City of Iqaluit

Preliminary Brief on Diversion and Disposal Options

Project Name
Iqaluit Waste Management Project

Project Number
OTT-00020728

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Canada

Date Submitted
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# Table of Contents

City of Iqaluit .................................................................................................................. 1
Legal Notification ............................................................................................................. 2
Table of Contents ............................................................................................................ 3
1 Introduction .................................................................................................................. 4
2 Current Cost of Waste Collection and Disposal ......................................................... 5
3 Diversion Options ........................................................................................................ 5
  3.1 Recycling Program .................................................................................................. 5
  3.1.1 Residential/Commercial Recycling ................................................................... 5
  3.1.2 Bulky Materials Recycling ............................................................................... 12
  3.2 Composting Program ............................................................................................... 13
  3.3 End-of-Life Vehicle Program ................................................................................ 20
  3.4 Household Hazardous Waste Program .................................................................. 22
  3.5 Re-use Centre ......................................................................................................... 23
  3.6 Promotion and Education Programs .................................................................... 25
  3.7 Policy Options ........................................................................................................ 26
4 Disposal Options .......................................................................................................... 28
  4.1 Waste-to-Energy Treatment Processes ................................................................ 28
    4.1.1 Advanced Thermal Treatment ....................................................................... 28
    4.1.2 Incineration ................................................................................................... 28
    4.1.3 Issues to Consider ......................................................................................... 30
  4.2 Landfill ................................................................................................................... 30
5 Site Selection ................................................................................................................ 31
Appendix A- Preliminary Site Inventory ......................................................................... 35
1 Introduction

As part of Phase 3 of its Solid Waste Management Project (see Figure 1 below), the City of Iqaluit is currently in the process of examining a wide range of disposal and diversion options. It is also investigating future waste management sites. This document provides an overview of the various options under consideration. As the Phase 3 work continues, these options will be further analyzed and evaluated against the following project criteria:

1. Environmental impact,
2. Appropriate technology for our remote Arctic community,
3. Alignment with project goals and objectives,
4. Track record of technology/program,
5. Cost effectiveness/affordability,
6. Social and cultural acceptability, and
7. Ease of implementation.

Figure 1: Process for Iqaluit’s Solid Waste Management Project.
2 Current Cost of Waste Collection and Disposal

Based on an estimated waste generation of 82,805 m$^3$ per year, and a population of 7405$^1$, it currently costs the City of Iqaluit $8.07 per m$^3$ per year and $90.22 per capita per year to collect and dispose of its waste. These numbers do not include capital projects, reserves for the purchase of capital equipment associated with waste management, or revenue from tipping or collection fees (i.e. only operation and maintenance).

Table 1. Summary of current cost of disposal

<table>
<thead>
<tr>
<th></th>
<th>Estimated Cost</th>
<th>Estimated Cost Per Tonne$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection (trucks, staff)</td>
<td>$348,595</td>
<td>$48.89</td>
</tr>
<tr>
<td>Landfill Operations and Maintenance</td>
<td>$319,460</td>
<td>$39.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$668,055</strong></td>
<td><strong>$82.39</strong></td>
</tr>
</tbody>
</table>

3 Diversion Options

3.1 Recycling Program

3.1.1 Residential/Commercial Recycling

*What is it?*

The separation of recyclables (such as paper, cardboard and food/beverage containers) from regular waste for recycling.

*How would it work?*

Instead of placing recyclables into regular garbage, residents would place them in a separate bin or bag inside their home. Residents would then drop off these materials at a recycling depot or set them outside for municipal collection. The collected materials would then either be processed locally or shipped south (sealift and truck) and sold to a southern recycling facility. Items with potential to be processed locally include paper and cardboard (if used in a composting program) and glass.

Marketplace revenues for glass are typically low per tonne (refer to Table 4) and glass could potentially be collected, crushed and used locally; therefore, while glass is a recyclable material, it is

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$^1$ Medium 2010 population projection presented in Iqaluit’s General Plan (2010).  
$^2$ Estimated tonnage based on Trow 2002 Waste Audit
not recommended that the City send the material south for recycling. Items to consider when planning for including glass in a recycling program include:

- Glass is an inert material made of sand and can be landfilled with no negative environmental issues.
- Crushing recovered glass and using it locally would be consistent with the philosophy of sustainability and would reduce shipping costs associated with sending recyclable material other than glass south for processing and marketing.
- Special equipment may be required for the crushing of glass (see examples of typical equipment in Figure 2 below).
- Whether there is a local demand for glass aggregate within the City.
- Whether glass crushing could take place within an indoor sorting building or whether glass crushing could occur seasonally in an outdoor location (with equipment stored inside over the winter).
- Applicable health and safety controls that are required to protect employees against glass dust in the facility.
- Whether the glass could be collected with other recyclables, or if should it be collected separately to avoid broken glass getting mixed in with the other recyclables.
- Opportunities to partner with the Liquor Commission bottle return program.

Figure 2: Examples of Glass Crushers

**Diversion Potential**

Based on the 2002 waste audit completed by Trow Associates\(^3\), approximately 3,400 tonnes of Iqaluit’s waste stream is made up of recyclable materials. Assuming a recovery rate of 70% and participation from Iqaluit’s residential and the commercial sector, a recycling program could potentially divert 29% (or 2,384 tonnes) of the City’s solid waste from disposal. This would include:

\(^3\) A new waste audit will be completed in July 2011 as part of this study.
- 1,287 tonnes of paper and cardboard;
- 596 tonnes of PET and HDPE plastic containers;
- 263 tonnes of glass; and
- 238 tonnes of metal containers (125 tonnes of steel cans and 107 tonnes of aluminum cans).

**Estimated Cost**

The preliminary shipping costs are based on the NEAS shipping rates\(^4\), plus container rental and road transport costs as described in Dillon Consulting's evaluation of the Government of Nunavut's recycling pilot project\(^5\). Table 2 below presents the estimated tonnage of recyclables collected, estimated costs and potential revenue.

