining capacity of 10,000m^3.



SECTION A-A' PROPOSED WASTE COVER CONTOURS

AS NOTED



POPULATION PROJECTIONS

POPULATION PROJECTIONS

Adjusted base population to include non-members living on-reserve and children not yet registered, total on-reserve population is 483.

Based on historical growth, the following average annual growth rates were calculated and compared:

	Total Population	On-Reserve	Off-Reserve
AAGR Base Year 1988	3.79	2.35	4.89
AAGR Base Year 1998	3.12	1.98	3.80
AAGR Base Year 2008	3.66	1.65	4.85

An AAGR of 1.98% is recommended, which projects a 20 year on-reserve population of 715. The following table summarizes the projection:

	Baseline	5th Year	10th Year	15th Year	20th Year	50th Year
Year:	2019	2024	2029	2034	2039	2068
Population:	483	533	588	648	715	1262

WASTE GENERATION ESTIMATE

Several waste generation rates were considered and are listed below:

Source	Generation Rate	Year
Ontario First Nations	1.67 kg/cap/day	1997
AANDC	1.50 kg/cap/day	2002
Atikameksheng Anishnawbek First Nation	1.81 kg/cap/day	2003
Statistics Canada - Canada	2.00 kg/cap/day	2010
Statistics Canada - Ontario	1.92 kg/cap/day	2010

A waste generation rate of 1.81 Kg/cap/day was used to estimate the 20 year waste generation.

$$Volume\ \left({}^{m^3}/_{yr}\right) = Population\ \times \frac{Generation\ Rate\ (kg/yr/cap)}{Waste\ Density\ (kg/m^3)}$$

The above calculation was used to project a 20 year volume of waste of 80,471.7 m^3. Based on this volume it is estimated a total area of 32.7 acres of landfill would be required.

WASTE COMPOSITION

- Solid Waste Management Strategy Planning Manual (1997) prepared for Ontario First Nations.

- Table 9 from the report categorizes the composition into waste items that can be diverted and its estimated that 87% could potentially be diverted from landfilling

Waste Items	Volume (m^3)
Organics	9,657
Recyclables (fibre, cardboard, plastic, metal, etc.)	39,431
Automobiles	8,691
Snowmobiles	3,380
Appliances	1,448
Furniture	966
Tires	483
Building Materials	2,897
Household Hazardous Waste	3,380
Maximum Potential Volume of Waste to be Diverted:	70,332
Percentage of Diverted Waste:	87%

Estimates assume 100% community participation

	Total 20 Year Waste Generation		80,472 m^3	
	Waste Item	Weight (kg)	Percentage	Projections (m^3)
Organics	Vegetable	0.075	3.0%	2,414
	Processed Foods	0.12	4.8%	3,863
	Meat/Parts	0.06	2.4%	1,931
	Other Organic	0.045	1.8%	1,448
	Total Organic	**0.3**	**12.0%**	**9,657**
Fibres	News/Flyers	0.24	9.6%	7,725
	White	0.24	9.6%	7,725
	Other Fibre	0.55	22.0%	17,704
	Total Fibre	**1.03**	**41.2%**	**33,154**
Containers	Steel	0.075	3.0%	2,414
	Aluminum	0.015	0.6%	483
	Wood	0.06	2.4%	1,931
	Plastic	0.09	3.6%	2,897
	Other	0.015	0.6%	483
	Total Containers	**0.255**	**10.2%**	**8,208**
Other Household Goods	Plastic Film	0.03	1.2%	966
	Foil	0.015	0.6%	483
	Diapers	0.06	2.4%	1,931
	Paper Towels	0.015	0.6%	483
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	Total other households	**0.15**	**6.0%**	**4,828**
Miscellaneous Bulk	Clothing	0.03	1.2%	966
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	Other	0.045	1.8%	1,448
	Total HHW	**0.105**	**4.2%**	**3,380**
Total weight		**2.5**	100.0%	80,472

Diversion Programs

Discussion on the changes to current recycling/diversion programs is included in the draft report.

Estimated diversion potential including:

Types of Diversion	Volume Diverted (m^3)
Recycling	27,360
Composting	30,579
Scrap Metals	6,438
Electronic Waste	1,609
Tires	483
Construction & Demolition Materials	2,897
Hazardous Household Wastes	3,380
Total	72,746

WASTE MANAGEMENT OPTIONS

Waste Transportation & Collection Operations

	Individual Disposal	Mandatory Collection – via Public Works	Mandatory Collection – via Contracted Out
Advantages	- No cost to operations	- Controlled - Convenience for residence	- Jobs created - Significant portion funded by ISC
Disadvantage	- Uncontrolled dumping - Not all residence can transport waste to site	- Strain on operations budget, ISC does not provide additional funding - Takes staff away from other duties	- Funds potentially directed away from community - Private contractor can hire who they want

Waste Diversion & Disposal Alternatives

CGS currently implements the following:

- **Blue Box** – cardboard, all paper, glass, cartons, plastic (#1,2,4,5 and 6), plastic bags, aluminum, empty paint cans, aerosol cans and egg cartons.
- **Green Cart** – paper coffee cups, paper bags, tissue paper, paper towels, paper takeout containers, all food waste
- **Leaf and Yard** – garden plants, straw, garden trimmings, grass clippings, branches
- **Household Hazardous Waste Depot** – batteries, fluorescent lights, syringes, propane/helium tanks, unused/expired medications
- **Garbage** – a one bag limit is currently being practiced.

- It is assumed, at minimum that Atikameksheng will continue to implement their Blue Box program and that 38% of their waste will be diverted.
- The following table provides a summary of waste volume accumulated each year, potential volume of recyclables and total landfill capacity required to dispose of waste
- Capacity of existing landfill will be reached by 2024

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2038	75,655.2	28749.0	46,906.2
2039	80,471.7	30579.2	49,892.4

Waste Disposal Alternatives

The following alternatives were considered within the draft report:

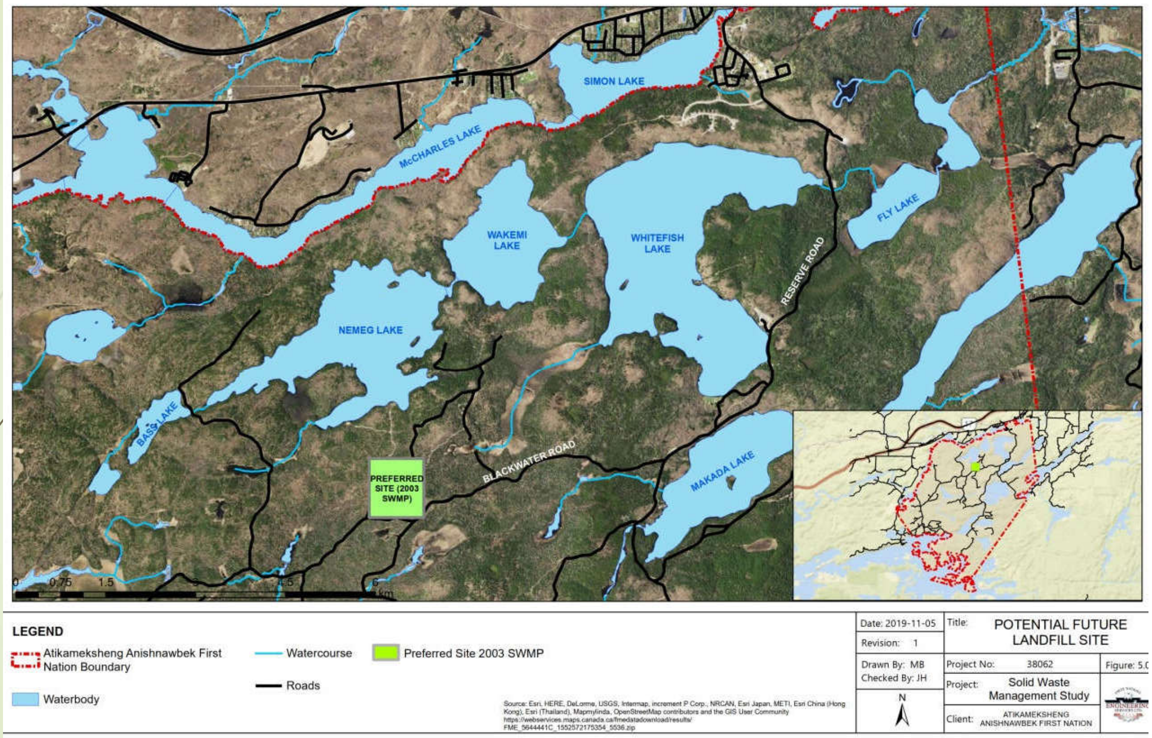
- Alternative 1 – Do Nothing
- Alternative 2 – Thermal Technology (Waste Incineration)
- Alternative 3 – Waste To Energy
- Alternative 4 – New Landfilling Site (with diversion)
- Alternative 5 – New Landfilling Site (without diversion)
- Alternative 2-5b – Waste Import
- Alternative 6 – Haul Off-Reserve to an Existing Landfill Site

The following alternatives were considered within the draft report:

- **Alternative 1 – Do Nothing**
  - Not recommended as it does not meet the 20 year needs of the community, since existing site will reach its capacity well before

Item	Amount
Capital Cost	$180,000
Annual Operation & Maintenance	$101,282
20 Year Life Cycle Cost	$1,445,814

- **Alternative 2 – Thermal Technology (Waste Incineration)**
  - The low waste generation rates for the community are too low to support this option
- **Alternative 3 – Waste To Energy**
  - Not enough waste is produced to support this



- **Alternative 4 – New Landfilling Site (with diversion)**
  - Assumes previously recommended site is developed
  - Assumes 38% diversion and new landfill area of 26.7 acres required

Advantages	Disadvantages
• FN has control of site • Job created • No tipping fees • Maintain recycling program	• Environmental liability • High capital cost • High operation & maintenance cost

Item	Amount
Capital Cost	$3,922,699
Annual Operation & Maintenance	$101,282 to $119,704
20 Year Life Cycle Cost	$7,079,246

- **Alternative 5 – New Landfilling Site (without diversion)**
  - Assumes no diversion and 32.7 acres of land required.

Advantages	Disadvantages
- Reduces operation costs - FN maintains control of their waste disposal	- No recycling - More land required - High capital cost

Item	Amount
Capital Cost	$4,119,759
Annual Operation & Maintenance	$70,204
20 Year Life Cycle Cost	$6,407,875

- **Alternative 2-5b – Waste Import**
  - Involves the acceptance of waste from neighboring communities to make the above alternatives feasible.
  - It is suspected First Nation members would not approve of this within their territory.

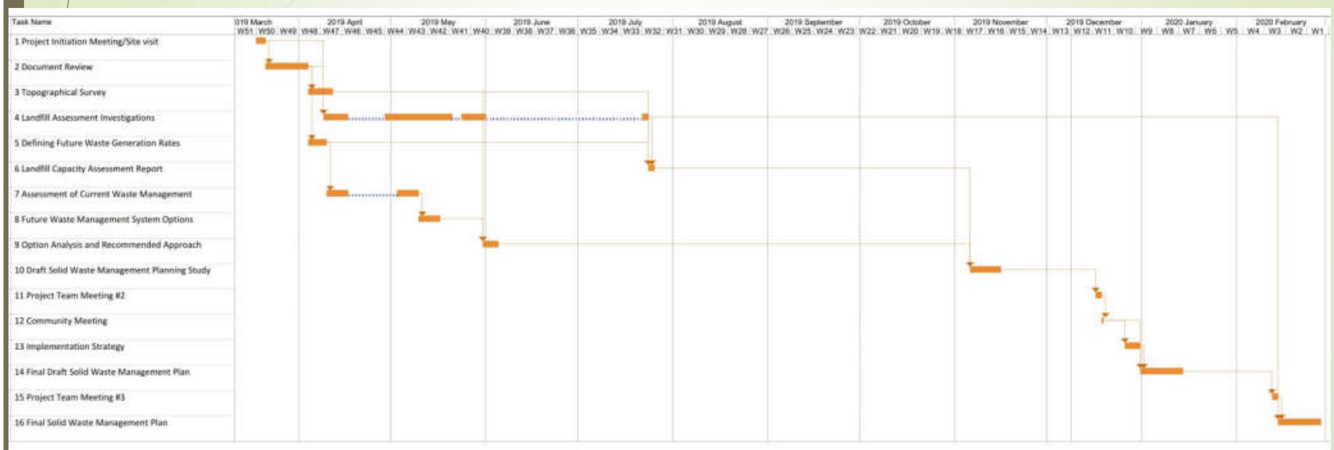
- **Alternative 6 – Haul Off-Reserve to an Existing Landfill Site**
  - Includes the development of a waste transfer station
  - Hauling of waste to final disposal site
  - Input and confirmation from CGS is recommended to refine this option.

