DILLON CONSULTING

CITY OF IQALUIT

Phase I Design Report (30% Submission)

Landfill and Waste Transfer Station

June 2019 | 19-9543

June 7, 2019

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Attention: Mr. Erik Marko, P.Eng. PMP
Project Manager

Iqaluit Landfill and Transfer Station
Phase I Design Report

Dear Mr. Marko:

Please find attached a copy of the Phase I Design Report for the Iqaluit Landfill and Transfer Station. This report presents the 30% design submission for the project.

If you have any questions regarding the information contained within the document, please don't hesitate to contact me at (867) 920-4555 ext. 4310, or by email at kbarnes@dillon.ca.

Sincerely,

DILLON CONSULTING LIMITED

Keith Barnes, P.Eng.
Project Manager

KGB:slg

Our file: 19-9543

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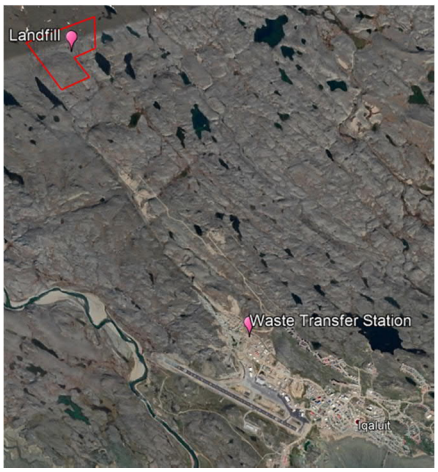
A Supplementary Waste Transfer Station Environmental Site Assessment Investigation Report
B Waste Transfer Station Geothermal Analysis Report (Wood Group)
C Landfill Drilling Program Report (EXP Services Inc.)
D Assessment of Leachate Treatment Options Report
E Design and Construction Options Technical Brief
F Facility Operations and Maintenance Manual
G Facility Risk Assessment Report
H Investing in Canada Infrastructure Program Reports
I Closure and Decommissioning Plan
J Environmental Management Plan

1.0 Introduction

The City of Iqaluit (City) is in the process of implementing its Solid Waste Management Strategy to service their near and long-term (75 years) municipal solid waste (MSW) disposal requirements. Founded on a previously completed conceptual design and facility siting exercise (see **Figure 1–1**), key elements of the project include a solid waste transfer station (WTS) within the immediate urban area of the City, where residential and commercial waste will be hauled to, processed, and compacted in bales or in the case of waste wood and cardboard, shredded and pelletized for use as a fuel source for an on-site biomass boiler. Tires, metals, and some construction and demolition (C&D) wastes will also be shredded and/or baled for landfilling or transported south for recycling. The resulting solid waste bales and possibly a smaller amount of unbaled C&D waste will be trucked to an engineered balefill / landfill site (Landfill) located approximately 6 km from the WTS. The vehicles transferring the waste bales will access the road leading to the Landfill from the WTS, to avoid having the transfer vehicle travel through the City.

Figure 1-1: Facility Site Locations



Other planned features of the WTS include a public drop off area for household hazardous wastes (HHW) and a vehicle logger/compactor unit; in both instances, allowing for the preparation of waste materials prior to shipping to approved management facilities in the south.

The access road that will be used to reach the new Landfill has been designed by EXP Services Inc. (EXP), who will also be providing Construction Contract Administration services for the construction of the road. It is anticipated that the construction of the road will be included in the new Landfill and WTS Contractor's scope of work.

To address their objectives, and following a competitive proposal process, the City engaged Dillon Consulting Limited (Dillon) in March 2019 to provide design and construction contract administration services to support the establishment of the WTS/baling facility and the Landfill. The Landfill will be designed for 75 years of operation. The first stage of the Landfill (Stage 1 Operational Landfill) will be constructed, which is the first two cells (e.g., five years per cell) and ancillary components to meet five and 10 year operational requirements

Development of the proposed facilities is scheduled to occur during the 2020 and 2021 construction seasons, with facility commissioning in the fall of 2021.

2.0 Purpose of this Document

As defined in the City's request for proposal (RFP) for this project and as detailed in Dillon's February 2019 proposal submission, the completion of the design and construction administration effort to support the establishment of the Landfill and WTS is to occur over four phases:

- Phase I –Pre-Design (30% Submission)
- Phase II –Preliminary Design (50% Submission)
- Phase III –Final Design (90 and 100% Submission)
- Phase IV –Contract Administration and Construction Inspection

This document addresses the deliverable requirements for **Phase I**, and presents the findings and recommendations of the following project tasks under this phase:

- Task 1 – Project Start/Kick Off Meeting/Initial Site Reconnaissance
- Task 2 – Review Existing Information and Conduct Additional Services
- Task 3 – Prepare Conceptual Design Information to Support City's Application Requirements
- Task 4 – Prepare/Submit Pre-Design Report
- Task 5– Prepare/Submit Draft Project Support Documents

Following **Section 1** (Introduction) and **Section 2** (Purpose of this Document), the Phase I Pre-Design Report is organized as follows:

- Section 3 – Key Project Assumptions
- Section 4 – Supplementary Site Investigations
- Section 5 – Facility Performance and Design Parameters
- Section 6 – Design and Construction Options Analysis
- Section 7 – Conceptual Design Information
- Section 8 – Project Support Documents
- Section 9 – Next Steps

It is acknowledged that supporting reports (including detailed supplementary information) are presented within the appendices section of this document.

3.0 Key Project Assumptions

As identified in the City's RFP, the establishment of the Landfill and WTS is to achieve the following waste management operational objectives below.

3.1 General

- Establishment of facilities to address the City's projected MSW management requirements for a 75 year design period.
- Development of a Landfill and WTS at two previously identified locations.

3.2 Waste Transfer Station

- Continuation of current waste collection procedures within the City.
- Quantification and documentation of incoming materials, using a scale and data recording system.
- Segregation of incoming materials at an enclosed WTS to extract targeted items for specialized handling with remaining residual materials being compacted into plastic-wrapped bales prior to landfilling.
- Shredding and pellitizing of cardboard and clean wood (e.g., pallets) to create pellets for use as fuel in an on-site biomass boiler.
- Shredding of tires, old furniture, and C&D waste for subsequent direction to the Landfill.
- Processing and compaction (logging) of end-of-life vehicles, segregation/packaging of HHW and separation of appliances/salvageable metals to allow for subsequent shipping to approved management facilities in the south.
- Incorporating an allowance in the WTS layout to accommodate the potential future addition of organics (e.g., food waste, dewatered wastewater treatment plant [WWTP] sludge) processing facility,

3.3 Landfill

- Definition and installation of an engineered containment liner appropriate for the identified site location, including considerations associated with permafrost and climate change.
- Definition and ongoing operation of a landfill leachate treatment system.
- Development of the overall 75 year landfill footprint in stages, with the initial two landfill cells (Stage 1 Operational Landfill), addressing anticipated disposal requirements for the first 10 years of operation.
- Installation of the final cap in stages, during the 75 year operational life of the Landfill, aligned with the proposed landfill cell development sequence.