**Table 2: Recycling Program Shipping Costs**

<table>
<thead>
<tr>
<th></th>
<th>Estimated Tonnes</th>
<th>Estimated Shipping Cost (baled(^*))</th>
<th>Container rental cost</th>
<th>Container road transport cost</th>
<th>Sorting and Baling (^\ast)</th>
<th>Total Cost</th>
<th>Est. Revenue</th>
<th>Net Cost (total cost - revenue)</th>
<th>% of Total Net Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper/ Cardboard</td>
<td>1,287</td>
<td>$618,712</td>
<td>$97,812</td>
<td>$61,132</td>
<td>$25,746</td>
<td>$803,402</td>
<td>$132,592</td>
<td>$670,810</td>
<td>62%</td>
</tr>
<tr>
<td>PET and HDPE plastic containers</td>
<td>596</td>
<td>$377,446</td>
<td>$69,518</td>
<td>$43,449</td>
<td>$11,914</td>
<td>$502,327</td>
<td>$264,640</td>
<td>$237,687</td>
<td>22%</td>
</tr>
<tr>
<td>Glass</td>
<td>263</td>
<td>$175,867</td>
<td>$33,173</td>
<td>$20,733</td>
<td>$5,250</td>
<td>$235,023</td>
<td>-$4,397</td>
<td>$239,420</td>
<td>22%</td>
</tr>
<tr>
<td>Steel</td>
<td>125</td>
<td>$35,471</td>
<td>$2,933</td>
<td>$1,833</td>
<td>$2,506</td>
<td>$42,743</td>
<td>$29,539</td>
<td>$13,203</td>
<td>1%</td>
</tr>
<tr>
<td>Aluminum</td>
<td>107</td>
<td>$71,754</td>
<td>$13,535</td>
<td>$8,459</td>
<td>$2,142</td>
<td>$95,890</td>
<td>$176,180</td>
<td>-$80,290</td>
<td>-7%</td>
</tr>
<tr>
<td>Total</td>
<td>2,378</td>
<td>$1,279,249</td>
<td>$216,971</td>
<td>$135,607</td>
<td>$47,558</td>
<td>$1,679,385</td>
<td>$602,951</td>
<td>$1,080,831</td>
<td></td>
</tr>
</tbody>
</table>

\(^*\) Additional sorting and bailing required in the south. Estimated at $20 per tonne.

\(^\ast\) Exception would be glass, which would be shipped loose.

Assuming all of the recyclable materials noted in the table above are sent south for recycling, the total estimated annual sorting and shipping costs for a recycling program in Iqaluit is about $1.1 Million, or $455 per tonne. Recycling of paper and cardboard contributes the greatest portion of the overall cost (62%), while glass is the most expensive per tonne to sort and ship ($912 per tonne).

Finding alternative and local diversion opportunities for some of the materials may help to reduce the overall costs of a recycling program. For example, glass could be crushed and used locally, possibly as a construction aggregate or as landfill cover. Little revenue would be expected from using crushed glass as an aggregate – while aggregate stone is currently valued at $6.50 per m\(^3\) in Iqaluit, concrete is not a commonly used product and mixers may need to alter their mix to accommodate the crushed

---


The per tonne revenue for the recyclable materials discussed above are based on the yearly average recyclable commodity prices in Ontario for 2008 to 2011. As Table 4 illustrates below, the market value for recyclable materials fluctuates over time. Aluminum traditionally has held the most value, while mixed glass has a negative market value (clear glass has fared better than mixed glass and has had an average value of $25 and $27 per tonne). Municipalities typically deal with this uncertainty by using rolling 3 to 5 year averages in their planning estimates.
Table 4: Yearly Average Recyclable Commodity Prices (2008-2011)\(^6\)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>$121</td>
<td>$72</td>
<td>$90</td>
<td>$129</td>
<td>$103</td>
</tr>
<tr>
<td>PET and HDPE plastic containers (combined)</td>
<td>$462</td>
<td>$253</td>
<td>$427</td>
<td>$633</td>
<td>$444</td>
</tr>
<tr>
<td>Glass (mixed)</td>
<td>-$24</td>
<td>-$18</td>
<td>-$15</td>
<td>-$10</td>
<td>-$17</td>
</tr>
<tr>
<td>Steel</td>
<td>$245</td>
<td>$89</td>
<td>263</td>
<td>346</td>
<td>236</td>
</tr>
<tr>
<td>Aluminum</td>
<td>$1,904</td>
<td>$1,215</td>
<td>1,591</td>
<td>1,870</td>
<td>1,645</td>
</tr>
</tbody>
</table>

**Issues to Consider**

There are a number of operational and infrastructure considerations that would need to be discussed if Iqaluit were to implement a recycling program. These are noted below.

**Partnership opportunities with existing non-municipal recycling programs:**

There are a number of other recycling programs currently operating in Iqaluit that the City needs to be aware of as it develops its own municipal recycling program:

- **Bottle return program run by Southeast Nunavut Company** – collects and bales liquor bottles and beer cans returned through the Iqaluit Liquor Commission deposit/refund program. Beer cans are shipped south for recycling.
- **Arctic Co-operatives Ltd. aluminum can recycling initiative** – a new program that will allow residents to drop off aluminum cans at member co-ops (estimated start date: June 2011). Other partners include The Co-operators, Nunavut Sealink and Supply Inc., Arctic Beverages, Canadian North Airlines, and the Government of Nunavut. Program funded in part through 10-cent charge on disposable plastic grocery bags.
- **NorthwesTel phone book recycling program** – Program uses an incentive program in schools to encourage children to return telephone books for recycling. Schools receive a donation based on the number of telephone books received per student. The telephone books are sent to Bell Canada in Montreal for recycling.
- **Government of Nunavut Community and Government Services (CGS) office paper recycling program** – Shredded paper is picked up from CGS by young offenders (provided by the Department of Justice, Young Offenders Division), which is baled and shipped south for recycling. The Government of Nunavut has a contract with Canadian North, who uses the paper as ballast. The City of Iqaluit, NorthwestTel, and Akhaliak each participate in the program, which sends approximately 1 tonne of paper for recycling each week.

The City intends to study these programs to understand current opportunities and constraints and to identify potential synergies.

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Program Scope

- Which materials should be included in a residential/commercial recycling program?
  - Low cost of glass and potential for local reuse/repurposing make it less feasible to ship it south for recycling.
  - Potential to compost or incinerate paper rather than ship south for recycling.
  - Materials may be diverted through other existing local recycling programs.
  - Other considerations will include impact on diversion, economic value and processing requirements.
- Whether paper and cardboard is composted or incinerated rather than shipped south for recycling should be assessed.
- Challenges and opportunities for effectively extending the recycling program to commercial, government and non-profit organizations in Iqaluit (e.g., how this portion of the recycling program would be funded and what their source separation and collection needs are).