Advantages	Disadvantages
- Most feasible option - Environmental liability reduced - Land not used up for waste disposal	- No control on tipping fees

Item	Amount
Capital Cost	$1,749,693
Annual Operation & Maintenance	$57,200 to $63,000
20 Year Life Cycle Cost	$4,488,593

Aundeck Omni Kaning – Waste Transfer Station

PROJECT SCHEDULE



THANK YOU, MIIGWETCH!

QUESTIONS / COMMENTS

January 17, 2020

ATIKAMEKSHENG ANISHNAWBEK

SWMP AND LANDFILL ASSESSMENT

Community Meeting #2 – Draft Report Presentation

The community meeting was held at the Atikameksheng Anishnawbek Administration Office on January 16, 2020 at 11:30am. Those in attendance were as follows:

Darin Migwans	Atikameksheng – Public Works Manager
Joanna Recollet	First Nations Engineering Services (FNESL) – Project Manager
John Haaland	FNESL – EIT

Community Members in Attendance:

Tiana Wabegijig	Stanley Muskell	Lisa Groulx
Lindsay Saikkonen	Darlene Paquin	Beverly Belanger
Teresa Migwans	Fitzgerald Reid	Cheryl Thurston
William Ransom	Myra Wabegijig	Vivian Naponse

Item		Follow Up
1	**Community Meeting:**	

Joanna presented the attached power point presentation and took questions during the presentation.

The following was noted during session:

- Surface water sampling locations clarified to Fly Lake, Whitefish Lake and Unnamed Creek connecting the two lakes.
- An additional historical landfill location was noted in the new subdivision area. Gabode area, 2 members present expressed interest in water quality as a result of historical landfill.
- Clarified with those present, waste generation rates are determined for current and projected on reserve residents. Members were concerned with the potential waste generation by businesses, (ie. Atikameksheng Industrial Park) and subsequent disposal.
- Tracking of diversion indicates that around 54% participation in recycling program.
- Education Programs – ISC provides funding for educational programs, many in attendance are in strong support for the need of more educational programs for community members.
- Member inquires whether a nearby facility would purchase waste for the purposes of "Waste to Energy" production.
- Can other forms of media be used to present to community members. For example, utilize YouTube video to share presentation and have members complete a survey via Survey Monkey. It was mentioned that some members may not want to leave their homes and attend community presentation.
- Diners club is held every Wednesday at noon, roughly 30 people attend club activities, potential presentation opportunity.

	• February 22nd, 2020, community carnival provides another opportunity to share information with community members.
2	**Next Steps** Further community consultation will take place before proceeding with the Final Draft Report. • Darin proposed next community session for January 29th, 2020 i) 5:30 pm – Dinner ii) 6:00 pm – Present to attendees iii) 6:30 pm – Question and Answer period iv) 7:00 pm – Closure

Copies of these Minutes of Meeting have been distributed to all those listed in attendance. If any errors/additions/deletions/omissions from these minutes of meeting, please contact the writer.

X

Joanna Recollet
FNESL Project Manager

ATIKAMEKSHENG ANISHNAWBEK SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT
Community Presentation

December 17, 2019

FIRST NATIONS ENGINEERING SERVICES LTD.

1

SUMMARY OF DRAFT REPORT

- PROJECT OBJECTIVES
- LANDFILL ASSESSMENT
- POPULATION PROJECTIONS
- WASTE GENERATION
- WASTE MANAGEMENT OPTIONS

2

STUDY OBJECTIVES

- Assessment of the existing landfill site and the abandoned landfill site at Panache, along Blackwater Rd.
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- Determine the remaining life of the existing landfill
- Alternatives / recommendations provided for:
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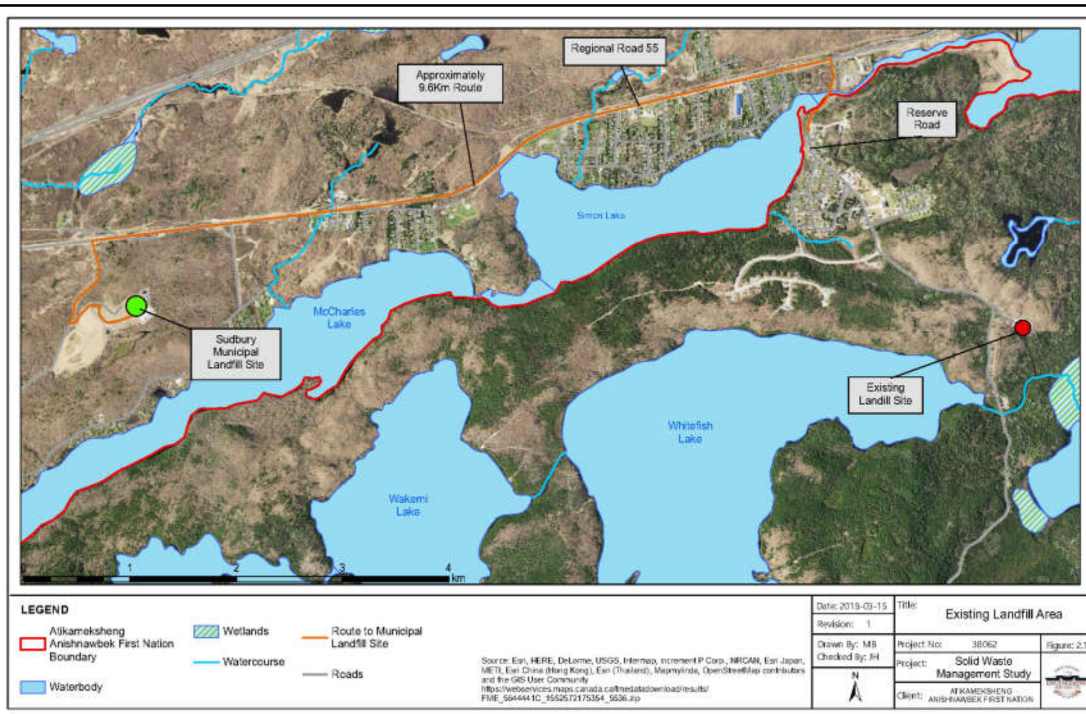
3



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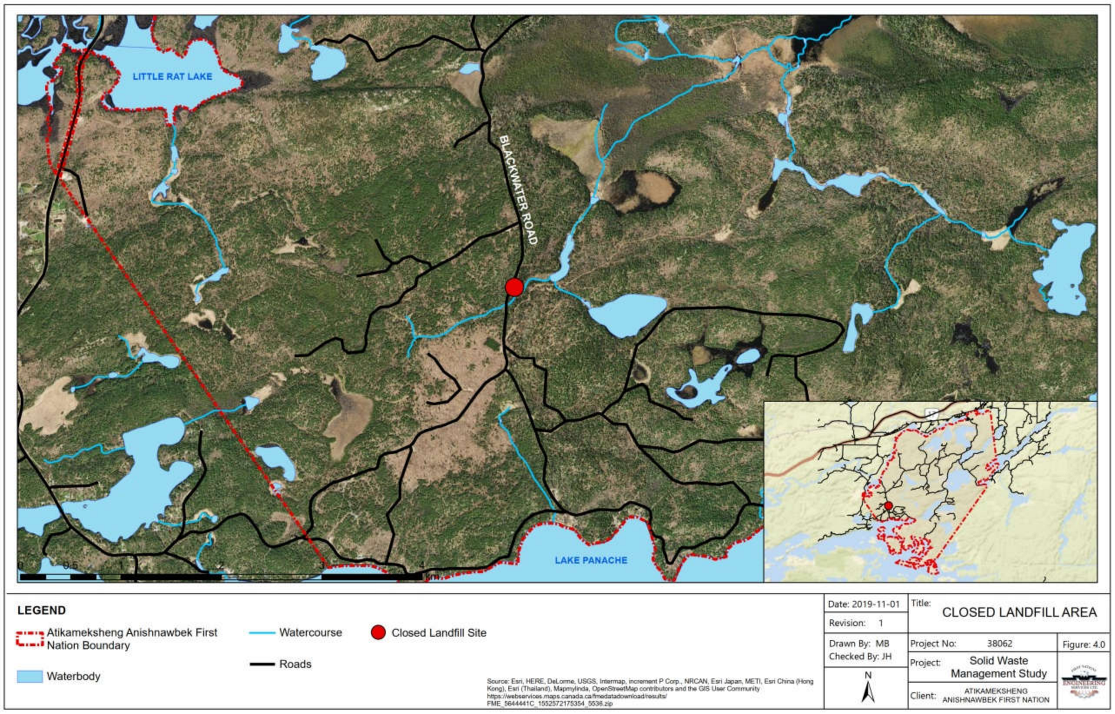

5

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- Hydrogeological assessment was completed at both sites and assessed for historical volumes of waste and estimated capacity remaining.
- Groundwater sampling results at both sites were not considered a significant environmental concern. It is noted this is one sampling event and regular monitoring is recommended.
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6