- Definition of an overall landfill development sequence that acknowledges the placement of bales along with loose/comingled C&D waste, shredded furniture, as well as (potentially) shredded tires.

3.4 Relevant Regulations

There are a number of acts and regulations applicable to waste management activities in Nunavut. The primary legislation governing waste management in Nunavut is *The Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), which establishes the Nunavut Water Board (NWB). A summary of the regulations, acts, legislation, and guidelines relating to the construction and operation of the Landfill and WTS are presented in **Table 3–1**.

Table 3-1: Applicable Regulations

Regulation/Act/Guideline/Bylaw	Source
Building Bylaw #710	City of Iqaluit
Highway Traffic Bylaw # 319	City of Iqaluit
Civic Holiday Bylaw #735	City of Iqaluit
Noise Bylaw #599	City of Iqaluit
Solid Waste Amendment By-Law #544	City of Iqaluit
Solid Waste By-Law # 341	City of Iqaluit
Solid Waste By-Law Amendment # 830	City of Iqaluit
Nunavut Waters and Nunavut Surface Rights Tribunal Act	Government of Canada
Water Licence Terms and Conditions	Government of Nunavut
Nunavut Environmental Protection Act	Government of Nunavut
Nunavut Public Health Act and General Sanitation Regulations	Government of Nunavut
Nunavut Wildlife Act	Government of Nunavut
Motor Vehicle Act	Government of Nunavut
Contingency Planning and Spill Reporting in Nunavut	Government of Nunavut
Waste Lead and Lead Paint (2014)	Government of Nunavut
Pesticide Regulations	Government of Nunavut
Biomedical and Pharmaceutical Waste	Government of Nunavut
Used Oil and Waste Fuel	Government of Nunavut
A Guide to Spill Contingency Planning and Reporting	Government of Nunavut
Waste Batteries (2011)	Government of Nunavut
Waste Solvent (2011)	Government of Nunavut
Waste Paint (2010)	Government of Nunavut
Waste Asbestos (2011)	Government of Nunavut

Regulation/Act/Guideline/Bylaw	Source
Waste Antifreeze (2011)	Government of Nunavut
Ozone Depleting Substances (2011)	Government of Nunavut
General Management of Hazardous Wastes (2010)	Government of Nunavut
Dust Suppression	Government of Nunavut
Ambient Air Quality (2011)	Government of Nunavut
Environmental Guideline for Used Oil and Waste Fuel	Government of Nunavut

4.0 Supplementary Site Investigations

4.1 Waste Transfer Station Environmental Site Assessment

Due to the frozen ground conditions at the site, an accurate environmental sampling program cannot be undertaken until the ground is thawed. As such, additional background environmental sampling will be conducted in the summer of 2019, to further assess the conditions at the site.

The proposed Baseline Environmental Data Investigation will focus on collecting data from soil, groundwater, and/or surface water in various areas in and around the proposed Landfill and WTS, in order to characterize current conditions at these locations. The results of the Baseline Environmental Data Investigation will be used to document the current site conditions for comparison to future sampling programs. Additionally, a Qualitative Risk Assessment and Risk Management Plan for site development will be prepared for the WTS, using the collected data.

A detailed Environmental Monitoring Plan is presented in **Appendix A**.

4.2 Landfill and Waste Transfer Station Geothermal Analysis

Wood Environment and Infrastructure Solutions, a division of Wood Canada Limited (Wood) has conducted geothermal modelling and developed geotechnical recommendations for the proposed WTS foundation and Landfill based on previous geotechnical drilling programs conducted by EXP. This information is presented in the report "*Geothermal Modelling and Geotechnical Recommendation Transfer Station and Landfill Iqaluit, Nunavut, Wood Environmental and Infrastructure Solutions, May 2019.*

4.2.1 Waste Transfer Station

4.2.1.1 Geotechnical Drilling Program

A geotechnical investigation was undertaken at the site of the proposed WTS, which is to be located on Qaqqamiut Road in the City. This work was authorized by the City via Service Contract SC000818, dated August 16, 2018.

Preliminary information indicates that the proposed structure will be an insulated metal-clad building set on a concrete pad at grade. It would be located on a 2.4 ha site. The exact location of the structure on the site and the structural details of the proposed structures were not available at the time of the preparation of this report. It is understood that other buildings may also be located at the site.

The geotechnical investigation comprised of drilling six boreholes across the site to a depth of 10 m to 15 m. The fieldwork was undertaken with an air-track drill rented from a local drilling company. During drilling, bulk soil samples were obtained from the boreholes at selected depths. The investigation

revealed that the surficial soil at the site is generally sand fill, which extends to 1.5 m to 2.5 m depth (Elev. 24.4 m to 26.4 m). The fill in the central part of the site (Borehole Nos. 1 and 3 to 5) is underlain by gravelly sand to sandy gravel to 3.1 m to 9.5 m depth (Elev. 18.4 m to 25.4 m). The predominant soil underlying this stratum in the north part of the site (Borehole Nos. 1 to 3) is well graded sand to gravelly sand, which extends to the entire depth investigated (i.e., 10 m to 15 m). In the south part of the site, the predominant soil underlying the gravelly sand to sandy gravel stratum is poorly graded sand, which extends to the entire depth investigated (i.e., 10 m to 15 m).

Free water was encountered in Borehole Nos. 2 to 5 and the groundwater table was established at a depth of 1.2 m to 3.0 m below the existing ground surface (Elev. 24.9 to 26 m.)

This investigation has revealed that the geotechnical conditions at the site are suitable for construction of the proposed building on a concrete pad at grade with provisions of extruded polystyrene insulation and thermosyphons to maintain the soil below the founding level permanently frozen. Adfreeze piles are not suitable for slab on grade structures because of the loss of heat from the building to the piles. End bearing piles are not feasible since bedrock was not encountered to the maximum depth investigated (i.e., 15 m).