Operations

- Materials may need to be stored longer than is typical in southern communities, as shipping is only available seasonally through sea lift.
- Materials will require some degree of preparation prior to shipping.
- Whether a depot or curb side pickup is more appropriate for Iqaluit. A benefit of curbside is that it is more convenient, which could result in more material being collected. However, curbside programs are typically more expensive than depot systems.
- Challenges and opportunities for greater source separation during collection (whether through curbside collection or at depots) to minimize processing requirements
- The amount of staff required for collection and operations is to be assessed.
- An appropriate data monitoring/recording/reporting program would be required to track the amount of material being diverted from disposal.
- What type of process would be used to sort recyclables during processing (e.g. manual or mechanical sorting or a combination of both).
- The amount of pre-processing/sorting required before shipping to ensure Iqaluit receives maximum value on the sale of recyclable materials.
- The potential for odour/cleaning issues associated with residual food and drink in food and beverage containers (can be mitigated by asking residents to ensure materials are empty and/or to rinse containers before recycling).
- Implementation of program could be phased in over time to allow for program testing, refinement and gradual purchase of required equipment.
Equipment

- Whether an indoor sorting facility is required to continue programs in winter months, and how the facilities would be serviced (heat, electricity, water, sewer).
- The type of container that would be most convenient for residents and workplaces to sort their recycling materials (for example, a plastic blue bag, reusable bag, or a blue box, as shown in Figure 3 below).
- To manage collection costs at existing levels, the same truck could be used to collect recyclables, whereby a garbage collection day is replaced with a recycling collection day.
- Potential for existing or future depots to accommodate/support non-municipal recycling or reuse initiatives.

Figure 3: Examples of plastic blue bag (left), cloth recycling bag (middle) and blue box (right)
3.1.2 Bulky Materials Recycling

What is it?

The separation of bulky recyclable material (such as electronics, tires, appliances, scrap metal and mattresses\(^7\)) from regular waste for recycling.

How would it work?

Residents with bulky recyclables would be able to drop off their materials at the landfill site or recycling depot. These materials would then be prepared for shipping south to be recycled.

Diversion Potential

Scrap metal recycling initiatives in Iqaluit have recycled approximately 6,500 m\(^3\) of metal. These programs have been joint initiatives between the Government of Nunavut, the Federal Government and the City of Iqaluit. These initiatives focused on historic metal waste and are not permanent programs to address future metal waste generation. Continuing these types of initiatives in the new municipal waste management program would allow for scrap metal recycling to continue. The majority of the scrap metal in Iqaluit is comprised of end-of-life vehicles (see Section 3.3), with some amounts of appliances and construction debris.

No data is currently available on the quantity of waste electronics, tires or mattresses available for recycling in Iqaluit.

Estimated Cost/Revenue

The Dillon recycling pilot study report\(^8\) describes the results of a scrap metal pilot study conducted in the communities of Rankin Inlet NU, Churchill MB, and Gillam MB. The Dillon report estimates that the program removed 0.025 tonnes of scrap metal/person/year at a cost of $585/tonne. Based on the costs described in this report it is estimated that the annual cost of such a program in Iqaluit could be around $90,000. A cost estimate more specific to Iqaluit is currently being developed based on current shipping rates, material value and past program costs, but this number is provided for initial discussion purposes.

Cost estimates for the recycling of the other bulky items are currently being researched and developed.

Issues to Consider

Issues to consider during the implementation of a bulky material recycling program in Iqaluit include:

- An accurate assessment of the quantities of bulky recyclables generated annually;
- How materials would be made ready for shipping (e.g., stacking and wrapping electronic waste on a pallet, etc)

\(^7\) Mattresses are shredded and the recyclable materials are separated out.

• Will likely be storing materials longer than in southern communities in order to accommodate issues related to shipping.
• Opportunities for reusing and/or recycling used tires locally.
• Availability of sorting/storage space at existing or future waste management sites;
• Whether the service would be available year-long, seasonally, or at a set number of days or events per year.
• Would the City provide any kind of pick-up service for larger items (for a fee?)?

3.2 Composting Program

What is it?

Composting is the process of converting organic materials such as food waste, paper, cardboard and/or woodchips into a soil-like substance called compost.

How does it work?

Residents and businesses would separate organics from their regular waste. In other communities with an organics diversion program, organic waste is placed in a mini-bin, which is emptied daily into a green cart (see Figure 4). Residents would either drop the organics off at a depot location or place the materials outside for municipal collection.

Paper, cardboard and wood waste collected separately could be composted along with the food waste. These materials would have to be shredded before being mixed with the food waste. Any wood waste used would have to be clean (e.g. no nails or screws).

A compost program may also be able to deal with the sewage sludge produced at the Waste Water Treatment Plant.

During the composting process, the organic materials breakdown and turn into a crumbly, earthy-type material. The composting process stabilizes the organic material, thereby reducing the risk of

_________________________________________________________

9 While depot locations for household organics are less common than curbside collection, other communities have used them in the past or continue to do so. For example, a neighbourhood in the community of Centre & South Hastings, Ontario used a depot system to collect organics between 2001 and 2006. No significant issues were reported, although the depot was closed due to lack of processing facility to accept the material. Also in Ontario, the County of Peterborough successfully operated a pilot organics depot in 2006, while the Township of Assiginack has recently implemented a depot to collect its municipal household organics.
leachate and the generation of methane (a potent greenhouse gas), kills pathogens, and destroys seeds. The composting process decreases the volume of organic matter by about 40% to 50%.

The City will also need to consider how the compost will be used. The Canadian Council of Ministers of the Environment (CCME) have established guidelines for compost quality to help ensure a consistent, high quality product that is safe for all uses\textsuperscript{10}. The guidelines are based on four criteria for product safety and quality, including:

- Foreign matter;
- Maturity;
- Pathogens; and
- Trace elements.

Using these criteria, the CCME has established two grades of compost:

- Category A – unrestricted: can be used for any application, such as agricultural lands, residential gardens, etc.
- Category B – restricted: has restricted use due to presence of sharp foreign matter or higher trace element content.

For these categories, the CCME has also established criteria concerning the presence of pathogens. For mixed municipal waste, the compost pile must achieve a temperature of 55 °C for a certain length of time (depending on the process used), have a fecal coliforms count of less than 1000 most probable number (MPN)/g of total solids calculated on a dry weight basis, and have no Salmonella sp. with a detection level more than 3 MPN/4g total solids calculated on a dry weight basis.