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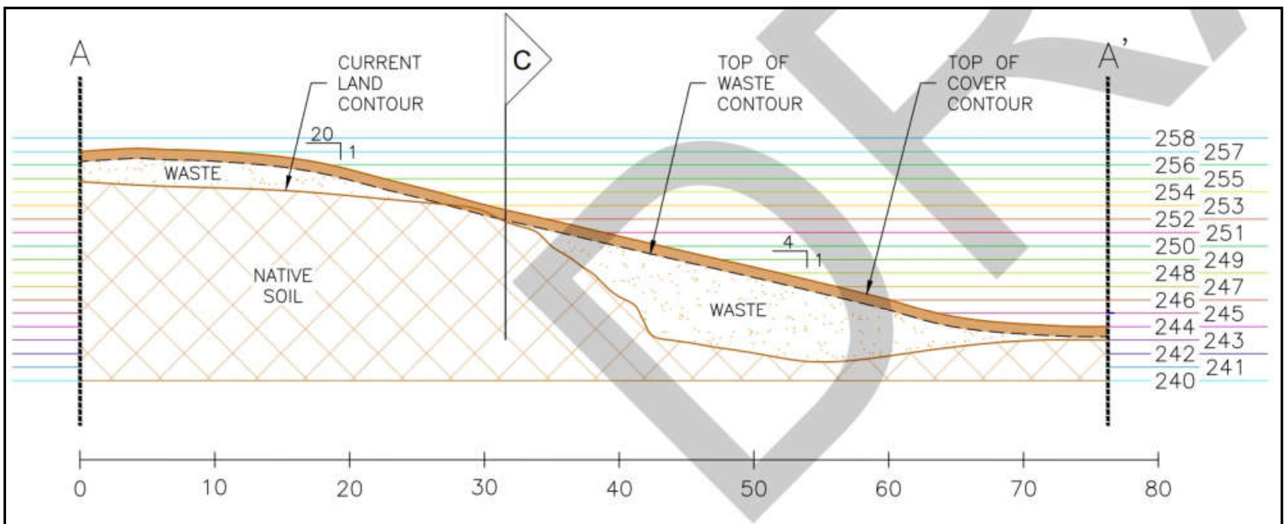
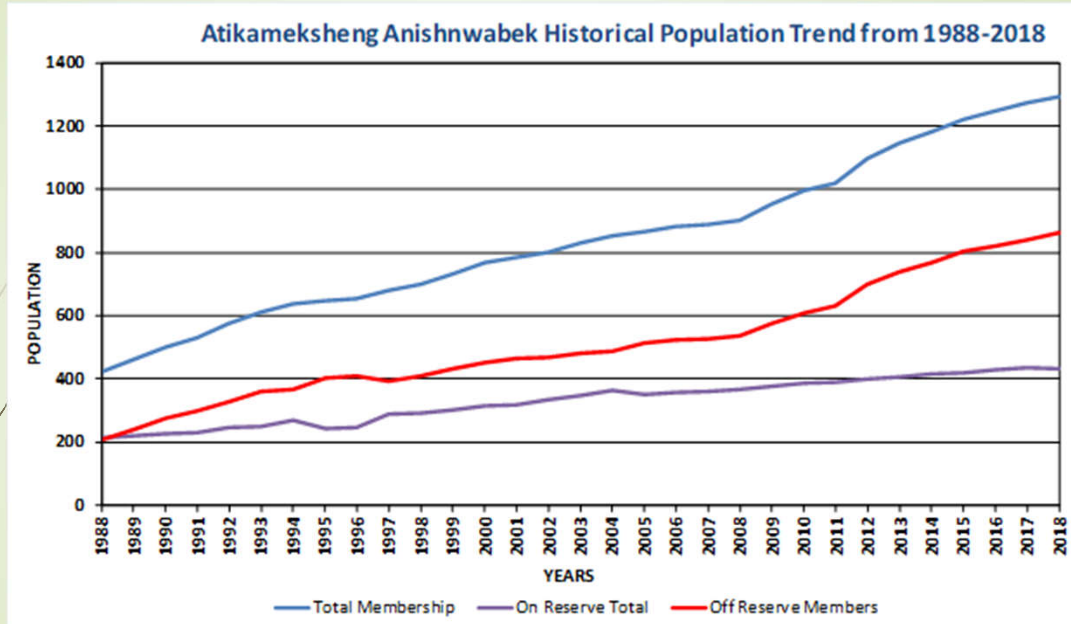


SECTION A-A' PROPOSED WASTE COVER CONTOURS

AS NOTED

8



POPULATION PROJECTIONS

9

POPULATION PROJECTIONS

Adjusted base population to include non-members living on-reserve and children not yet registered, total on-reserve population is 483.

Based on historical growth, the following average annual growth rates were calculated and compared:

	Total Population	On-Reserve	Off-Reserve
AAGR Base Year 1988	3.79	2.35	4.89
AAGR Base Year 1998	3.12	1.98	3.80
AAGR Base Year 2008	3.66	1.65	4.85

An AAGR of 1.98% is recommended, which projects a 20 year on-reserve population of 715. The following table summarizes the projection:

	Baseline	5th Year	10th Year	15th Year	20th Year	50th Year
Year:	2019	2024	2029	2034	2039	2068
Population:	483	533	588	648	715	1262

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WASTE GENERATION ESTIMATE

Several waste generation rates were considered and are listed below:

Source	Generation Rate	Year
Ontario First Nations	1.67 kg/cap/day	1997
AANDC	1.50 kg/cap/day	2002
Atikameksheng Anishnawbek First Nation	1.81 kg/cap/day	2003
Statistics Canada - Canada	2.00 kg/cap/day	2010
Statistics Canada - Ontario	1.92 kg/cap/day	2010

A waste generation rate of 1.81 Kg/cap/day was used to estimate the 20 year waste generation.

$$Volume\ \left(m^3/_{yr}\right) = Population\ \times \frac{Generation\ Rate\ (kg/yr/cap)}{Waste\ Density\ (kg/m^3)}$$

The above calculation was used to project a 20 year volume of waste of 80,471.7 m^3. Based on this volume it is estimated a total area of 32.7 acres of landfill would be required.

11

WASTE COMPOSITION

- Solid Waste Management Strategy Planning Manual (1997) prepared for Ontario First Nations.
- Table 9 from the report categorizes the composition into waste items that can be diverted and its estimated that 87% could potentially be diverted from landfilling

Waste Items	Volume (m^3)
Organics	9,657
Recyclables (fibre, cardboard, plastic, metal, etc.)	39,431
Automobiles	8,691
Snowmobiles	3,380
Appliances	1,448
Furniture	966
Tires	483
Building Materials	2,897
Household Hazardous Waste	3,380
Maximum Potential Volume of Waste to be Diverted:	70,332
Percentage of Diverted Waste:	87%

**Estimates assume 100% community participation*

Total 20 Year Waste Generation		80,472 m^3		
Waste Item		Weight (kg)	Percentage	Projections (m^3)
Organics	Vegetable	0.075	3.0%	2,414
	Processed Foods	0.12	4.8%	3,863
	Meat/Parts	0.06	2.4%	1,931
	Other Organic	0.045	1.8%	1,448
	Total Organic	**0.3**	**12.0%**	**9,657**
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	White	0.24	9.6%	7,725
	Other Fibre	0.55	22.0%	17,704
	Total Fibre	**1.03**	**41.2%**	**33,154**
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	Aluminum	0.015	0.6%	483
	Wood	0.06	2.4%	1,931
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	Foil	0.015	0.6%	483
	Diapers	0.06	2.4%	1,931
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	Total HHW	**0.105**	**4.2%**	**3,380**
Total weight		**2.5**	100.0%	80,472

12

Diversion Programs

Discussion on the changes to current recycling/diversion programs is included in the draft report.

Estimated diversion potential including:

Types of Diversion	Volume Diverted (m^3)
Recycling	27,360
Composting	30,579
Scrap Metals	6,438
Electronic Waste	1,609
Tires	483
Construction & Demolition Materials	2,897
Hazardous Household Wastes	3,380
Total	72,746

13

WASTE MANAGEMENT OPTIONS

Waste Transportation & Collection Operations

	Individual Disposal	Mandatory Collection – via Public Works	Mandatory Collection – via Contracted Out
Advantages	- No cost to operations	- Controlled - Convenience for residence	- Jobs created - Significant portion funded by ISC
Disadvantage	- Uncontrolled dumping - Not all residence can transport waste to site	- Strain on operations budget, ISC does not provide additional funding - Takes staff away from other duties	- Funds potentially directed away from community - Private contractor can hire who they want

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Waste Diversion & Disposal Alternatives

CGS currently implements the following:

- **Blue Box** – cardboard, all paper, glass, cartons, plastic (#1,2,4,5 and 6), plastic bags, aluminum, empty paint cans, aerosol cans and egg cartons.
- **Green Cart** – paper coffee cups, paper bags, tissue paper, paper towels, paper takeout containers, all food waste
- **Leaf and Yard** – garden plants, straw, garden trimmings, grass clippings, branches
- **Household Hazardous Waste Depot** – batteries, fluorescent lights, syringes, propane/helium tanks, unused/expired medications
- **Garbage** – a one bag limit is currently being practiced.

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- It is assumed, at minimum that Atikameksheng will continue to implement their Blue Box program and that 38% of their waste will be diverted.
- The following table provides a summary of waste volume accumulated each year, potential volume of recyclables and total landfill capacity required to dispose of waste
- Capacity of existing landfill will be reached by 2024

Year	Volume (m^3)	Recyclables (38%)	Landfill Volume (m^3)
2020	3,318.6	1261.0	2,057.5
2021	6,702.8	2547.1	4,155.7
2022	10,154.1	3858.5	6,295.5
2023	13,673.7	5196.0	8,477.7
2024	17,263.0	6559.9	10,703.0
2025	20,923.3	7950.9	12,972.5
2026	24,656.2	9369.3	15,286.8
2027	28,462.9	10815.9	17,647.0
2028	32,345.0	12291.1	20,053.9
2029	36,304.0	13795.5	22,508.5
2030	40,341.4	15329.7	25,011.7
2031	44,458.7	16894.3	27,564.4
2032	48,657.5	18489.9	30,167.7
2033	52,939.5	20117.0	32,822.5
2034	57,306.2	21776.4	35,529.9
2035	61,759.5	23468.6	38,290.9
2036	66,300.9	25194.3	41,106.5
2037	70,932.2	26954.2	43,977.9
2038	75,655.2	28749.0	46,906.2
2039	80,471.7	30579.2	49,892.4

16

Waste Disposal Alternatives

The following alternatives were considered within the draft report:

- Alternative 1 – Do Nothing
- Alternative 2 – Thermal Technology (Waste Incineration)
- Alternative 3 – Waste To Energy
- Alternative 4 – New Landfilling Site (with diversion)
- Alternative 5 – New Landfilling Site (without diversion)
- Alternative 2-5b – Waste Import
- Alternative 6 – Haul Off-Reserve to an Existing Landfill Site

17

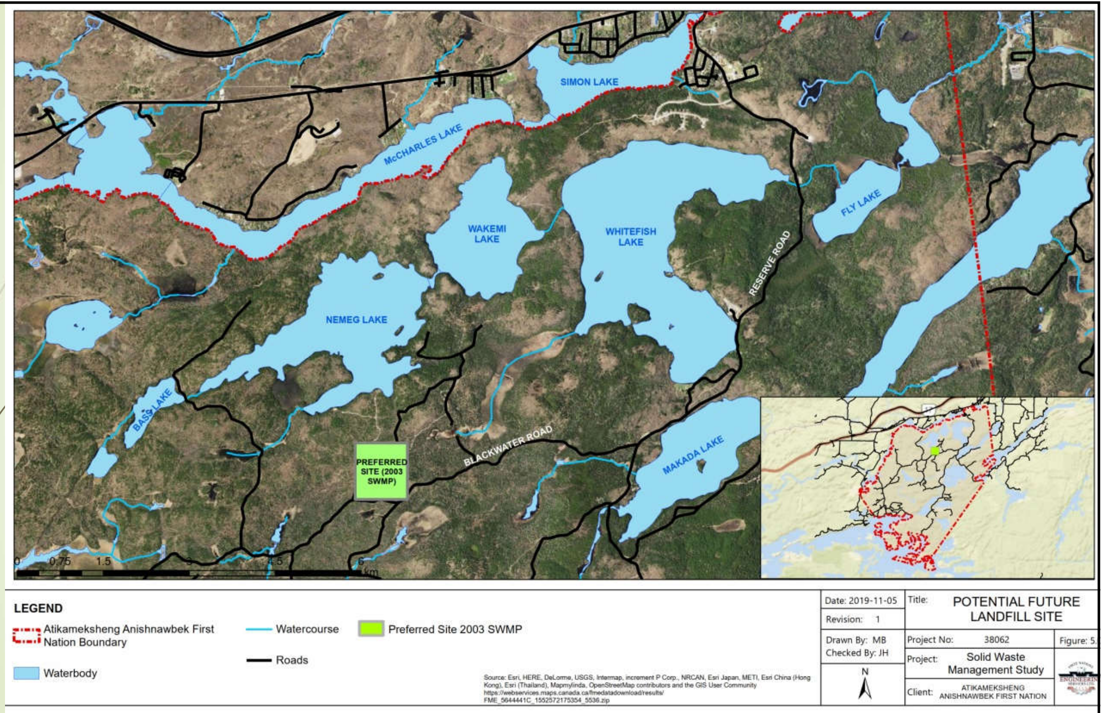
The following alternatives were considered within the draft report:

- **Alternative 1 – Do Nothing**
  - Not recommended as it does not meet the 20 year needs of the community, since existing site will reach its capacity well before

Item	Amount
Capital Cost	$180,000
Annual Operation & Maintenance	$101,282
20 Year Life Cycle Cost	$1,445,814

- **Alternative 2 – Thermal Technology (Waste Incineration)**
  - The low waste generation rates for the community are too low to support this option
- **Alternative 3 – Waste To Energy**
  - Not enough waste is produced to support this

18



19

Alternative 4 – New Landfilling Site (with diversion)

- Assumes previously recommended site is developed
- Assumes 38% diversion and new landfill area of 26.7 acres required

Advantages	Disadvantages
• FN has control of site • Job created • No tipping fees • Maintain recycling program	• Environmental liability • High capital cost • High operation & maintenance cost

Item	Amount
Capital Cost	$3,922,699
Annual Operation & Maintenance	$101,282 to $119,704
20 Year Life Cycle Cost	$7,079,246

20

Alternative 5 – New Landfilling Site (without diversion)

- Assumes no diversion and 32.7 acres of land required.