The concrete pad should be set on an engineered granular fill mat. The thickness of the granular mat would have to be established by undertaking a geothermal analysis of the site. The Serviceability Limit State bearing pressure will be a function of the compressive strength of the insulation used, as detailed in the *Geotechnical Report" Geotechnical Investigation Proposed Waste Transfer Station Qaqqamiut Road, Iqaluit, Nunavut, EXP Services Inc. October 2018"*.

Any other structures proposed for the site may be founded on adfreeze piles, so long as a minimum air gap of 600 mm is provided below the floor slab to prevent heat loss from the building to the piles. The criteria for design of the piles are presented in the Geotechnical Report

The site has been classified as Class C for seismic site classification, in accordance with the requirements of the National Building Code, 2015. The on-site frozen soils are not susceptible to liquefaction during a seismic event.

Limited chemical tests undertaken on selected soil samples indicate that General Use Portland cement may be used in the subsurface concrete at this site. The on-site soils are considered to be mildly corrosive to corrosive to buried steel. A corrosive specialist should be consulted if steel is to be buried at the site.

Excavation at the site for construction of the granular mat is expected to be relatively straight forward, if undertaken during the cold months when the soil is frozen, since only minimal free water would be encountered in the excavation. However, site dewatering would be required if construction is

undertaken during the summer months to maintain the groundwater table below the excavation base level, during construction and the installation of the piles.

The exterior grade should be sloped away from the building to prevent water ponding adjacent to the structure.

The above noted Geotechnical Report was located in the RFP background documentation, Appendix D – Preliminary Geotechnical Investigation Report for this project.

4.2.1.2 Geothermal Analysis

The WTS design was based on the understanding that it should be supported by a mat (slab-on-grade) foundation with no crawl space between underside of the station and the ground surface. Such a foundation option for heated structures within permafrost regions with ice-rich surficial materials can be used if some device or method is applied to eliminate or considerably reduce the amount of heat released by the heated structure into the permafrost. For the current project, two foundation options were considered: 1) thermosiphons to freeze surficial soils under the heated structure; and 2) a thick layer of insulation immediately under the slab, to reduce heat flux from the heated structure.

The scope of work included the following sections required for designing suitable foundations for the WTS:

- Compilation of climate data.
- Regional geological and permafrost conditions.
- Results of geotechnical drilling.
- Results of geothermal modelling.
- Geotechnical recommendations on suitable foundation options (slab-on-grade and slab-on-grade with thermosiphons, including soil design parameters).
- Geotechnical recommendations on site grading and drainage.

Based on results of field geotechnical investigations and geothermal modelling, it was concluded that the foundation system for the WTS can be designed as a reinforced concrete slab supported on a compacted gravel pad - either with or without installation of thermosiphons. However, some limitations will apply to the slab-on-grade foundation alternative that does not include thermosiphons to remove heat energy from the area below the structure.

Geothermal Modelling and Geotechical Recommendations Report (Wood, 2019) is presented in **Appendix B**.

4.2.2 Landfill

4.2.2.1 Geotechnical Drilling Program

A preliminary geotechnical investigation ("*City of Iqaluit Preliminary Geotechnical Investigation Report, Proposed New Landfill Facility, Iqaluit, Nunavut, EXP Services Inc., May 2019")*was undertaken at the site of the proposed Landfill to be located on a 64.12 ha parcel of land approximately 8 km northwest of the City (Figure 1, EXP).

The purpose of the investigation was to establish the geotechnical and groundwater conditions at the site, and to make recommendations regarding the design and construction of the facility from a geotechnical perspective.

The preliminary geotechnical investigation comprised of drilling six sampled boreholes to a 3 m to 6 m depth, as well as five additional boreholes to a 4.4 m to 6.6 m depth for installation of PVC piping and standpipes, for long-term groundwater and ground temperature monitoring at the site.

The investigation revealed that the site predominantly contains sand and gravel, which extends to the bedrock contacted at a depth of 1.0 m to 5.0 m. This stratum has low moisture content and is free of ice lensing. Geological information indicates that the bedrock at the site is likely to be Monzogranite. At the time of the fieldwork, soil at the site was frozen to the ground surface; therefore, the groundwater table and the active layer thickness could not be established.

The salinity of the on-site soils is low. General Use Portland cement may be used in subsurface concrete requirements at the site. The concrete mix design should conform to Canada Standards Association A23.1.

The site has been classified as Class C for seismic site classification, in accordance with the requirements of Section 4.1.8.4 of the National Building Code of Canada, 2015.

The investigation revealed that the on-site soils are suitable for construction of the proposed Landfill. Since the natural soils are permeable, the landfill cell, leachate collection sump and leachate holding ponds will have to be fully lined. The guidelines recommend the following:

1. The base of the cells and the leachate holding ponds should be set at a depth of 1 m below existing grade, or 1.5 m above the seasonal high groundwater table or at the permafrost level. Information regarding the seasonal high groundwater table and the permafrost level was not available at the time of writing this report. It is likely that the seasonal high groundwater table may govern the design. Therefore, additional monitoring of groundwater and temperature are recommended on the spring prior to finalizing of the design.
2. Since the on-site soils are very permeable and clayey impermeable soils are not available in the Iqaluit area, the landfill cell and inside slopes of the berms, leachate collection sump and

leachate holding ponds will all have to be lined with two liners (i.e., a 60 mil geosynthetic clay liner and a 60 mil High Density Poly Ethylene [HPDE]) liner. A leachate collection system should be installed in a 600 mm granular layer above the HDPE liner leading to the leachate sump. Leachate from the sump should be directed to the leachate holding ponds.

3. The berms of the proposed landfill cell and the leachate holding ponds are expected to be stable when sloped back on an inclination of 3H:1V. This would require conformation based on slope stability analysis, once the design of the facility has been finalized. The inside faces of the berms of the Landfill, leachate holding ponds and the sides of the leachate collection sump should also be lined with a 60 mil geosynthetic clay liner overlain by 60 mil thick HDPE liner. The outside slopes of the berms and the leachate holding pond should be protected with coarse gravel to minimize erosion.
4. Any permanent buildings proposed to be constructed would have to be supported on rock socketed piles. Additional recommendation on foundation alternatives and design will be provided once the design is finalized.