If compost does not achieve either category A or B, then it must be disposed (it can also be used as landfill cover material).

Two common methods that could be used for composting the organic material are open windrow composting and in-vessel composting, which are described in more detail below.

**Open Windrow Composting**

Open windrow composting occurs in long piles that are turned regularly for aeration and mixing. This method is currently used by the City of Yellowknife (see case study below) and by the Bill MacKenzie Humanitarian Society (BMHS) to compost material from about 100 Iqaluit households.

In windrow composting, organic waste is composted in long piles or rows, often on a concrete or paved pad. To improved odour and moisture control, windrows can be covered with a removable fabric-like membrane or built under a roof. Heavy equipment is used to regularly mix or turn the pile in order to aerate and blend the material. Turning frequency depends on the size of the pile and feedstock and can range from several times daily to once a month. Generally, the composting process takes about 13 weeks, but would likely take longer in Iqaluit's arctic environment. For example, it took approximately two years for the City of Yellowknife to completely compost their material.

A key benefit of windrow composting is its low cost and low-tech approach. Another is its flexibility, as windrow systems can handle volumes ranging from 5 tonnes/day to 100 tonnes/day. As observed with the Yellowknife project, a key challenge with windrow composting in Iqaluit would be that its processing would slow considerably during the winter in sub-zero temperatures. Other challenges with windrow composting include odour issues from food waste, managing liquid runoff, and land requirements.

### Case Study: City of Yellowknife Composting Program

The City of Yellowknife is currently running a composting pilot project. The project collected organic material from 10 to 15 local businesses, with each business given a 4 yard, overhead tipping bin for collecting the materials. Collection was once every two weeks in the winter months and weekly during summer months. Approximately 400-700 tonnes of organic materials were collected over a two year period. The organic material was piled in long, open trapezoid piles and were periodically turned to provide aeration, control temperatures and blend organic material.

Three separate piles were created at the waste facility. The first was for mixing and storing incoming organic waste, the second was an active composting pile, and the third was a curing pile (i.e., a pile where organics complete the last part of the composting process). The whole process, from collecting organic material to producing usable compost, took two years. During the first year, organic materials were allowed to actively compost, while the second year was used for curing the composted material.

There were a number of issues pertaining to local climate and geography that Yellowknife had to address that may provide lessons for composting in Iqaluit.

**Timeframe:** The prolonged winters and short summers typical of a northern climate caused the composting to take a relatively long time. Under conditions found in southern Canada or in the United States, composting takes between 13 to 15 weeks (from organics collection to marketable compost). In Yellowknife, the composting process took two years from start to finish. Between November and April, no activity was evident in the windrows, as the piles were almost completely frozen. During the remaining months, crews were able to turn and monitor the piles and active composting was evident.

**Animal Issues:** Another issue was the attraction of animals and birds. An electric fence was constructed around the perimeter of the designated compost area in order to deter bears from entering the open facility. In addition, covers were installed on top of every windrow in order to prevent birds (mostly gulls and ravens) from landing and foraging on the windrows. Special geotextile material was used, as regular tarp material was easily punctured by some types of bird.

**Collection Issues:** Winter conditions also created issues during collection, as organic material often froze to the inside of bins during winter months and thus made it difficult to empty.
In-vessel Composting

An alternative to windrow composting is in-vessel composting. During this process, organic material is composted within large or small enclosed structures. The enclosures may be a series of chambers within a larger sealed building or individual containers located outdoors (see Figure 5 above). The containers/chambers help to better manage temperature and aeration in the compost pile, which can result in a shorter composting process. This system provides some flexibility over tonnage amounts, as this type of system can be outfitted for 180 tonnes/year to 30,000 tonnes/year or more. Once the material has finished primary composting in the vessels, the material can then be finished in a turned windrow system.

Benefits of the in-vessel approach include the ability to compost organics material during the winter months. Other advantages include composting speed and better control over odour and other composting issues. It also provides an opportunity for biogas production and collection, which can be used to generate energy (the organics would need to be processed aerobically, which means “without oxygen”. See process diagram in Figure 6). However, these systems are more technically complex and have higher capital and operational costs.
Diversion Potential

A composting program could divert approximately 1,987 tonnes of organics from disposal (not including paper/cardboard, wood), assuming that the program recovered 70% of organics from the waste stream. Assuming that the composting process reduces raw organic matter by about 40% to 50%, this could result in up to 890 tonnes of compost being produced annually.

While office paper and cardboard can be included in the City’s recycling program, composting provides another option for the material. Including paper and cardboard in the composting program instead of the recycling program could increase the amount of material managed through composting to 3,274 tonnes annually. An in-vessel anaerobic system could potentially manage all of the City’s paper, while a windrow system would be much more sensitive to the mix of material being composted.

Composting system could also accept approximately one-third of Iqaluit’s wood waste. If wood shredding is to take place, an indoor facility may be required during winter months. Wood for shredding should be clean, containing no nails, screws or other materials.

Estimated cost

The estimated capital and operating costs for a windrow and an in-vessel system are presented in the table below. These costs are based on typical North American compost facility costs adjusted for Iqaluit’s northern location and anticipated tonnage.

---

Table 5: Estimated Composting Costs

<table>
<thead>
<tr>
<th></th>
<th>Open Windrow¹²</th>
<th>In-Vessel¹³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$500,000 - $650,000</td>
<td>$1M - $3M</td>
</tr>
<tr>
<td>Operating Cost¹⁴¹⁵</td>
<td>$50,000 - $70,000/year</td>
<td>$100,000 - $150,000/year</td>
</tr>
<tr>
<td></td>
<td>$25-35/tonne/year</td>
<td>$30-46/tonne/year</td>
</tr>
</tbody>
</table>

**Issues to Consider**

Operational and infrastructure considerations to be further assessed during the implementation of a composting program include:

**Infrastructure**
- Composting method must be selected:
  - The Bill Mackenzie Humanitarian Society successfully implemented a composting program using the Open Windrow method.
  - Alternatively, an in-vessel system may be able to produce energy and/or biofuel through bio-gas production. This would use an anaerobic approach, which means no oxygen is used in the composting process. Energy could be useful on-site or in nearby facilities.
- Iqaluit’s existing shredder may be of suitable size/type for shredding food waste and cardboard. If shredding is to take place, an indoor facility maybe required during winter months.