Advantages	Disadvantages
- Reduces operation costs - FN maintains control of their waste disposal	- No recycling - More land required - High capital cost

Item	Amount
Capital Cost	$4,119,759
Annual Operation & Maintenance	$70,204
20 Year Life Cycle Cost	$6,407,875

21

Alternative 2-5b – Waste Import

- Involves the acceptance of waste from neighboring communities to make the above alternatives feasible.
- It is suspected that First Nation members would not approve of this within their territory.

22

- **Alternative 6 – Haul Off-Reserve to an Existing Landfill Site**
  - Includes the development of a waste transfer station
  - Hauling of waste to final disposal site
  - Input and confirmation from CGS is recommended to refine this option.

Advantages	Disadvantages
- Most feasible option - Environmental liability reduced - Land not used up for waste disposal	- No control on tipping fees

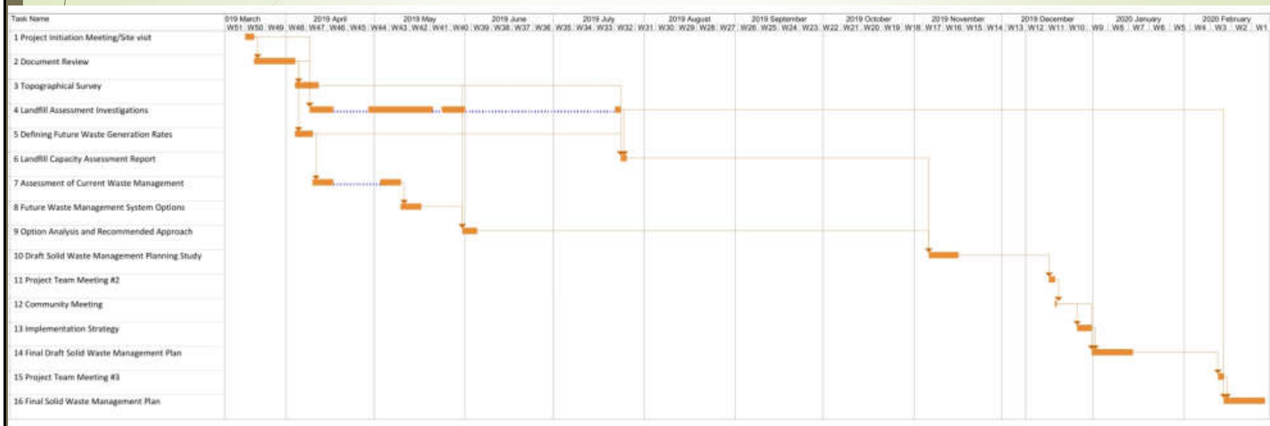
Item	Amount
Capital Cost	$1,749,693
Annual Operation & Maintenance	$57,200 to $63,000
20 Year Life Cycle Cost	$4,488,593

23

Aundeck Omni Kaning – Waste Transfer Station

24

PROJECT SCHEDULE



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THANK YOU, MIIGWETCH!

QUESTIONS / COMMENTS

26

February 21, 2020

ATIKAMEKSHENG ANISHNAWBEK

SWMP AND LANDFILL ASSESSMENT

Community Meeting #3 – Draft Report Presentation

The community meeting was held at the Atikameksheng Anishnawbek Administration Office on February 19, 2020 at 5:00pm. Those in attendance were as follows:

Darin Migwans	Atikameksheng – Public Works Manager
Arvind Sharma	Atikameksheng – Director of Planning and Infrastructure
Joanna Recollet	First Nations Engineering Services (FNESL) – Project Manager
John Haaland	FNESL – EIT
Bea Rodh	Mamaweswen – The North Shore Tribal Council (NSTC)

Community Members in Attendance:

Robert Paishegwon	Monica Homer	Melissa Godfrey

Item		Follow Up
1	**Community Meeting:** Joanna presented the attached power point presentation and took questions during the presentation. The following was noted during session: • McCharles Lake Road Transfer Station accepts solid waste, no recyclables. • Recyclables are transported to Frobisher Road at the City of Greater Sudbury. • Clarification was provided to attendees on location of sampling wells at the existing and historical landfill. (Background and downstream sampling). • Surface water sample locations also clarified. Noted that sampling was a one time occurrence and continued sampling spanning multiple seasons is recommended by PINCHIN. • Community members noted that training of a community member possible to obtain and deliver sample to laboratory. Approximate 5 community members are trained for water sampling already exist. Confirmation of licence and certification for sampling requirements. • Environmental funding, Skills & Partnership moneys potentially available for training as required. • Since recycling has begun, participation levels within the community has seen some increasing numbers. A strong recommendation for future educations programs on waste diversion needed for community members. • Location of proposed landfill site for Atikameksheng reserve was noted to be local deer hunting grounds and would strongly oppose this location.	**Atik/ NSTC/ FNESL**

		• Historically, there was a problem at the existing landfill where non-members and non-residents of the community deposited trash at landfill. Attendant at landfill has been a significant improvement for the operations of the community's landfill. • Meeting between community representative and CGS representative to discuss establishing MTSA. • NSTC noted that the time to construct the transfer station for the Aundeck Omni Kaning community was roughly 6 months to complete. • Serpent River & Mississauga have also constructed transfer stations and have seen large money returns for their diversion programs.	 **Atik**
2	**Next Steps**	Further community consultation will take place before proceeding with the Final Draft Report. i) FNESL to provide summary of selected alternatives from community input for upload to Atikameksheng newsletter. ii) Atikameksheng to set up online survey of selected alternatives for further community input.	 **FNESL** **Atik**

Copies of these Minutes of Meeting have been distributed to all those listed in attendance. If any errors/additions/deletions/omissions from these minutes of meeting, please contact the writer.

X

Joanna Recollet
FNESL Project Manager

ATIKAMEKSHENG ANISHNAWBEK SOLID WASTE MANAGEMENT SYSTEM PLANNING STUDY AND LANDFILL ASSESSMENT
Community Presentation

February 19, 2020

FIRST NATIONS ENGINEERING SERVICES LTD.

PINCHIN

ATIKAMEKSHENG ANISHNAWBEK

FIRST NATIONS ENGINEERING SERVICES LTD.

1

SUMMARY OF DRAFT REPORT

- PROJECT OBJECTIVES
- LANDFILL ASSESSMENT
- POPULATION PROJECTIONS
- WASTE GENERATION
- WASTE MANAGEMENT OPTIONS

2

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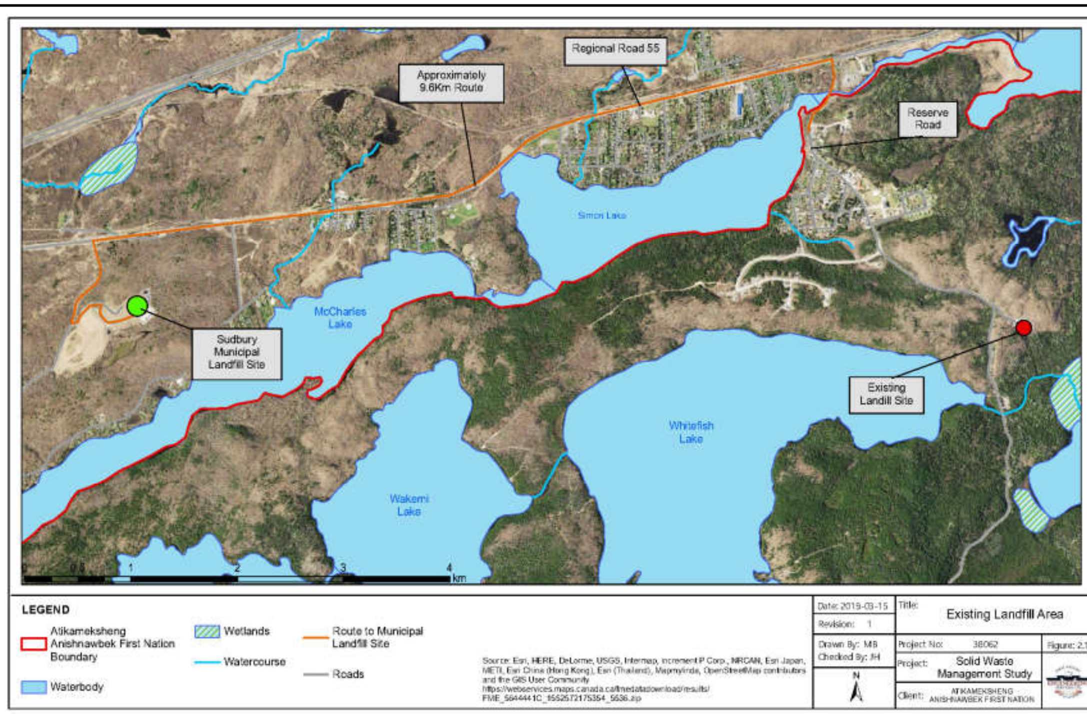

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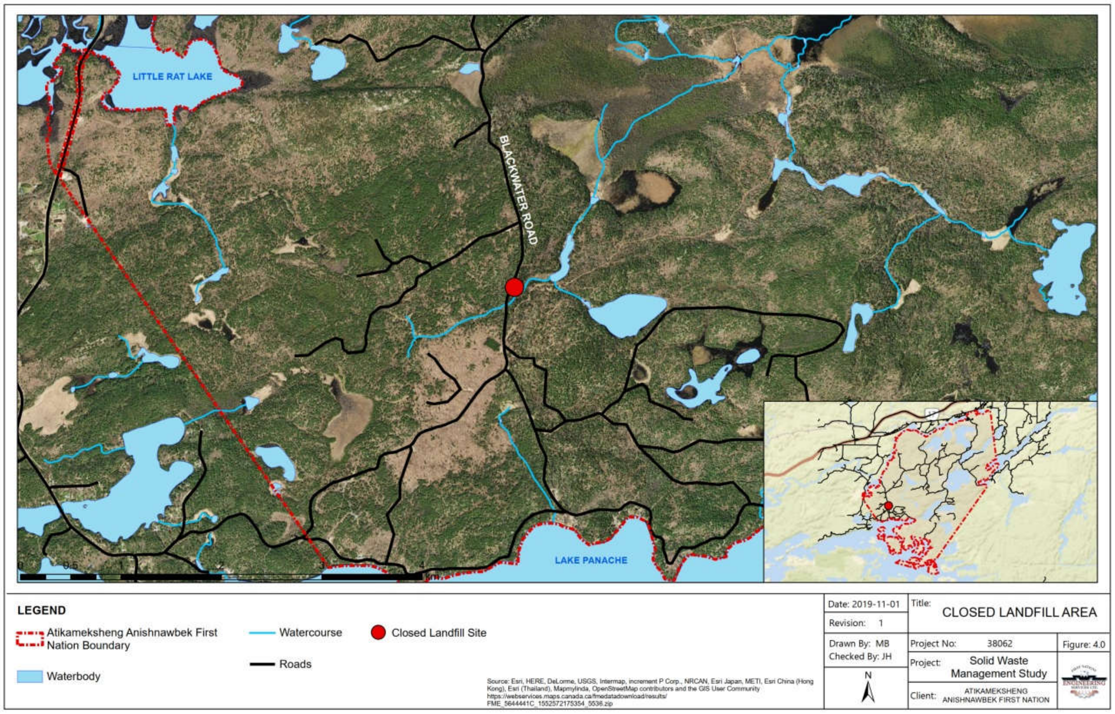