The on-site soils underneath the Landfill are expected to thaw due to the heat generated by decomposition of the waste. Similarly, the soils under the leachate holding ponds are expected to thaw due to absorption of heat from the sun rays by the leachate. The settlements of the cell and the leachate holding ponds were estimated to vary from 20 mm to 150 mm. Therefore, it is recommended that liners should be installed with enough folds to accommodate the anticipated settlements. The manufacturer of the liners should be consulted for this purpose.

Groundwater and temperature monitoring should be undertaken at the site to establish seasonal high groundwater table and to establish the active layer thickness.

It was recommended that groundwater and gas monitoring networks should be installed to ensure that the leachate is not impacting the groundwater, and that explosive gases are not migrating from the property during operation of the Landfill.

Methane monitoring devices should be installed, in any of the structures located on the site, to ensure that methane is not accumulating in the building(s).

Preliminary Geotechnical Investigation Report (EXP, 2019) is presented in **Appendix C**.

4.2.2.2 Geothermal Analysis

The scope of work for the proposed Landfill included geothermal modelling for the baled waste, prepared by Wood Environmental and Infrastructure Solutions. The purpose of the modelling was determination of the period of time for freezing the baled waste and underlying soil of the active layer, if placement of the bales occurs at the end of summer.

Based on results of the geothermal analyses, it can be concluded that five to six years is required for complete freezing of the bale and soil below the bale, if the bale placement occurs at the end of summer or in early winter.

4.3 Landfill Baseline Environmental Data Collection

Due to the frozen ground conditions at the site, an accurate environmental sampling program cannot be undertaken until the ground has thawed. As such, additional background environmental sampling will be conducted in the summer of 2019, to further assess the conditions at the site.

The proposed Baseline Environmental Data Investigation will focus on collecting data from soil, groundwater and/or surface water in various areas in and around the proposed Landfill and WTS, in order to characterize current conditions at these locations. The results of the Baseline Environmental Data Investigation will be used to document current site conditions for comparison to future sampling programs. Additionally, a Qualitative Risk Assessment and Risk Management Plan for site development will be prepared for the WTS, using the collected data.

A detailed environmental monitoring plan is presented in **Appendix A**.

5.0 Facility Performance and Design Parameters

5.1 Waste Quantity Estimates

The estimate of the total quantity of waste anticipated at the proposed Landfill is a factor of waste generation per population and anticipated population growth for the City. The anticipated life of the proposed Landfill is 75 years. The Nunavut Bureau of Statistics (2014) has released population projections for the City to the year 2035. This population projection was used to calculate an annual population growth rate of 1.416% for projecting the population of Iqaluit beyond 2035 to the year 2094. **Table 5–1** presents a summary of the projected population of the City for the anticipated life of the project. For each summary table, complete information is provided in **Table 5–4**.

Table 5-1: Projected Population Summary, City of Iqaluit

Operating Year	Year	Projected Population
1	2020	8,090
15	2034	9,265
25	2044	10,588
35	2054	12,186
45	2064	12,359
55	2074	12,534
65	2084	12,711
75	2094	12,891

Current waste generation values provided by the City have been used as the baseline annual waste disposal quantities. At the direction of the City, an annual increase in waste generation per person of 1.00% was applied. Base assumptions for the waste densities assumptions used to arrive at the estimated disposal quantities over the life of the facility are summarized in **Table 5–2**.

Table 5-2: Assumed Waste Disposal Densities

Waste Component	Density	Source
Baled MSW	750 kg/m^3	AECOM Report (based on estimated 975kg bale weight, 0.762 m^3 per bale)
Shredded baled tires	654 kg/m^3	AECOM Report (est. 850 kg/bale)
Whole baled tires	462 kg/m^3	AECOM Report (est. 600 kg/bale)
C&D Waste	449 kg/m^3	Volume-to-Weight Conversion Factors Report (USEPA, 2016)

Table 5–3 provides the initial annual generation, and summarized annual and cumulative amounts.

Table 5-3: Waste Generation Forecast Summary Table

Operating Year	Year	Municipal Solid Waste			Wood Waste	Scrap Metal	Tires	Hazardous Waste	Cardboard	Non-Metallic C&D Waste	Mattresses	Vehicles
		Annual (Tonnes)	Cumulative (Tonnes)	Cumulative (m^3)	Annual (tonnes)	Annual (tonnes)	Annual (tonnes)	Annual (tonnes)	Annual (tonnes)	Annual (tonnes)	Annual (each)	Annual (each)
1	2020	8,580	8,580	11,440	7,300	7,714	5.0	10.0	2,704	32	312	80
15	2034	12,008	153,076	204,102	10,217	10,797	7.0	14.0	3,784	40	437	112
25	2044	15,267	290,437	387,249	12,989	13,727	8.9	17.8	4,811	46	555	142
35	2054	19,410	465,076	620,101	16,515	17,452	11.3	22.6	6,117	52	706	181
45	2064	24,678	687,110	916,147	20,997	22,188	14.4	28.8	7,777	58	897	230
55	2074	31,376	969,402	1,292,535	26,695	28,210	18.3	36.6	9,888	64	1,141	293
65	2084	39,890	1,328,304	1,771,072	33,939	35,866	23.2	46.5	12,572	70	1,451	372
75	2094	50,716	1,784,609	2,379,478	43,150	45,599	29.6	59.1	15,983	70	1,844	473

The proposed Landfill will be sized for the disposal of approximately 2.4 million m^3 of baled, wrapped MSW, and non-metallic C&D waste. Wood and cardboard waste is to be shredded at the Transfer Station and burned to supplement space heating at the Transfer Station. Scrap metal, tires, recyclables, mattresses, and vehicles are to be processed at the Transfer Station, stored, and processing or recycled.
Table 5–4 presents the data for the 75 years

City of Iqaluit
Waste Forecasts

Assumptions:

Population Growth Rate	1.42%	Recyclables Growth Rate	1.00%	Density of Baled MSW	750	kg/m^3
Municipal Solid Waste Growth Rate	1.00%	Cardboard Growth Rate	1.00%	Density of baled tires (shredded)	654	kg/m^3
Wood Waste Growth Rate	1.00%	Hazardous Waste Growth Rate	1.00%	Density of baled tires (whole)	462	kg/m^3
Scrap Metal Growth Rate	1.00%	End of Life Vehicle Growth Rate	1.00%	C&D Density	449	kg/m^3
Scrap Tire Growth Rate	1.00%	Mattress Growth Rate	1.00%			