**Operations**
- Current sewage sludge management could be included in the process. However, this process would require more rigorous management, testing and health and safety requirements, especially if a windrow process is used. If an anaerobic system was implemented, the material requirements would not be as sensitive.
- A composting process could be used to manage a portion (up to one-third) of the City’s wood waste.
- Techniques for maximizing the composting process (e.g., using aerated windrow, gore-tech cover, tension fabric structures, or buildings – see Figure 7)).

¹² Assuming windrow would include all food waste and sewage sludge.
¹³ Assuming in-vessel would include food waste, sewage sludge and paper.
¹⁴ Assuming 1,987 - 3247 tonnes could be composted/year (70% capture rate)
¹⁵ Does not include collection costs.
- The type of container system residents/organizations would use to collect organic waste, for example a green bin or a compostable bag (see Figure 8).
- The type of vehicle to collect the food waste and the number of crew members needed per truck (can an existing City vehicle be used, or does a new one need to be purchased?).

**Figure 7:** Covered Windrow (left); tension fabric structure (right).

**Figure 8:** Paper composting bag (left); green cart (middle); green cart and automatic lift (right).
3.3 End-of-Life Vehicle Program

What is it?

An end-of-life vehicle is one that has reached the end of its useful life. End-of-life vehicles can be recycled or reused. The vehicles can be stripped of all salvageable parts and scrap metal can be recycled.

How does it work?

Residents would be able to drop off their end-of-life vehicles at a worksite near the landfill, and trained professionals would safely remove hazardous materials (batteries etc), drain fluids and remove reusable parts from the vehicles. The unsalvageable metal could be compacted and shipped down south as scrap metal. In 2008, an end-of-life vehicles initiative run jointed by the City and the Government of Nunavut collected about 700 cars, snowmobiles and four-wheelers for recycling. This material (approximately 5,000 tonnes) was processed on an industrial site in the West 40 and stored until it could be shipped south as scrap metal.

Diversion Potential

No annual disposal rate data is available for end-of-life vehicles, but the success of past programs shows that this is an important program for the community.

Estimated Cost

Safely dismantling the vehicles and preparing for recycling is estimated to cost $25,000 annually in staff time (assumes 2 staff members, working part-time between May and September). The estimated cost of shipping end-of-life vehicles would be similar to that of scrap metal (approximately $585/tonne). The cost of safely disposing of fluids and batteries will be part of the household hazardous waste program (see Section 3.4).

Issues to Consider

Dismantling, storing and recycling end-of-life vehicles requires proper training, safety considerations and the proper infrastructure to implement. Before implementation, the following considerations should be addressed:

- Confirmation of shipping costs.
- Availability of space for dismantling and storing vehicles.
- Whether an indoor service area would be required, and whether indoor servicing requirements would be lower if program was seasonal (e.g., just in summer).
- Type of training/certification required for staff dismantling the vehicles.
- Accurate estimates of quantities of vehicles stockpiled or requiring disposal annually.
- Health and safety issues to be considered.
• Whether the City would help to pick-up end of life vehicles.
• How do local garages deal with fluid disposal? Are there opportunities for partnership?

The New Hampshire Department of Environmental Services identified a number of best practices with respect to dismantling end-of-life vehicles, including\textsuperscript{16}.

• Prior to removing parts and dismantling vehicle components, completely drain all vehicle fluids, including antifreeze, brake fluids, engine oils, transmission fluids, windshield washer fluid, power steering fluid, rear axle housing fluids, etc. Do this over an impervious surface.
• Do not mix the fluids. Recycle, reuse, or dispose of fluids in an appropriate manner.
• Dismantle and drain vehicles, parts, scrap, and cores in one centralized location that is under a roof and over an impervious surface (for example, concrete). Make sure there are no open drains or cracks in the surface.
• Use drip pans when unclipping hoses, unscrewing filters and removing parts.
• Replace drain plugs when done draining.
• Fully drain parts and cores on a drain table or drip rack before moving them to a storage area.
• Keep spill control equipment nearby. Clean up spills immediately.
• Seal all fluid lines after draining to prevent leaks. Metal lines can be crimped or bent; rubber hoses can be plugged with clamps, balls, or golf tees.
• Remove and separate recyclable and potentially hazardous components, including the fuel tank, radiator, tires, battery, catalytic converter, air bag units, and mercury switches.
• Remove and capture air conditioning refrigerants (R-12 and R-134a). Qualified persons, using certified equipment, must perform this work.
• Remove engines through the hood. Do not tip vehicles on their sides, because this allows fluids to run out and spill on the ground.
• Establish a good routine for dismantling vehicles and stick with it.
• At “you-pull-it” facilities (where customers are allowed to remove parts), make sure the fluids are drained from vehicles before customers are allowed to remove parts. Instruct customers on proper procedures to prevent leaks during removal of parts, and provide spill control supplies for convenient customer use.
• Store engines, transmissions, and other oily, greasy parts off the ground, over an impervious surface, and under cover to prevent soil, groundwater, and storm water contamination. Have spill controls, including drip pans and absorbents handy.
• Keep an inventory of the vehicles and parts stored at the facility


### 3.4 Household Hazardous Waste Program

**What is it?**

Diverting corrosive, flammable, explosive or poisonous waste from landfill by using designated drop-off sites or special collection days and events.

**How does it work?**

Household hazardous waste would be dropped off at a designated area of the waste management facility. Where feasible, some of the waste material could be reused (e.g., paint or stain), with the remainder being sorted and shipped to a southern hazardous waste facility for recycling and/or safe disposal. Household hazardous waste materials could include the following materials (among others):

- Cleaning products
- Batteries
- Light bulbs
- Automotive fluids
- Paint
- Stain removers

- Propane tanks
- Thermometers with mercury
- Wood varnish
- Needles
- Medication
- Drain openers

- Fire extinguishers
- Shoe care products
- Lighter fluid
- Fluorescent light tubes
- Abrasive powders
- Rust remover

**Diversion Potential**

Approximately 25 to 35 tonnes of household hazardous waste could be diverted annually by this type of program.

**Estimated Cost**

The estimated cost to manage and ship this material to a hazardous waste management location could range from $10,000 to $20,000 annually, which would be approximately $400 to $570/tonne/year.