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MW1
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PINCHIN
LEGEND
UAV Survey Area
Benchmark
Monitoring Well
Surface Water Sample
Landfill Boundary
Major Topographic Contour (2m)
Minor Topographic Contour (50cm)
SCALE
0 9 18 27 36 45
Meters
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NOTES, REFERENCES AND SOURCES
1) Proprietary information may not be reproduced or divulged without prior written consent of Pinchin Ltd.
2) Do not scale drawing
3) This drawing may have been reduced. All scale notations indicated are based on a 11"x17" format drawings.
4) Coordinate system: NAD 1983 UTM Zone 17N
Sources:
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WHITEFISH LANDFILL
CLIENT
ATIKAMEKSHENG ANISHNAWBEK FIRST NATION
TITLE
SITE MAP FOR ACTIVE LANDFILL
FIGURE
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PROJECT 224078.000
DATE SEPTEMBER 2019
PREPARED PKM
REVIEWED TIM

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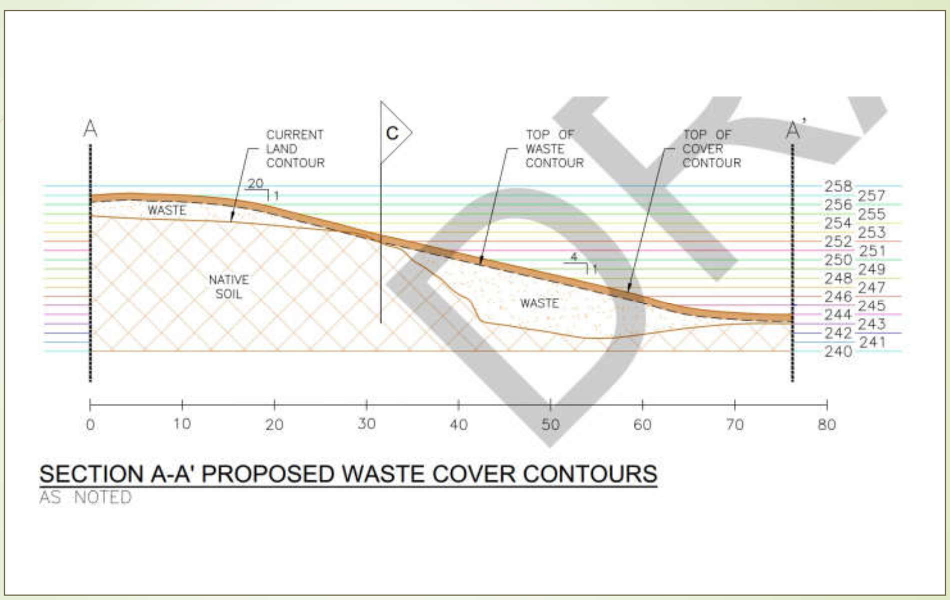
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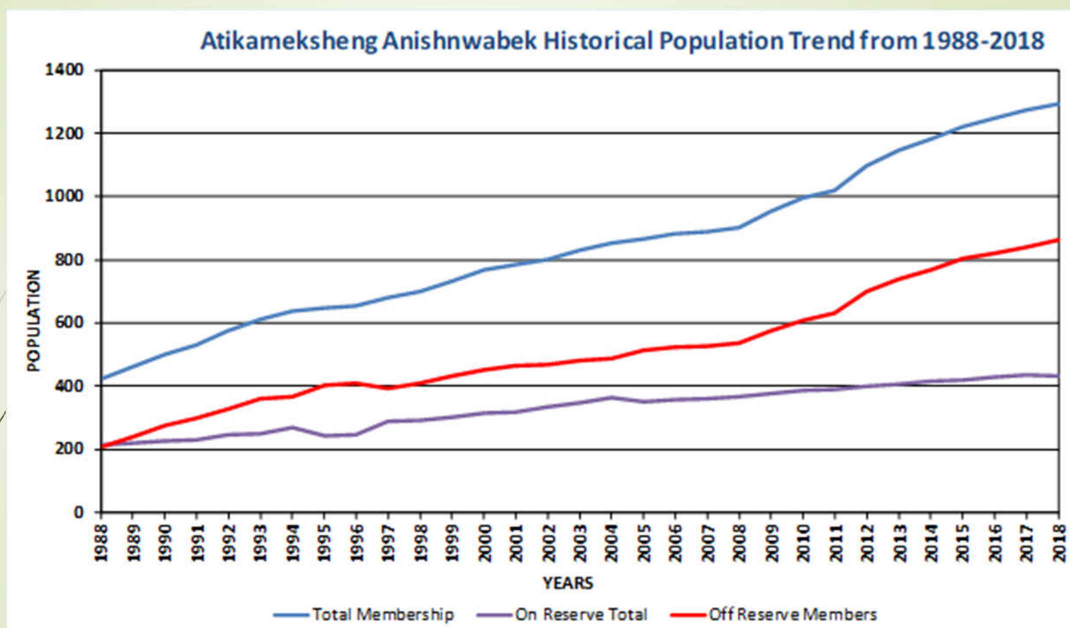

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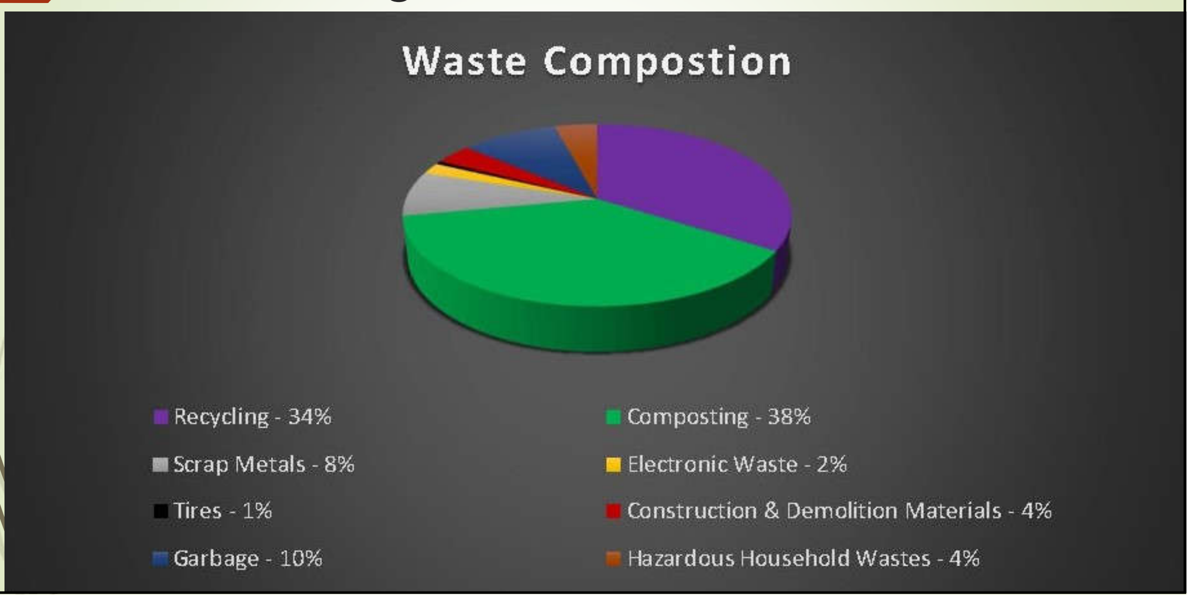
13

Diversion Programs



14

Waste Diversion & Disposal Alternatives

CGS currently implements the following:

- **Blue Box** – cardboard, all paper, glass, cartons, plastic (#1,2,4,5 and 6), plastic bags, aluminum, empty paint cans, aerosol cans and egg cartons.
- **Green Cart** – paper coffee cups, paper bags, tissue paper, paper towels, paper takeout containers, all food waste
- **Leaf and Yard** – garden plants, straw, garden trimmings, grass clippings, branches
- **Household Hazardous Waste Depot** – batteries, fluorescent lights, syringes, propane/helium tanks, unused/expired medications
- **Garbage** – a one bag limit is currently being practiced.

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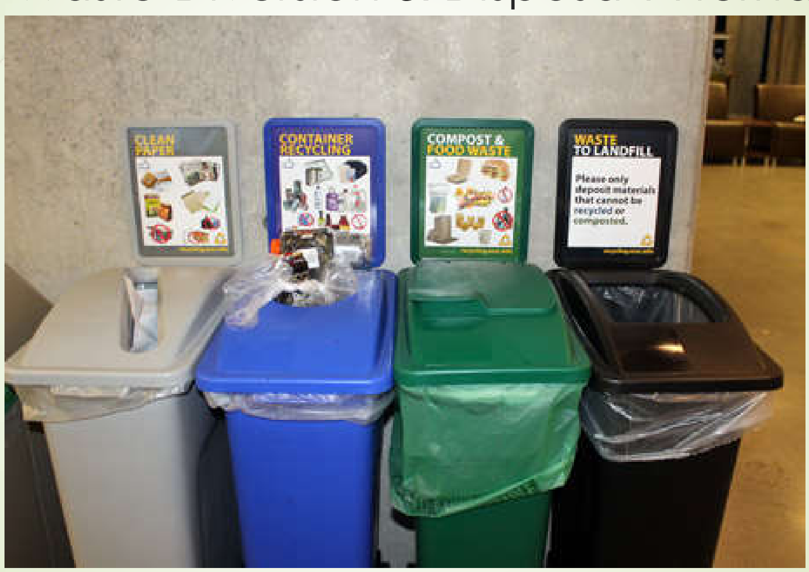
Waste Diversion & Disposal Alternatives



https://news.ucsc.edu/2014/12/zero-waste-project.html

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- It is assumed, at minimum that Atikameksheng will continue to implement their Blue Box program and that 38% of their waste will be diverted.
- The following table provides a summary of waste volume accumulated each year, potential volume of recyclables and total landfill capacity required to dispose of waste
- Remaining Capacity: ~10,000m^3
- Capacity of existing landfill will be reached by 2024

Year	Volume (m³)	Recyclables (38%)	Landfill Volume (m³)
2020	3,318.6	1261.0	2,057.5
2021	6,702.8	2547.1	4,155.7
2022	10,154.1	3858.5	6,295.5
2023	13,673.7	5196.0	8,477.7
2024	17,263.0	6559.9	$\boxed{10,703.0}$
2025	20,923.3	7950.9	12,972.5
2026	24,656.2	9369.3	15,286.8
2027	28,462.9	10815.9	17,647.0
2028	32,345.0	12291.1	20,053.9
2029	36,304.0	13795.5	22,508.5
2030	40,341.4	15329.7	25,011.7
2031	44,458.7	16894.3	27,564.4
2032	48,657.5	18489.9	30,167.7
2033	52,939.5	20117.0	32,822.5
2034	57,306.2	21776.4	35,529.9
2035	61,759.5	23468.6	38,290.9
2036	66,300.9	25194.3	41,106.5
2037	70,932.2	26954.2	43,977.9
2038	75,655.2	28749.0	46,906.2
2039	80,471.7	30579.2	49,892.4

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WASTE MANAGEMENT OPTIONS

Waste Transportation & Collection Operations

	Individual Disposal	Mandatory Collection – via Public Works	Mandatory Collection – via Contracted Out
Advantages	- No cost to operations	- Controlled - Convenience for residence	- Jobs created - Significant portion funded by ISC
Disadvantage	- Uncontrolled dumping - Not all residence can transport waste to site	- Strain on operations budget, ISC does not provide additional funding - Takes staff away from other duties	- Funds potentially directed away from community - Private contractor can hire who they want

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Waste Disposal Alternatives

The following alternatives were considered within the draft report:

- Alternative 1 – Do Nothing
- Alternative 2 – Thermal Technology (Waste Incineration)
- Alternative 3 – Waste To Energy
- Alternative 4 – New Landfilling Site (with diversion)
- Alternative 5 – New Landfilling Site (without diversion)
- Alternative 2-5b – Waste Import
- Alternative 6 – Haul Off-Reserve to an Existing Landfill Site