Year		Population	Annual MSW (tonnes)	Cumulative MSW (tonnes)	Cumulative MSW Volume (m^3)	Annual Wood Waste (m^3)	Scrap Metal (m^3)	Annual Scrap Tires (tonnes)	Annual Hazardous Waste (tonnes)	Annual Cardboard (tonnes)	Non-metallic C&D waste (tonnes)	Non-metallic C&D waste, cumulative (tonnes)	Annual Mattess (each)	Annual Vehicles (each)
1	2020	8,090	8,580	8,580	11,440	7,300	7,714	5.0	10.0	2,704	32	32	312	80
2	2021	8,205	8,789	17,369	23,158	7,477	7,902	5.1	10.2	2,770	33	65	320	82
3	2022	8,318	9,002	26,371	35,161	7,659	8,094	5.2	10.5	2,837	34	99	327	84
4	2023	8,427	9,221	35,591	47,455	7,845	8,290	5.4	10.7	2,906	34	133	335	86
5	2024	8,524	9,445	45,036	60,048	8,036	8,492	5.5	11.0	2,977	35	168	343	88
6	2025	8,615	9,674	54,711	72,948	8,231	8,698	5.6	11.3	3,049	35	203	352	90
7	2026	8,694	9,910	64,620	86,161	8,431	8,910	5.8	11.5	3,123	36	239	360	92
8	2027	8,767	10,150	74,771	99,694	8,636	9,126	5.9	11.8	3,199	36	275	369	95
9	2028	8,859	10,397	85,168	113,557	8,846	9,348	6.1	12.1	3,277	37	312	378	97
10	2029	8,925	10,650	95,818	127,757	9,061	9,575	6.2	12.4	3,356	38	350	387	99
11	2030	8,993	10,909	106,726	142,301	9,281	9,808	6.4	12.7	3,438	38	388	397	102
12	2031	9,062	11,174	117,900	157,200	9,507	10,046	6.5	13.0	3,521	39	427	406	104
13	2032	9,132	11,445	129,345	172,460	9,738	10,290	6.7	13.3	3,607	39	466	416	107
14	2033	9,202	11,723	141,068	188,091	9,974	10,540	6.8	13.7	3,695	40	506	426	109
15	2034	9,265	12,008	153,076	204,102	10,217	10,797	7.0	14.0	3,784	40	547	437	112
16	2035	9,329	12,300	165,376	220,502	10,465	11,059	7.2	14.3	3,876	41	588	447	115
17	2036	9,461	12,599	177,975	237,300	10,719	11,328	7.3	14.7	3,971	42	630	458	117
18	2037	9,595	12,905	190,880	254,507	10,980	11,603	7.5	15.0	4,067	42	672	469	120
19	2038	9,731	13,219	204,099	272,132	11,247	11,885	7.7	15.4	4,166	43	715	481	123
20	2039	9,869	13,540	217,639	290,185	11,520	12,174	7.9	15.8	4,267	43	758	492	126
21	2040	10,009	13,869	231,508	308,677	11,800	12,470	8.1	16.2	4,371	44	802	504	129
22	2041	10,150	14,206	245,714	327,618	12,087	12,773	8.3	16.6	4,477	45	847	517	132
23	2042	10,294	14,551	260,265	347,020	12,380	13,083	8.5	17.0	4,586	45	892	529	136
24	2043	10,440	14,905	275,170	366,893	12,681	13,401	8.7	17.4	4,697	46	938	542	139
25	2044	10,588	15,267	290,437	387,249	12,989	13,727	8.9	17.8	4,811	46	984	555	142
26	2045	10,738	15,638	306,075	408,100	13,305	14,060	9.1	18.2	4,928	47	1,031	569	146
27	2046	10,890	16,018	322,093	429,458	13,628	14,402	9.3	18.7	5,048	48	1,079	582	149
28	2047	11,044	16,407	338,501	451,334	13,960	14,752	9.6	19.1	5,171	48	1,127	597	153
29	2048	11,200	16,806	355,307	473,742	14,299	15,110	9.8	19.6	5,296	49	1,176	611	157
30	2049	11,359	17,215	372,521	496,695	14,646	15,478	10.0	20.1	5,425	49	1,225	626	161
31	2050	11,520	17,633	390,154	520,205	15,002	15,854	10.3	20.6	5,557	50	1,275	641	164
32	2051	11,683	18,061	408,215	544,287	15,367	16,239	10.5	21.1	5,692	50	1,325	657	168
33	2052	11,848	18,500	426,716	568,954	15,740	16,634	10.8	21.6	5,830	51	1,377	673	172
34	2053	12,016	18,950	445,666	594,221	16,123	17,038	11.0	22.1	5,972	52	1,428	689	177
35	2054	12,186	19,410	465,076	620,101	16,515	17,452	11.3	22.6	6,117	52	1,480	706	181
36	2055	12,359	19,882	484,958	646,611	16,916	17,876	11.6	23.2	6,266	53	1,533	723	185
37	2056	12,534	20,365	505,323	673,764	17,327	18,310	11.9	23.7	6,418	53	1,587	741	190