**Issues to Consider**

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As mentioned, initiating this type of option requires proper training, storage containers, shipping containers and education and promotion. The following are considerations to be reviewed further if this option is developed:

- The advantages and disadvantages of privatizing this part of Iqaluit’s solid waste management program, even if government subsidies are available.
- Whether a specialized indoor facility would be required for this option during the winter months, and what kind of specialized ventilation and explosion proofing is required for such a facility.
- Whether the program could be operated during the summer months only.
- The territory and federal regulatory controls that would govern this program, including the shipment of household hazardous to another province.
- Staff training. It should be noted that training opportunities are available through the Nunavut Municipal Training Organization (NMTO). In 2001, the organization received the Canadian Association of Municipal Administrators 2011 Environment Award for its Household Hazardous Waste Management Training Program for Operators.  
  - The Government of Nunavut has prepared the document Environmental Guideline for the General Management of Hazardous Waste (October 2010). This document should be consulted during the development of a municipal household hazardous waste recycling program. It provides additional considerations on:
    - Disposal of hazardous waste;
    - General requirements on storage, containers, facilities; and
    - How to ensure generators, carriers and receivers of hazardous waste are registered before undertaking activities involving these wastes.

3.5 Re-use Centre

What is it?

A dedicated location where re-usable materials can be dropped off, exchanged, bought or sold.

How does it work?

Anytime a resident has an item that they no longer need, but is still functioning, they could bring it to the re-use centre. Based on the condition of the item, the re-use centre would accept items as a donation (no money is given in return by the re-use centre) and they sell the items to recover costs for running the centre.

Items that could potentially be reused include:

- Wood

• Building Materials
• Glassware
• Arts and Crafts
• Packaged Toys
• Electronics
• Books and other publishing
• Bicycles
• Furniture
• Appliances

**Estimated Cost**

Depending on the scope of this program, its implementation could require a large capital cost for a dedicated building with a large floor space if no building is available. Capital cost of such a building may range from $100,000 to $300,000, plus ongoing maintenance and utilities. Approximately one full time staff would be required to run and operate the re-use centre, depending on hours of operation.

**Issues to Consider**

Issues to consider with respect to establishing a re-use centre include:

- Whether some items would need to be protected from the elements to allow for re-use (and if Seacan containers could be used for this).
- Whether a new building is required to house and display the materials received, or if there is existing municipal or private sector space (e.g. second hand store).
- The potential for coordinating such a program with local charitable organizations.
- The types of items that would be acceptable.
- Methods for ensuring residents do not drop off unusable goods or waste.
- Hours of operation and staffing requirements.
- Whether the focus should be on wood and larger items rather than clothing and small household items, which could go to second hand store or local charities instead of being accepted at the re-use centre.
- The potential for coordinating the program with local charitable organization(s).
- The feasibility of posting available items online (e.g. Iqaluit sell/swap Facebook page).
3.6 Promotion and Education Programs

What is it?

All of the information and encouragement residents require to participate in the City’s diversion programs.

How does it work?

A promotion and education program is key to the success of any waste management program. It raises awareness about the program’s availability and helps ensure the program is used correctly. It educates residents about the environmental and social benefits of diverting waste, and inspires them to participate and take action. It also helps to educate the public on household hazardous waste items so they can be identified and properly disposed of.

A promotion and education program can change over time to respond to the needs of the municipality/community. Typical components of an education program may include:

- Print materials, such as a brochure or posters
- Face-to-face contact to promote specific programs, possibly at community events or by going door-to-door;
- Using neighbourhood champions or community leaders to teach others or to lead by example;
- Give-aways or discounts to help overcome physical barriers to participation;
- Youth/school programs
- Interactive on-line waste forums and feedback forms; and
- Community-based social marketing approaches.

An education program should also include a monitoring and reporting plan to track its effectiveness and provide recommendations for improvement.

Estimated Cost

According to the Blue Box Program Enhancement and Best Practice Assessment Project Final Report by KPMG (prepared for Stewardship Ontario), on-going promotion and education programs can cost between $0.83 to $1.18 per household, while costs of $3 to $4 per household can occur when implementing a new program or system. The costs are expected to be higher in Iqaluit due to higher printing and material costs.

3.7 Policy Options

In addition to the programs listed above, there are a number of policy options that the City could use to encourage diversion, which are described below. It is important to note that the policy options would require material diversion programs in place in order to have an effect. The policy options would help support the other diversion programs and encourage their use by residents and businesses.

- **Deposit-return**: residents pay a deposit for each beverage container, and receive a refund when it is returned for recycling.
- **Mandatory recycling bylaw**: the City could explore developing a by-law that makes recycling mandatory for materials that have a diversion program in place.
- **Disposal ban**: materials that have a diversion program in place (e.g., wood waste) could be banned from the landfill.
- **Ban on materials**: some hard-to-recycle materials could be banned from Iqaluit, such as plastic bags (or certain types of plastic bags).
- **Greater enforcement of waste management programs**: Currently, the City has programs in place requesting the separation of some waste materials (such as wood, household hazardous waste) from regular garbage. The City can increase enforcement of these existing programs to help ensure the divertible materials do not enter the landfill.
In addition to the policy options listed above, the City could also lobby the Government of Nunavut to pursue Extended Producer Responsibility (EPR) or product stewardship opportunities. EPR or product stewardship involves the producers of products taking some or all of the responsibility for managing products at the end of their useful life. There are several examples of product stewardship across Canada, including for used oil, beverage containers, electronics, pharmaceuticals, tires, and other materials. In many of these cases, distributors and manufacturers administer the collection and processing of their respective waste products. These costs are often recovered through the application of a recycling fee at the point of purchase. In Nova Scotia’s paint recovery program, paint brand owners must register with Resource Recovery Fund Board Inc. (RRFB Nova Scotia), which administers the province’s waste diversion programs. Registered brand owners are able to sell their product within the province, and unused paint is returned by the public through a depot system.

There are no external costs associated with these policy options other than staff time (e.g. Municipal Enforcement Officers).