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The following alternatives were considered within the draft report:

- **Alternative 1 – Do Nothing**
  - Not recommended as it does not meet the 20 year needs of the community, since existing site will reach its capacity well before

Item	Amount
Capital Cost	$180,000
Annual Operation & Maintenance	$101,282
20 Year Life Cycle Cost	$1,445,814

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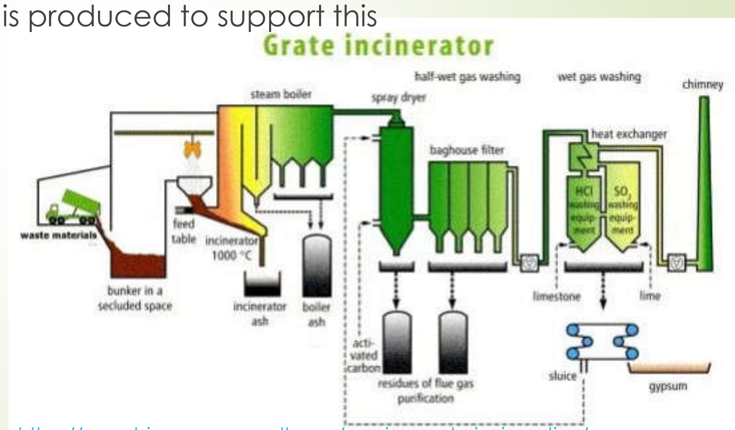
- **Alternative 2 – Thermal Technology (Waste Incineration)**
  - The low waste generation rates for the community are too low to support this option
- **Alternative 3 – Waste To Energy**
  - Not enough waste is produced to support this



https://www.bioenergyconsult.com/moving-grate-incineration/

21

Waste to Energy Plant Port Arthur, Texas

Land usage: ~12.4 acres or ~ 5 Ha

https://www.veolianorthamerica.com/media/newsroom/hurricane-harvey-update

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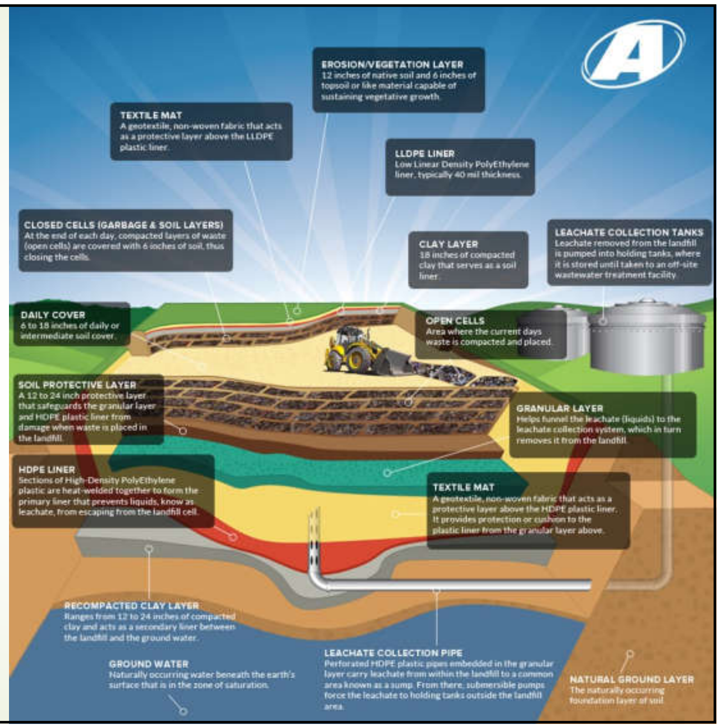
New Landfill Design

- Alternatives 4 & 5 consider the construction of a new landfill
- Modern Landfill Design requires many environmental protection barriers installed to meet standards.
- https://www.advanceddisposal.com/for-mother-earth/education-zone/landfill-diagram.aspx



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- **Alternative 4 – New Landfilling Site (with diversion)**
  - Assumes previously recommended site is developed
  - Assumes 38% diversion and new landfill area of 26.7 acres(~10.8 Ha) required

Advantages	Disadvantages
• FN has control of site • Job created • No tipping fees • Maintain recycling program	• Environmental liability • High capital cost • High operation & maintenance cost

Item	Amount
Capital Cost	$3,922,699
Annual Operation & Maintenance	$101,282 to $119,704
20 Year Life Cycle Cost	$7,079,246

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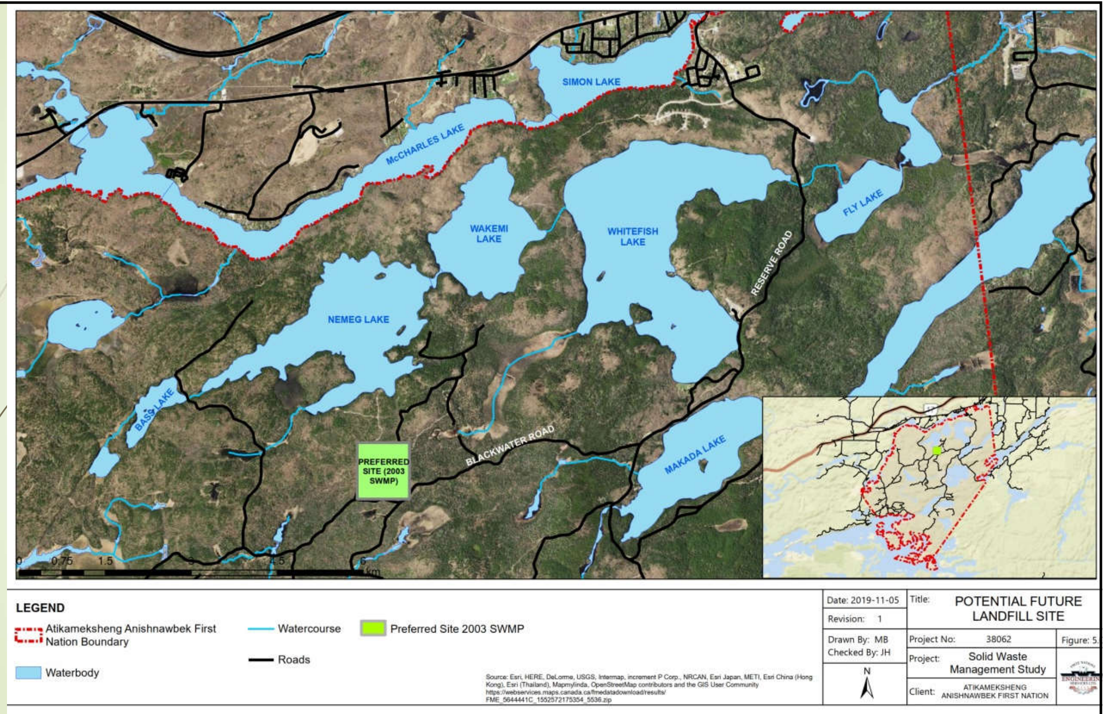

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- **Alternative 5 – New Landfilling Site (without diversion)**
  - Assumes no diversion and 32.7 acres (~13.2 Ha) of land required.

Advantages	Disadvantages
- Reduces operation costs - FN maintains control of their waste disposal	- No recycling - More land required - High capital cost

Item	Amount
Capital Cost	$4,119,759
Annual Operation & Maintenance	$70,204
20 Year Life Cycle Cost	$6,407,875

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Historical Landfill

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- **Alternative 2-5b – Waste Import**
  - Involves the acceptance of waste from neighboring communities to make the above alternatives feasible.
  - It is suspected that First Nation members would not approve of this within their territory.

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Alternative 6 – Haul Off-Reserve to an Existing Landfill Site

- Includes the development of a waste transfer station
- Hauling of waste to final disposal site
- Input and confirmation from CGS is recommended to refine this option.

Advantages	Disadvantages
- Most feasible option - Environmental liability reduced - Land not used up for waste disposal	- No control on tipping fees

Item	Amount
Capital Cost	$1,749,693
Annual Operation & Maintenance	$57,200 to $63,000
20 Year Life Cycle Cost	$4,488,593

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Aundeck Omni Kaning – Waste Transfer Station

30

CGS Transfer Station

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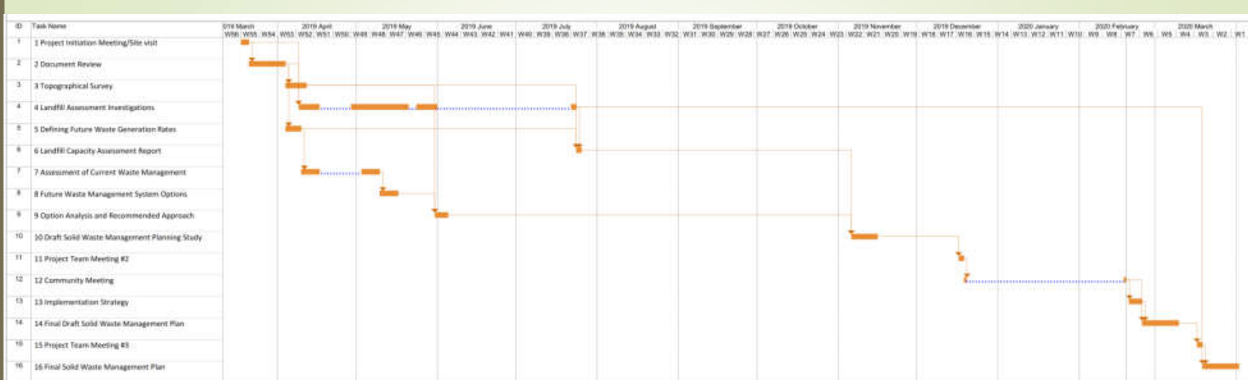

PROJECT SCHEDULE

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THANK YOU, MIIGWETCH!

QUESTIONS / COMMENTS

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Appendix V MTSA template from ISC

SOLID WASTE SERVICE AGREEMENT

(GCDocs #61955795)

This is the effective date of the agreement.
There must be 2 dates, the date on which the agreement is signed and the period for which the services must be supplied.

This agreement made at *[location/address]* this *[day]* of *[month, year]*

Referred to as the Parties of the agreement.

BETWEEN:

[NAME OF FIRST NATION, FIRST NATION NUMBER]
[RESERVE NAME, RESERVE NUMBER]
[Address]

(hereinafter call the "First Nation/Owner")

AND:

[NAME OF MUNICIPALITY/CONTRACTOR]
[Address]
(hereinafter called the "Municipality/Contractor")

(collectively, the "Parties")

WHEREAS:

A. The First Nation's Band Council has approved this Service Agreement by passing Band Council Resolution *[Name of Resolution]* at its meeting held on *[Date]* in accordance with the provisions of the Indian Act, R.S.C. 1985, c. I-5. A certificate of the Band Council Resolution is attached to this Service Agreement as Schedule *[Name of Schedule]*.

B. The Municipal Council has approved this Agreement by passing By-law No. *[Number of By-law]* at its meeting held on *[Date]*. A copy of the By-law is attached to this Service Agreement as Schedule *[Name of Schedule]*.
[*remove this section if service agreement is with a contractor*]

C. The First Nation is responsible for the administration and control of Reserve Lands.

D. The Municipality/Contractor and the First Nation have reached an agreement whereby the First Nation will pay the Municipality/Contractor to provide Solid Waste Services to the Lands.

E. The said Parties deem it to their mutual interest to enter into this agreement.

THEREFORE THIS AGREEMENT WITNESSES that in consideration of the mutual covenants and agreements herein contained the sufficiency which is hereby acknowledged, the PARTIES hereto agree as follows:

1.0 DEFINITIONS

This section defines terms in the Agreement; definitions should be added, amended or deleted to suit the specific local requirements.

1.1 In this agreement, including this section, the recitals and schedules hereto, unless the context otherwise requires:

"Annual Fee" has the meaning ascribed in Section 4.