Year		Population	Annual MSW (tonnes)	Cumulative MSW (tonnes)	Cumulative MSW Volume (m^3)	Annual Wood Waste (m^3)	Scrap Metal (m^3)	Annual Scrap Tires (tonnes)	Annual Hazardous Waste (tonnes)	Annual Cardboard (tonnes)	Non-metallic C&D waste (tonnes)	Non-metallic C&D waste, cumulative (tonnes)	Annual Mattess (each)	Annual Vehicles (each)
38	2057	12,711	20,860	526,183	701,578	17,748	18,755	12.2	24.3	6,574	54	1,641	759	195
39	2058	12,891	21,367	547,551	730,067	18,179	19,211	12.5	24.9	6,734	55	1,695	777	199
40	2059	13,074	21,886	569,437	759,249	18,621	19,678	12.8	25.5	6,898	55	1,751	796	204
41	2060	13,259	22,418	591,855	789,140	19,074	20,156	13.1	26.1	7,065	56	1,806	815	209
42	2061	13,447	22,963	614,818	819,757	19,537	20,646	13.4	26.8	7,237	56	1,863	835	214
43	2062	13,637	23,521	638,339	851,119	20,012	21,148	13.7	27.4	7,413	57	1,920	855	219
44	2063	13,830	24,093	662,432	883,242	20,498	21,662	14.0	28.1	7,593	58	1,977	876	225
45	2064	14,026	24,678	687,110	916,147	20,997	22,188	14.4	28.8	7,777	58	2,035	897	230
46	2065	14,224	25,278	712,388	949,850	21,507	22,727	14.7	29.5	7,966	59	2,094	919	236
47	2066	14,426	25,892	738,280	984,373	22,029	23,280	15.1	30.2	8,160	59	2,154	942	241
48	2067	14,630	26,521	764,801	1,019,735	22,565	23,845	15.5	30.9	8,358	60	2,213	964	247
49	2068	14,837	27,166	791,967	1,055,956	23,113	24,425	15.8	31.7	8,561	60	2,274	988	253
50	2069	15,047	27,826	819,793	1,093,058	23,675	25,018	16.2	32.4	8,769	61	2,335	1,012	259
51	2070	15,260	28,502	848,296	1,131,061	24,250	25,626	16.6	33.2	8,983	62	2,397	1,036	266
52	2071	15,477	29,195	877,490	1,169,987	24,840	26,249	17.0	34.0	9,201	62	2,459	1,062	272
53	2072	15,696	29,904	907,395	1,209,860	25,443	26,887	17.4	34.9	9,424	63	2,522	1,087	279
54	2073	15,918	30,631	938,026	1,250,701	26,061	27,540	17.9	35.7	9,653	63	2,585	1,114	286
55	2074	16,143	31,376	969,402	1,292,535	26,695	28,210	18.3	36.6	9,888	64	2,649	1,141	293
56	2075	16,372	32,138	1,001,540	1,335,386	27,344	28,895	18.7	37.5	10,128	65	2,714	1,169	300
57	2076	16,604	32,919	1,034,459	1,379,278	28,008	29,598	19.2	38.4	10,374	65	2,779	1,197	307
58	2077	16,839	33,719	1,068,178	1,424,237	28,689	30,317	19.6	39.3	10,627	66	2,845	1,226	314
59	2078	17,077	34,538	1,102,716	1,470,288	29,386	31,054	20.1	40.3	10,885	66	2,911	1,256	322
60	2079	17,319	35,378	1,138,094	1,517,458	30,100	31,808	20.6	41.2	11,149	67	2,978	1,286	330
61	2080	17,564	36,237	1,174,331	1,565,775	30,831	32,581	21.1	42.2	11,420	68	3,046	1,318	338
62	2081	17,813	37,118	1,211,449	1,615,266	31,581	33,373	21.6	43.3	11,698	68	3,114	1,350	346
63	2082	18,065	38,020	1,249,469	1,665,959	32,348	34,184	22.2	44.3	11,982	69	3,183	1,383	355
64	2083	18,321	38,944	1,288,414	1,717,885	33,134	35,015	22.7	45.4	12,273	69	3,252	1,416	363
65	2084	18,581	39,890	1,328,304	1,771,072	33,939	35,866	23.2	46.5	12,572	70	3,322	1,451	372
66	2085	18,844	40,860	1,369,164	1,825,552	34,764	36,737	23.8	47.6	12,877	70	3,392	1,486	381
67	2086	19,110	41,853	1,411,017	1,881,356	35,609	37,630	24.4	48.8	13,190	70	3,462	1,522	390
68	2087	19,381	42,870	1,453,887	1,938,516	36,474	38,544	25.0	50.0	13,511	70	3,532	1,559	400
69	2088	19,656	43,912	1,497,798	1,997,065	37,361	39,481	25.6	51.2	13,839	70	3,602	1,597	409
70	2089	19,934	44,979	1,542,777	2,057,036	38,269	40,441	26.2	52.4	14,175	70	3,672	1,636	419
71	2090	20,216	46,072	1,588,849	2,118,466	39,199	41,423	26.8	53.7	14,520	70	3,742	1,675	430
72	2091	20,502	47,192	1,636,041	2,181,388	40,151	42,430	27.5	55.0	14,872	70	3,812	1,716	440
73	2092	20,793	48,338	1,684,379	2,245,839	41,127	43,461	28.2	56.3	15,234	70	3,882	1,758	451
74	2093	21,087	49,513	1,733,892	2,311,856	42,127	44,517	28.9	57.7	15,604	70	3,952	1,800	462
75	2094	21,386	50,716	1,784,609	2,379,478	43,150	45,599	29.6	59.1	15,983	70	4,022	1,844	473

5.2 Approval Processes

Water licenses, and their terms and conditions are the primary means through which MSW facilities are regulated in Nunavut. The most relevant Federal and Territorial legislation, applicable to solid waste management in Nunavut, are detailed in the following sections.

5.2.1 Nunavut Water Board

The terms and conditions of the water license are set by the NWB, in consultation with federal and provincial government agencies, and other stakeholders. The primary goal of a water license is to ensure that contaminants from solid waste disposal sites do not enter watercourses or water bodies. The *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the Nunavut Waters Regulations (Regulations) define the powers and responsibilities of the NWB.

As outlined in the Solid Waste Management Plan (Government of Nunavut, 2014), the key sections of the NWNSRTA that relate to solid waste management in Nunavut include:

- Section 12, which states that no person shall deposit or permit the deposit of waste in waters in Nunavut or in any other place in Nunavut under conditions in which the waste (or any other waste that results from the deposit of that waste), may enter waters in Nunavut except in accordance with the conditions of a licence.
- Sections 14 to 34, which establishes and describe the NWB, including the size of the NWB, the positions of the NWB and their responsibilities, and various rules regarding the NWB's organizational structure and governance.
- Sections 42 to 81, which describe the rules governing the issuing of licences by the NWB. Topics addressed by the sections include the maximum term for a licence, application requirements, the application procedure, including when a public hearing is and is not required, conditions under which the Board may issue a licence, the ability for the Board to include conditions and monitoring requirements in the licence, and the requirement of a public register.
- Sections 85 to 94, which address enforcement of the NWNSRTA. In particular, Section 86 provides inspectors with the authority to examine works or take samples when they have reasonable grounds to believe waste is entering waters and to examine any relevant documents or records. Section 87 provides inspectors with the authority to order those in charge of the wastes to take remedial measures to remedy those situations. Section 90 to 94 addresses offenses and punishments, including terms for fines and imprisonment.