**Issues to Consider**

Implementing policy options often requires hiring and/or training existing enforcement officers to properly enforce by-laws and regulations. Up-front educational material and public awareness is typically required to educate residents before by-laws come into effect. The following are points of consideration for the above policy options:

- Whether current staff levels are sufficient to monitor/enforce policy directions.
- Additional training for staff to deal with enforcement issues (e.g., approaches to enforcement, how to address issues).
- The kinds and size of penalties given to first time and repeat offenders.
- Whether current enforcement programs meet a set standard or if they can be improved.
- Potential impact policies may have on current supply contracts and local businesses (especially policies banning certain materials).
- Whether enforcement take place at curbside, at landfill site or both.
- Added benefit of combining policies (e.g. a clear bag policy would make enforcing disposal bans easier).
- Whether the City have the authority to implement the policies or if they would have to be regulated at the territorial level (for example, some of the policies the City could lobby for, but it may be up to the territorial or federal government to implement).
4 Disposal Options

After the City and its residents have reduced, reused, recycled and composted as much waste as possible, some waste will still require disposal.

There are two main options being considered for disposal: waste-to-energy and a new landfill. These are described below.

4.1 Waste-to-Energy Treatment Processes

One option for dealing with the City's remaining waste is to convert it to energy (i.e. waste-to-energy). The two main methods of doing this is through incineration or through more advanced techniques collectively referred to as Advanced Thermal Treatment. These are described in greater detail in the following sections.

There are a number of advantages of incineration and waste-to-energy technologies over landfill, including that they significantly reduce the volume of waste that needs to be landfilled, that there is the potential for energy or heat generation, and that they do not attract animals as a landfill would.

Alternatively, there are drawbacks compared to landfilling. For example, the process of incineration and (in particular) waste-to-energy is technically much more complex. This generally means that the process is more expensive than landfills and that advanced technical training is required to operate and maintain the machinery. Furthermore, many of these technologies require a considerable amount of energy (e.g. external supply of electricity or fuel) for start up and operation, which can outweigh any energy output benefit. There is also the concern of emissions of pollutants, especially if the facility is not run properly.

The capital cost of these technologies range from an estimated capital cost of $2M to $10M. Operation of an incineration facility sized for Iqaluit could require a staff of two to three general operators and at least one skilled technician.

4.1.1 Advanced Thermal Treatment

There are various forms of advanced thermal treatment that converts solid waste into forms of energy. These involve the decomposition of carbon-based materials using an indirect source of heat and result in a synthetic, combustible gas. Three common types of waste to energy technologies include gasification, pyrolysis, and plasma-arc. Pyrolysis is undertaken in the absence of oxygen, while gasification and plasma-arc use a limited amount of oxygen. The limited use or absence of oxygen results in the production of fewer air emissions at the thermal treatment source compared to combustion type thermal treatment technologies.

4.1.2 Incineration

In general, incineration involves converting residual waste into fuel or directly into energy. This conversion greatly reduces the quantity of waste for disposal while in most applications, providing a source of energy. The technologies required for incineration can vary in complexity, cost and
economies of scale. Based on the application, wastes can be fed into an incinerator on a continuous basis, or the material can be burned in batches.

Incineration can reduce the amount of waste requiring landfill by up to 90 percent by volume, or 70 percent by weight. While incineration can handle most wastes, its efficiency depends on the heat value (BTU) of the materials being processed. For example, glass and metals have little heat value, while plastics and fibres have more. While these types of processes can reduce the volume of waste, a waste disposal site or landfill is still required to manage the remaining waste residue known as ash.

The process for incineration typically consists of five key steps:

1. **Pre-processing** – waste is sorted to remove unsuitable materials, such as recyclables, hazardous waste, or over-sized items. Cleared waste may then be shredded and screened before being processed.

2. **Incineration** – waste is treated or destroyed under carefully controlled conditions. Heat is applied and concentrations of oxygen are adjusted to reduce the waste into simpler elements more suitable for use as a fuel or for landfill disposal.

3. **Energy recovery** – heat energy can be recovered from the process. This may involve boilers, which helps to convert the heat energy into steam, which is in turn converted to energy using turbines or generators. The steam can also be used for district heating. In some thermal treatment processes, the waste is converted into a solid, liquid or gaseous fuel that can be sold and used at other facilities (e.g., kilns or energy generations stations).

4. **Air pollution control** – air pollution control systems are used to reduce emissions from the incineration processes. These may include chemical or physical capture and removal technologies, neutralizing acid gases with lime, and capturing heavy metals, trace gases, and particulates.

5. **Ash management** – incineration results in an ash that will go to landfill for disposal or, depending on its chemical composition, may be used as an aggregate substitute.

A key issue related to incineration of waste is the release of pollutants into the atmosphere. Waste must be burned at a high temperature (in excess of 1,000 °C) in order to safely destroy wastes. Open burning does not provide sufficient temperatures to safely burn waste.

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**Air Emission Standards**

Solid waste incinerators in Nunavut are required to meet the Canadian Council of Ministers of the Environment Canada-Wide Standards for dioxins/furans and mercury. Dioxins/furans are considered persistent organic pollutants (POPs), which, along with mercury, bio-accumulate in the environment and may cause adverse effects to human health and other organisms. Dioxins/furans can be generated when waste is incinerated improperly or at too low a temperature. Mercury is not created during the incineration process, so therefore it is very important that waste materials (such as thermostats) are not fed into an energy from waste system.

4.1.3 Issues to Consider

Issues to consider with respect to incineration and waste-to-energy include:

- Some materials may be better than others for incineration/thermal treatment (e.g., wood, papers and plastics combust better than glass or metals)
- Some of the waste materials from the current West 40 landfill may also be incinerated, but several issues must be carefully considered, such as:
  - Safety of "mining" the pile (risk of fire, stability of pile);
  - Blowing litter when cover material is exposed; and
  - Sorting out material that is not safe for incineration (health and safety issues, cost of disposal).
- While the residual ash typically would be landfilled, it might potentially be used as an aggregate substitute, depending on its chemistry.
- Heat energy could be recovered from this process and used for energy production (steam) or district/onsite heating.
- The availability of an incinerator or advanced thermal treatment facility may reduce the political/public will to fund diversion programs.
- Advanced thermal treatments generally require a significant amount of waste to efficiently run and to make them financially feasible.
- An alternate means of waste disposal and the ability to repair the facility is required in case of equipment breakdown.
- The Government of Nunavut is currently finalizing a desktop study on incineration and thermal treatment solid waste management facilities. Discussions with the GN indicate that no such facilities currently operate in Nunavut.

4.2 Landfill

Waste that cannot be diverted by other programs (e.g. non-recyclable plastics) is disposed of in an area designed to separate the waste from groundwater and surface water. Precipitation that comes in contact with the waste (runoff) will be managed and treated before it is discharged into the environment.