"Lands" means the lands outlined in Schedule [*Number of Schedule*] and includes anything within the boundaries of those lands.

"Leasehold Land" means any areas of the Reserve that is leased under the provisions of the Indian Act, RSC 1985, c. 1-5 to any non-Band members at any time during the Term.

"Leaseholder" means a tenant or occupier of leasehold land.

"Reserve" means the [*Name of First Nation*] which is a reserve within the meaning of the *Indian Act* R.S.C. 1985, c. 1-5.

"Service Agreement" means this agreement, including the recitals and schedules hereto, as amended and supplemented from time to time.

"Serviced Properties" has the meaning ascribed in Section 3.2.

"Solid Waste Services" means, where appropriate, the gathering, transporting, separating, sorting, selling, processing, and disposing of wastes, refuse trash, garbage and recyclables.

"Term" means a period of time which this Agreement remains in force and effect, as described in Section [Number of section which describes the term of the agreement].

2.0 TERM

The term of agreement is the duration of the service contract.
The duration will depend on the type of funding agreement that the First Nation has with INAC.
Renewals will also be contingent on the availability of INAC funding for MTSAs.

2.1 Subject to earlier termination under paragraph 2.2 this agreement commences on [*Date of Agreement*] and shall continue to [*End date parties agree upon*] and may be renewed in accordance with Section 2.3 below. Subject to termination under Section 2.2 or paragraph 7.1 below.

2.2 This agreement may be terminated on [*Number of months/year(s)*] of written notice by a Party, at their sole discretion.

2.3 RENEWAL: If the First Nation fulfils the terms and conditions of this Agreement so as to be on good standing with the Municipality/Contractor, the First Nation shall have an option to renew the Agreement for [*number of terms this agreement can be renewed*] additional terms of [*term of the agreement*] years each, and may exercise such option by providing the Municipality/Commtractor written notice at least [*minimum number of months notice*] months in advance of the expiry of the initial Term or any renewal term. The same terms and conditions as outlined in this Agreement shall apply to each renewal term.
Failure to provide such notice shall extinguish the renewal option under this agreement.

[*The dates should be in line with ICMS timelines for renewals currently as Dec. 15th.*]

The renewal of an existing service agreement will be contingent on the following:

- FN submits all required reporting to INAC
- Copies of all invoices are submitted with report.
- Assessment and review of service agreement is conducted.
- Mutually agreed upon service fees.
- Confirmation of funding sources.

3.0 SERVICES

There must be an itemized description of what is to be supplied, the quantity, the quality, an address or site for the desired service and a schedule or interval for the service

3.1 During the Term, the Municipality/Contractor will provide Solid Waste Services through its own resources and/or independent contractors to the following properties of the initial year in existence as of the commencement date of this Agreement:

Service (i)
(a) [*number of*] on-reserve housing units
(b) [*number of*] band buildings
(c) [*number of*] mobile homes and non-Band housing (at expense of private owner)

Service (ii)

Service (iii)

Q: Who is actually providing the service? A municipality (ie. Municipal worker), by the municipality through a private contractor, or directly by a private contractor?

3.2 On the first day of [*agreed upon month, usually the month the Agreement came into effect*] during each year of the Term, the First Nation shall provide the Municipality/Contractor, in a form and with content satisfactory to the Municipality/Contractor, information regarding all parcels of property and other taxable folios within the Lands. On an annual basis of the initial date of the Service Agreement, the Municipality/Contractor and the First Nation, acting reasonably, will determine the number of properties which will be services under this Service Agreement for each upcoming year, collectively the "Serviced Properties".

3.3 Co-ordination of the provision of Solid Waste Service to be provided with the Municipal or Reserve boundaries shall be the responsibility of the Municipality/Contractor. The First Nation agrees to expend all reasonable efforts in supporting this coordination function.

3.4 The quality and quantity of the Services to be provided by the Municipality/Contractor under this Agreement will be substantially the same as the quality and quantity of Services provided by the Municipality/Contractor to the users of such Services on non-Reserve lands within the Municipality. The Municipality/Contractor is not obliged to provide Services at a greater level or degree than the level or degree to which the same Service is provided elsewhere within the Municipality. The Municipality makes no representation or warranty that the level or degree of Services provided under this Service Agreement will be maintained or continued to any particular standard, other than as stated expressly herein. The First Nation acknowledges and agrees that there may be from time to time interruptions or reductions in the level of Services, and that the Municipality will not be held liable for any losses, costs, damages, claims or expenses arising from or connected with a temporary interruption or reduction in the level of a Service provided under this Agreement.

3.5 Services will be provided within the Level of Service Standards and will comply with all Federal Acts, regulations, and policies, as well as Provincial Acts, regulations and polies. These can be listed below.

3.6 Time shall be deemed the essence of this agreement. The service schedule and interval of the service(s) should be outlined below. Some services should take into consideration any special conditions based on the nature, urgency and extent of the services.

3.7 The Municipality/Contractor shall, for the prices set out in this agreement and except as otherwise specifically provided, provide at no additional cost to the First Nation/Owner all and every kind of labour, machinery, plant, structures, roads, ways, materials, appliances, articles and things necessary for the due execution and completion of all the work set out in this Contract and shall forthwith according to the instructions of the agreement, commence the works and diligently execute the respective portions thereof, and deliver the works complete in every manner to the First Nation/Owner within the time specified in the Contract.
[*Taken from original template in ICMS manual*]

Q: Who is actually providing the service(s)?
Q: Who is responsible for paying taxes and duties, 3rd party liability insurance, and injury compensation?

4.0 PAYMENT FOR SERVICES

4.1 As compensation for the provision of Solid Waste Services provided hereunder, the First Nation shall pay the Municipality/Contractor the Annual Fee, which shall be payable and calculated in accordance with this Section 4.

4.2 On the [*day of the month*] of [*month*] each year of the Term, the Municipality/Contractor will calculate the Annual Fee payable by the First Nation for the provision of Solid Waste Services for the upcoming year, as follows:

(a) the Parties will designate a reasonable property fee acting in a reasonable manner;

(b) that property fee will be multiplied by the number of serviced properties in accordance with Section 3.1; and,

(c) the result of that calculation shall be the Annual Fee payable that year.

4.3 The Annual Fee payable by the First Nation for the provisions of Solid Waste Services for the first year of the Term of this Service Agreement will be calculated as follows:

[*Demonstrate an initial calculation of the fees*]
[*The price can be a fixed or lump sum price, an upset limit, a cost plus or unit price*]

Q: Frequency of service (daily, weekly, bi-weekly, monthly)?
Q: Bin Rental fees, bin purchase fees?
Q: Volume of solid waste/bin limit?
Q: Additional fees for exceeding limits?
Q: Who will maintain the transfer station, recycling bins, garbage bins?
Q: Who will own and maintain garbage/recycling bins?
Q: How do you ensure that the garbage is being taken to a licensed and permitted landfill or transfer station?

Q: Are rates set by volume, frequency, flat rate?
Q: Are tipping fees included/excluded in price?
Q: How does the rate compare with similar municipal users?
Q: Will fees stay the same for the duration of the agreement, or will they increase each year?
Q: Billing/invoice frequency? (monthly, quarterly, annually?)
Q: Method of payment (cheque, electronically?)

4.4 On or before [*date an invoice for services is to be sent*] of each calendar year, the Municipality/Contractor shall send an estimated invoice the First Nation for the Annual Fee(s) for the upcoming year.

4.5 The First Nation will pay all of the Municipality/Contractor's invoices within thirty days of issuance. Interest on all outstanding invoices shall accrue at a rate of [*agreed interest rate*] percent, calculated monthly. (current template has a 1%/month interest rate)

4.6 The First Nation shall, within [*number of days*] of the date upon which the agreement is executed, provide the Municipality/Contractor with an irrevocable standby Letter of Credit drawn upon a Canadian Chartered bank in the amount of [*estimated cost of services for one year*] dollars to be used as security for payment of amounts owing to the Municipality pursuant to this. Any renewed or substituted Letter of Credit shall be delivered by the First Nation to the Municipality/Contractor not less than [*number of days*] prior to the expiration of the then current Letter of Credit.

5.0 COVENANTS OF THE MUNICIPALITY

5.1 The Municipality/Contractor shall provide Solid Waste Services to the Lands.

5.2 The Municipality/Contractor shall bill the First Nation for the cost of the Solid Waste Services in accordance with the payment provisions of this Service Agreement.

6.0 COVENANTS OF THE FIRST NATION

6.1 The First Nation shall give the Municipality/contractor maps and other information required by the Municipality/Contractor in order to enable the Municipality/Contractor to identify the location of all existing residents and business which require Solid Waste Services.

6.2 The First Nation will comply with, and take all reasonable steps to ensure compliance with any person receiving the Solid Waste Service with the Municipality's [insert name of bylaw], and any amendments thereto or replacements thereof, and all applicable provincial and federal regulations.

7.0 RIGHTS OF ACCESS

7.1 Representatives of the Municipality/Contractor may at any time enter upon the Reserve for the purpose of providing any of the Services required in accordance with this Service Agreement as outlined by Section 3 and inspecting the Reserve Infrastructure and ensuring compliance with the terms of the Agreement.

8.0 TERMINATION FOR BREACH OF AGREEMENT

8.1 Should either party be in breach of its covenants or undertakings under this Service Agreement, other than a failure by the First Nation to pay for Services, which remains un-rectified for a period of [*acceptable period for rectification of breaches of the agreement*] following written notification of such breach, the party not in breach may, at its option and without prejudice to any other rights or remedies it might have, immediately terminate this Service Agreement.

8.2 Whether or not the Services or any of them are discontinued or any disconnections are made, where invoices remain unpaid by the First Nation as at [*Date*] of the following year, the Municipality/Contractor shall have the right, without prejudice to any other right or remedy, to call upon the Letter of Credit as outlined in section 4.6. If, at any time during the term of this Service Agreement invoices remain unpaid as at [*Date*] and the First Nation fails to have the Letter of Credit in place, the Municipality may give immediate notice of termination of this Service Agreement.

Consider procedure for temporarily stopping services [suspension] as oppose to ending the agreement before the end of its term [termination]

8.3 If this Service Agreement is terminated or otherwise cancelled for any reason, a prorated portion of any advance payments made by the First Nation will be refunded.

9.0 LIABILITY AND FORCE MAJEURE

9.1 The Municipality does not warrant or guarantee the continuance or quality of any of the services provided under this Service Agreement and shall not be liable for any damages, expenses or losses occurring by reason of suspension of discontinuance of the Solid Waste Services, for any reason which is beyond the reasonable control of the Municipality, including without limitation acts of God, forces of nature, soil erosion, landslides, lightning, washouts, floods, storms, serious accidental damage, strikes or lockouts, vandalism, negligence in the design and supervision or construction of the Reserve Systems, or in the manufacture of any materials used therein, and other similar circumstances.

10.0 COMMUNICATIONS AND CONTRACT PROTOCOL

10.1 All the Parties to this agreement will appoint one or more representatives, with notice to the other Parties of such appointments as the principal contacts for official communications about this Agreement, and as the principal contacts for operational matters pursuant to this Agreement. The Parties further agree to establish a communications protocol to manage issues arising under this Agreement.

[Should be same individual noted in section 15.0 "Notice"]

11.0 DISPUTE RESOLUTION

11.1 In the interest of cooperative and harmonious co-existence, the parties agree to use their best efforts to avoid conflict and to settle any disputes arising from or in relation to this agreement.

11.2 In the event that the parties fail to resolve matters, the parties shall seek a settlement of the conflict by utilizing [*Outline agreed upon method(s) of dispute resolution*], and recourse to the Courts shall be a means of last resort except where public health and safety is concerned.

Q: Who will arbitrate the dispute?
Q: What is the process/timeline?

Q: Who will pay for mediation fees?
Q: Who will may for arbitration fees?
Review FCM handbook for sample clauses.