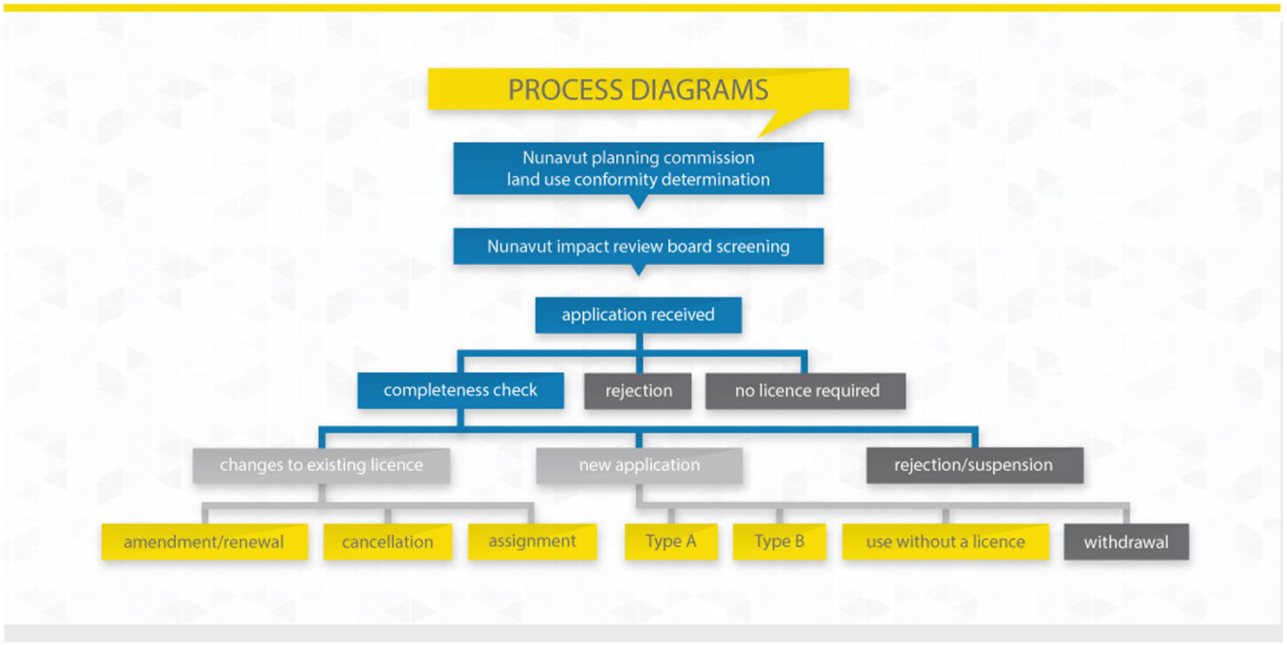
Examples of typical water licence terms and conditions, as they relate to solid waste management, include:

- Conditions for an effluent monitoring program, including sampling locations, frequencies and parameters.
- Posting of signage for the monitoring program.
- Requirements for submitting copies of studies, reports and plans to the NWB, including:

  - Operation and Maintenance manuals;
  - Construction design and drawings, including as-built; and
  - Abandonment and restoration plans.
- The disposal of and permanent containment of all solid wastes at the solid waste disposal facilities.
- The segregation and storing of all hazardous materials and hazardous waste within the solid waste disposal facilities in a manner to prevent the deposit of deleterious substances into water, until such a time that the materials can be removed for proper disposal at a licensed facility.
- The implementation of measures to ensure leachate from solid waste disposal facilities and hazardous waste storage areas do not enter water.
- Annual reports that summarize:
  - Water monitoring results; modifications or major maintenance work carried out on waste disposal facilities, unauthorized discharges and follow-up actions;
  - Abandonment and restoration work recently completed or planned;
  - Updates to operation and maintenance manuals; relevant studies; and
  - Other details requested by the NWB.

Water licences for solid waste facilities are required to be renewed before they expire. If an Operator's water licence expires before it can be renewed, the operator is required to discontinue using the solid waste facility, as well as any water use covered by their water licence. Otherwise, the Operator will be in contravention of the Nunavut Land Claims Agreement and the NWNSRTA. The expiry of the license does not relieve the City of its obligations imposed by the license. The process by which the NWB regulates undertakings in Nunavut is outlined in **Figure 5–1**.

Figure 5-1: Nunavut Water Board Regulatory Process Overview (Nunavut Water Board, 2019)



Item 3 of Schedule 1 of the Regulations identify that:

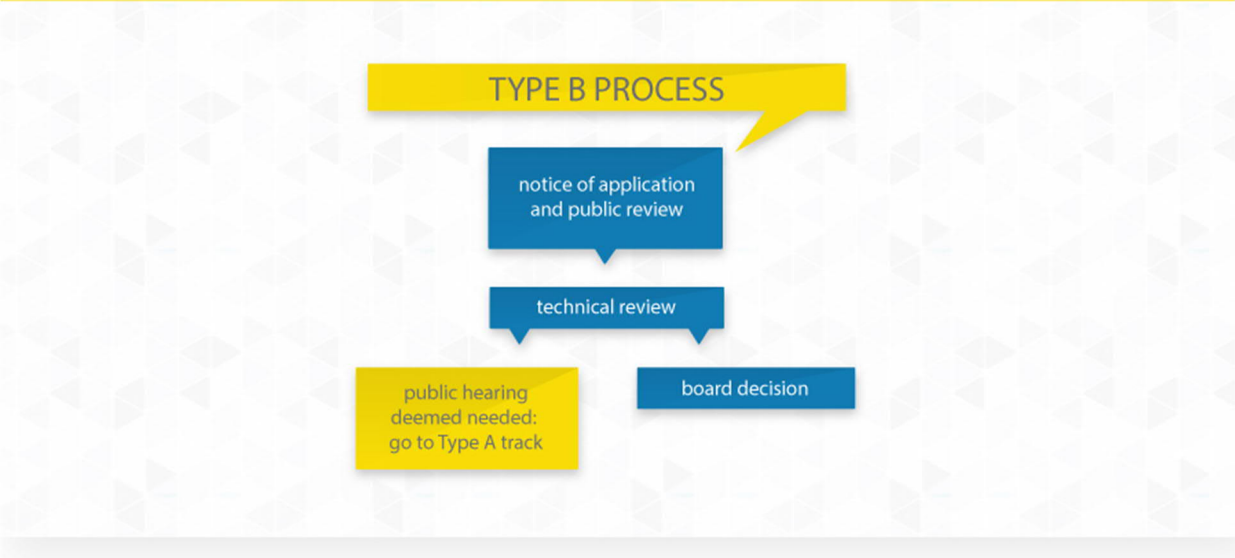
- For a Municipal Undertaking for a waste disposal or water system for a municipality a NWB, an authorization or a license is required.