Landfills generally form one of three types: an open dump, a modified landfill and a sanitary landfill. An open dump has little to no site management, operations procedures or engineering design to safely manage the waste disposed. A modified landfill site will have some site management and operations procedures in place with some engineered design (e.g., leachate control). Modified landfills are the most common in the arctic. Sanitary landfills are heavily engineered, with geotextile material lining the bottom of landfill areas and leachate collection and treatment systems.

To help maximize available space in the landfill and minimize nuisance issues such as pests and blowing litter, waste is often compacted in landfills using equipment such as a bulldozer or other large machinery.
Landfills do have a number of advantages and disadvantages compared to waste-to-energy systems. For example, landfills generate fewer dioxins and furans, can be less expensive to build, operate and maintain than incineration or thermal systems and require less technical training and maintenance. However, landfills require more space, give off odours (this can be minimized by diverting organics into a composting program), and are viewed as ruining the landscape.

5 Site Selection

Iqaluit’s future Solid Waste Management Program will need a new waste management worksite for waste diversion and disposal activities. A new waste management site will include the following features:

- Landfill area
- Areas for diversion programs:
  - Re-use
  - Household/commercial recycling
  - Bulky recycling
  - Household hazardous waste
  - Composting
  - End-of-life vehicles
  - Sewage sludge management (if not included in the compost program)
- Water management for clean water flowing toward the site and contaminated water within the site; and
- Litter management.

In addition to the project evaluation criteria listed in Section 1, the site selection process will consider:

- Regulatory requirements and land use constraints,
- Space requirements for both diversion and disposal programs,
- Setbacks from airports and residential areas,
- Development and servicing costs,
- Operation and maintenance costs,
- Ecological impacts,
- Groundwater and surface water protection,
- Geotechnical suitability,

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20 Even if an incinerator is chosen, the City will still require a landfill area to dispose of incinerator waste ash.
- Visibility from town, and
- Ability to access landfill site during winter months.

Figure 10 shows a map of the land use constraints affecting this project (e.g. municipal boundary, park lands, watershed protection zones, setbacks from current and future community development areas, proposed airport zoning regulations, etc.).

To date, six sites (shown in Figure 11 below) are being assessed in the site selection process:

1. Northwest,
2. Trail Area,
3. North 40,
4. West 40,
5. East Iqaluit, and

The North 40, West 40 and East Iqaluit sites were all identified by residents at Open House #1 and considered viable for inclusion in the site selection process by the consulting team. A preliminary inventory of these sites can be found in Appendix A.
Figure 10. Solid waste management site land use constraints map.
Figure 11. Six sites currently being assessed in the site selection process.
Appendix A- Preliminary Site Inventory

1. West 40
   - The site is located 1.8 km southwest of the City center (Azimuth 222 degrees) adjacent to the existing West 40 landfill area.
   - Access road: use the existing road to the Causeway
   - Development: The northerly section of this site is the location of the DND receiver/transmitter site for the FOL operation at the airport. These lands are designated ‘Transportation Facility’ in the General Plan.
   - Setback from airport (1.6 km) may pose a significant limitation.
   - Geology: rock and gravel
   - Surface water body: Frobisher Bay and Sylvia Grinneu River nearby
   - Topography is relatively flat with drainage toward the river.
   - Land ownership: City
   - Community involvement: this site was identified by a resident at the first open house.
   - Capacity: equal or less than 20 years

2. North 40
   - The site is located 2.4 km northwest of the City centre (Azimuth 326 degrees), within the North 40 gravel pit.
   - Access road: use the existing Federal Road.
   - Development: within the former military landfill area and gravel extraction area. Current Gravel processing area for local contractors.
   - Setback from airport (1.1 km) may pose a significant limitation.
   - Geology: rock and sandy
   - Surface water body: adjacent to a river/stream
   - Topography is relatively flat
   - Land ownership: not City owned
   - Community involvement: this site was identified by a resident at the first open house.
   - Capacity: equal or less than 20 years

3. East Iqaluit
   - The site is located 4.5 km east of the City centre (Azimuth 103 degrees), north of Apex.
   - Access road: would be developed with a new road beyond the Road to Nowhere, and an upgrade of a portion of the road to the Sandpits.
   - Development: within an undisturbed area of the Iqaluit municipal boundary. Located approximately 600 m from planned residential uses (Future Development Areas A & B as shown on Figure B of General Plan).
   - Setback from airport (4.9 km) is not a limitation.
   - Geology is bedrock.
   - Surface water body: 850 m from a river
   - Site slopes northeast and southwest
Client: City of Iqaluit
Project Name: Iqaluit Waste Management Project
Project Number: OTT-00020728
Date: June 17, 2011

4. North of Tarr Inlet

- The site is located 6.0 km southeast of the City centre (Azimuth 102 degrees), north and inland from Tarr Inlet.
- Access road: would be developed with a new road beyond the Road to Nowhere, and an upgrade of a portion of the road to the Sandpits.
- Development: within an undisturbed area of the Iqaluit municipal boundary
- Setback from airport (8.5 km) is not a limitation.
- Geology is bedrock.
- Surface water body: 2300 m from a river
- Site is sloping northeast and southwest
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team NOT by the community resident.
- Capacity: more than 20 years

5. Trail Area

- The site is located 5.2 km northwest of the City Centre (Azimuth 341 degrees), adjacent to the site of the City's current gravel pit.
- Access road: would be developed as an upgrade to road leading to the Trail gravel extraction area.
- Development: within an undisturbed area of the Iqaluit municipal boundary
- Setback from airport (3.5 km) is not a limitation.
- Geology is bedrock.
- Surface water body: adjacent to ponds/lakes
- Site is sloping east and west
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team.
- Capacity: more than 20 years
6. **Northwest**

- The site is located 8.5 km northwest of the City centre (Azimuth 334 degrees), adjacent to a site identified as a future gravel pit for the City.
- Access road: to be developed with a new road beyond the Trail Area Deposit and an upgraded road to the Trail Area Deposit.
- Development: within a disturbed area of the Iqaluit municipal boundary
- Setback from airport (6.3 km) is not a limitation.
- Geology is bedrock.
- Surface water body: adjacent to ponds/lakes
- Topography is near height of land and sloping west
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team.
- Capacity: more than 20 years