12.0 ACKNOWLEDGEMENT OF RIGHTS

12.1 Nothing contained in this Agreement will be deemed to limit or affect any other Aboriginal rights or claims the First Nation may have at law or in equity. Nothing contained in this Agreement will be deemed to limit or affect the legal rights, duties of obligations of the Municipality/Contractor. The Parties agree that nothing in this Agreement will affect the cooperation or consultation covenants the Parties have entered into pursuant to other Agreements.

13.0 HEADINGS

13.1 Headings that precede sections are provided for the convenience of the reader only and shall not be used in constructing or interpreting the terms of this Agreement.

14.0 ENTIRE AGREEMENT

14.1 This Service Agreement constitutes the entire agreement between the parties and there are no undertakings, representations or promises express or implied, other than those expressly set out in this Service Agreement.

14.2 This Service Agreement supersedes, merges and cancels any and all pre-existing agreements and understandings in the course of negotiations between the parties.

15.0 NOTICE

15.1 The address for delivery of any notice or other written communication required or permitted to be given in accordance with this Service Agreement, including any notice advising the other party of any change of address, shall be as follows:

(a) to First Nation:

[Provide Address including the attention the letter should be directed to and other relevant contact information]

(b) to Municipality/Contractor:

[Provide Address including the attention the letter should be directed to and other relevant contact information]

15.2 The parties may change their address for delivery of any notice or other written communication in accordance with section 13.1.

15.3 The following conditions will require proper notification;

(a) Amendments to agreement or schedules
(b) Changes in service area
(c) Changes in invoicing
(d) Renewal
(e) Violations
(f) Suspension/termination of services

Q: At what point is notice assumed to have been received?

No amendments of or departure from the terms and conditions of this agreement will become effective unless evidenced in writing and signed by both parties.

16.0 SEVERANCE

16.1 In the event that any provision of the Service Agreement should be found to be invalid, the provision shall be severed and the Agreement read without reference to that provision.

16.2 Where any provision of the Service Agreement has been severed in accordance with Section 14.1 above and that severance materially affects the implementation of this Agreement, the parties agree to meet to resolve any issues as may arise as a result of that severance and to amend this Agreement accordingly.

17.0 AMENDMENT

17.1 The Service Agreement shall not be varied or amended except by written agreement of both parties.

17.2 No waiver of the terms, conditions, warranties, covenants, and agreements set out herein shall be of any force and effect unless the same is reduced to writing and executed by all parties hereto and no waiver of any of the provisions of this Agreement will constitute a waiver of any other provision (whether or not similar) and no waiver will constitute a continuing waiver unless otherwise expressly provided.

Q: Can the agreement be amended during the term, to accommodate growth and development, or an increase/decrease in services?
Q: How much advanced notice does the First Nation have to provide?

18.0 GOVERNING LAWS

18.1 The provisions of this Agreement will be governed and interpreted in accordance with the laws of [*insert province*] or Canada, as applicable.

19.0 ASSIGNMENT

19.1 The rights and obligations of the parties may not be assigned or otherwise transferred. An amalgamation by a party does not constitute an assignment.

20.0 ENUREMENT

20.1 The Service Agreement enures to the benefit and is binding upon the parties and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF the parties hereto have executed this Agreement.

On behalf of the ***[NAME OF FIRST NATION OR MUNICIPALITY/CONTRACTOR]***

____
[*Position*]

____
[*Position*]

On behalf of the ***[NAME OF FIRST NATION OR MUNICIPALITY/CONTRACTOR]***

____
[*Position*]

____
[*Position*]

Appendix VI Final Cost Estimates

Alternative 6a: Off-Reserve Landfill (with Diversion) & On-Reserve Transport
Class 'D' Construction Cost Estimate

Capital Costs

Item	Description	Unit	Quantity	Price	Amount
Rolloff Station Phase 1					
1	Subgrade Preparation for Transfer Station	100%	L.S	$284,000	$284,000
2	Reinforced Concrete Pad	100%	L.S	$128,000	$128,000
3	Waste Receiving Ramp	100%	L.S	$287,000	$287,000
4	Concrete Block Bunker Construction	100%	L.S	$338,000	$338,000
5	Extend Overhead Hydro to Transfer Station Site	100%	L.S	$56,000	$56,000
6	Supply & Install H&S instruments, Spill Containment/Cleanup Equip.	100%	L.S	$48,000	$48,000
7	Fencing & Gates	100%	L.S	$31,500	$31,500
9	Garage and signage	100%	L.S	$80,000	$80,000
10	Access Road - Based 1.5 km, 8 m wide, 150 mm gravel	m^2	520	$330	$171,600
10	Rolloff Bin Truck	ea.	1	$ 220,000	$ 220,000
Environmental Protection					
12	Siltation Control Fencing	m	155	$ 44	$ 6,820
13	Straw Bale Retention Barriers	ea.	3	$ 550	$ 1,650
14	Rock Check Dams	ea.	1	$ 830	$ 830
15	Sedimentation Pond	l.s.	100%	$ 8,000	$ 8,000
16	Landfill Decommissioning	l.s.	100%	$ 768,990	$ 768,990
	Total				**$ 2,430,390**
	Contingency Allowance (10%)				$ 243,039
	TOTAL CAPITAL COST				**$ 2,673,429**

Labour Costs

Item	Description	Unit	Hrs/wk	Quantity	Price	Amount
1	Public Works curbside pickup					$14,000
2	Transfer Station Bin Mtn and Painting					$6,000
3	Staff and site maintenance	hrs	55	2860	$15	$42,900
4	Site Maintenance (snow removal, etc)	l.s.		100%	$5,000	$5,000
5	Truck Maintenance	l.s.		100%	$15,000	$15,000
	Total					**$82,900**
	Administration Allowance (10%)					$8,300
	TOTAL CAPITAL COST					**$91,200**

20 Year Life Cycle Cost Estimates

Interest: 5.0% Escalation 2.0%

Annual O&M Cost: $91,200

Year	Capital Item	Cost	Resident Incr	PV Factor	PV Cost
1	Construction	$2,673,429	$23,737	1.000	$2,788,366
2			$24,278	0.971	$112,178
3			$24,818	0.944	$109,483
4	New Bin	$23,500	$25,349	0.917	$130,342
5			$25,889	0.891	$104,270
6			$26,472	0.865	$101,796
7			$27,055	0.840	$99,377
8			$27,691	0.816	$97,057
9	New Bin	$24,000	$28,274	0.793	$118,746
10			$28,900	0.770	$92,521
11	Truck Replacement	$220,000	$29,568	0.748	$310,378
12			$30,204	0.727	$88,257
13			$30,872	0.706	$86,208
14	New Bin	$24,000	$31,592	0.686	$108,239
15			$32,261	0.666	$82,277
16			$32,981	0.647	$80,393
17			$33,745	0.629	$78,576
18	New Bin	$24,000	$34,508	0.611	$100,798
19			$35,271	0.593	$75,056
20			$36,077	0.577	$73,376
Total					**$4,837,694**

Alternative 6b: Contractor to Haul to CGS + FN Curbside Pickup

Capital Costs

Item	Description	Unit	Quantity	Price	Amount
Transfer Station					
1	Subgrade Preparation for Transfer Station	100%	L.S	$284,000	$284,000
2	Reinforced Concrete Pad	100%	L.S	$128,000	$128,000
3	Waste Receiving Ramp	100%	L.S	$287,000	$287,000
4	Concrete Block Bunker Construction	100%	L.S	$338,000	$338,000
5	Extend Overhead Hydro to Transfer Station Site	100%	L.S	$56,000	$56,000
6	Supply & Install H&S instruments, Spill Containment/Cleanup Equip.	100%	L.S	$48,000	$48,000
7	Fencing & Gates	100%	L.S	$31,500	$31,500
9	Garage and signage	100%	L.S	$80,000	$80,000
10	Access Road - Based 1.5 km, 8 m wide, 150 mm gravel	m^2	520	$330	$171,600
Environmental Protection					
11	Siltation Control Fencing	m	155	$44	$6,820
12	Straw Bale Retention Barriers	ea.	3	$550	$1,650
13	Rock Check Dams	ea.	1	$830	$830
14	Sedimentation Pond	l.s.	100%	$8,000	$8,000
15	Landfill Decommissioning	l.s.	100%	$768,990	$768,990
	Total				***$2,210,390***
	Contingency Allowance (10%)				$221,039
	TOTAL CAPITAL COST				**$2,431,429**

Labour Costs

Item	Description	Unit	Hrs/wk	Quantity	Price	Amount
1	Public Works curbside pickup					$14,000
2	Staff and site maintenance (1FT + 1PT)	hrs	55	2860	$15	$42,900
3	Site Maintenance (snow removal, etc)	l.s.		100%	$5,000	$5,000
	Total					**$61,900**
	Administration Allowance (10%)					$6,190
	TOTAL O&M COSTS					**$68,090**

20 Year Life Cycle Cost Estimates

Year	Capital Item	Cost	Resident Incr	PV Factor	PV Cost
	Interest:	5.00%		Escalation	2.00%
	Annual O&M Cost:		$68,090		
1	Construction	$2,431,429	$16,153	1.000	$2,515,672
2			$16,533	0.971	$82,169
3			$16,922	0.944	$80,251
4			$17,319	0.917	$78,320
5			$17,726	0.891	$76,462
6			$18,143	0.865	$74,592
7			$18,569	0.840	$72,794
8			$19,006	0.816	$71,070
9			$19,452	0.793	$69,421
10			$19,909	0.770	$67,759
11			$20,377	0.748	$66,173
12			$20,856	0.727	$64,664
13			$21,346	0.706	$63,142
14			$21,848	0.686	$61,697
15			$22,361	0.666	$60,240
16			$22,887	0.647	$58,862
17			$23,425	0.629	$57,563
18			$23,975	0.611	$56,252
19			$24,538	0.593	$54,928
20			$25,115	0.577	$53,779
Total					**$3,785,811**

Alternative 6B - Contractor to Haul Off-Reserve

Residential Incremental Costs

Contractor costs	$50	per lift of Recyclables
Contractor costs	$80	per lift of Residential Waste
Weight per lift:	0.721	metric tonne
Recycleable %	38%	

Population	Total annual waste volume (m3)	Recycleables (38%) (m3)	Landfill Volume (m3)	#of Recyle lifts/ month	# of Waste Lifts/ month	Recycle Annual Charges	Waste Annual Charges	Annual Charges
494	3266	1241	2025	7.46	12.17	$4,474	$11,680	$16,154
506	3343	1270	2073	7.63	12.45	$4,580	$11,955	$16,535
518	3421	1300	2121	7.81	12.74	$4,686	$12,234	$16,920
530	3502	1331	2171	8.00	13.05	$4,797	$12,524	$17,321
542	3584	1362	2222	8.18	13.35	$4,910	$12,817	$17,727
555	3668	1394	2274	8.37	13.66	$5,025	$13,117	$18,142
568	3754	1427	2327	8.57	13.98	$5,143	$13,425	$18,568
582	3843	1460	2383	8.77	14.32	$5,265	$13,743	$19,008
595	3933	1495	2438	8.98	14.65	$5,388	$14,065	$19,453
609	4025	1530	2496	9.19	14.99	$5,514	$14,394	$19,908
624	4120	1566	2554	9.41	15.35	$5,644	$14,734	$20,378
638	4217	1602	2615	9.63	15.71	$5,777	$15,081	$20,858
653	4316	1640	2676	9.85	16.08	$5,912	$15,435	$21,347
669	4417	1678	2739	10.08	16.45	$6,051	$15,796	$21,847
684	4521	1718	2803	10.32	16.84	$6,193	$16,168	$22,361
700	4627	1758	2869	10.56	17.24	$6,339	$16,547	$22,885
717	4736	1800	2936	10.81	17.64	$6,488	$16,937	$23,425
734	4847	1842	3005	11.07	18.06	$6,640	$17,334	$23,974
751	4961	1885	3076	11.33	18.48	$6,796	$17,741	$24,537
769	5078	1930	3148	11.59	18.92	$6,956	$18,160	$25,116