Schedules 3 (Licensing Criteria for the Deposit of Waste) of the Regulations defines that:

- For any Municipal undertaking of any deposit of waste, if the water system for the municipality uses less than 300 m^3 of water per day, a Type B license is required.

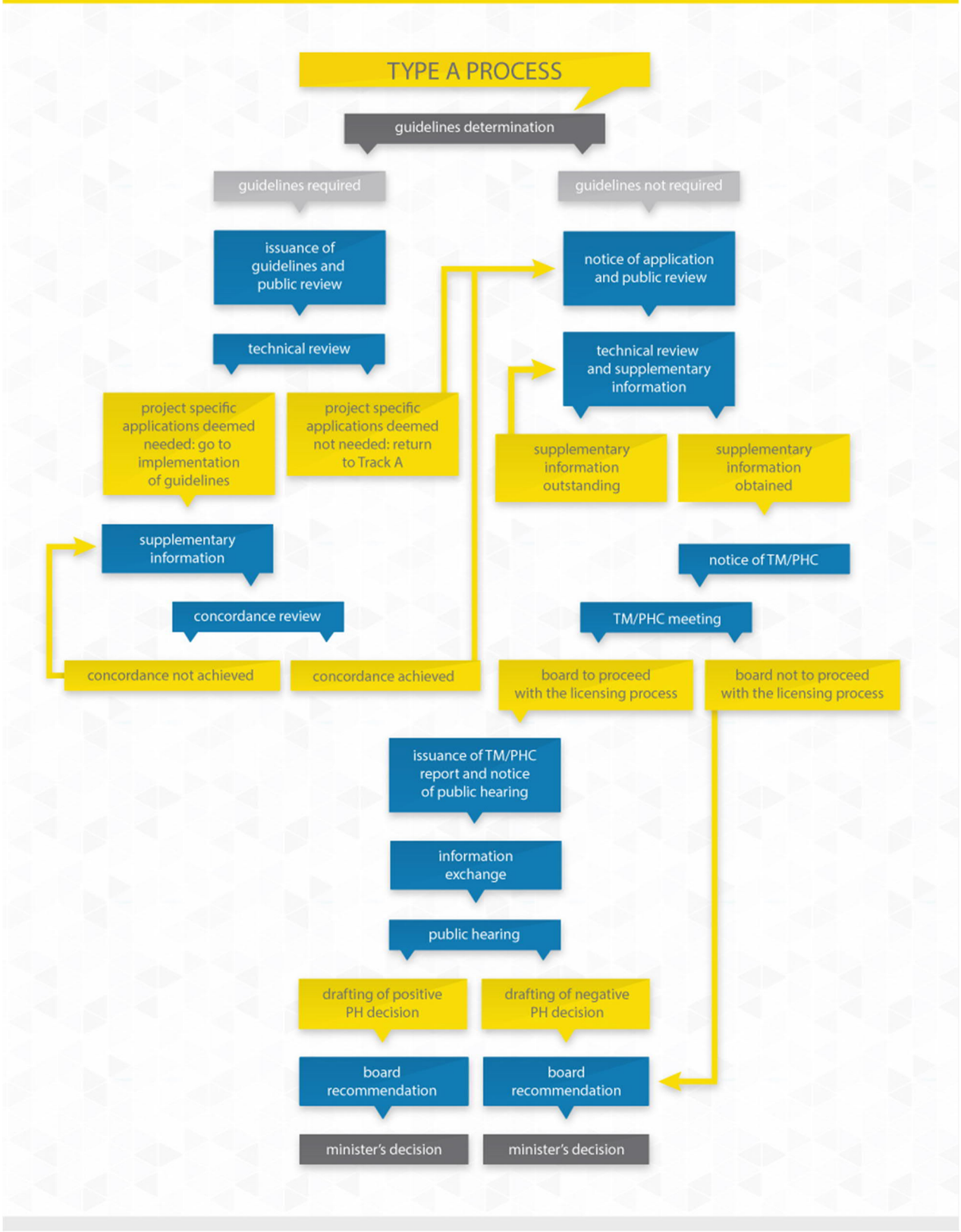
Proposed daily water usage is forecasted to be less than 300 m^3; as such, a Type B Process is anticipated. The Type B Process is presented in **Figure 5–2**.

Figure 5-2: Nunavut Water Board Type B Regulatory Process (Nunavut Water Board, 2019)



During the Technical Review process, the NWB may decide the Operator must follow Type A process, which is outlined in **Figure 5–3**.

Figure 5-3: Nunavut Water Board Type A Regulatory Process (Nunavut Water Board, 2019)



5.2.2 *Nunavut Environmental Protection Act*

The *Nunavut Environmental Protection Act* (EPA) provides general responsibilities and authority for environmental protection. The current version of the EPA has been in force since March 10, 2011. While solid waste is not mentioned specifically, the EPA regulates the discharge of contaminants into the environment. Air emissions from the open burning of mixed waste or leachate run-off could potentially be offenses under the EPA.

As outlined in the Solid Waste Management Plan (Government of Nunavut, 2014), the key sections of the EPA that relate to solid waste management in Nunavut include:

- Section 1, which provides definitions for terms such as contaminant, discharge environment and inspector.
- Section 2.2, which provides the Minister with authority to: monitor environmental quality; conduct studies and training; develop policies, standards, guidelines and codes of practice; and to collect, publish and distribute information relating to contaminants and to the preservation, protection and enhancement of the environment.
- Section 3, which allows for and describes the role of Chief Environmental Protection Officer.
- Section 5, which sets the conditions under which the discharge of a contaminant into the environment is allowed or prohibited.
- Sections 6 and 7, which provides inspectors with the authority to issue an order requiring that a discharge of a contaminant I not the environment be stopped and repair or remedy any damages that the discharge may have caused.

5.2.3 *Nunavut Public Health Act* and General Sanitation Regulations

The *Nunavut Public Health Act* (PHA) outlines the general requirements and authorities for public health and safety in Nunavut. The current version of the PHA has been in force since April 1, 2008. Section 25 of the PHA provides the Commissioner with the authority to create regulations concerning the control of waste disposal grounds for the disposal of excreta and garbage.

The General Sanitation Regulations, created under the PHA, describes the general requirements for the management and disposal of waste and minimum setbacks for waste disposal sites. They also include requirements for landfill cover and to include a scavenging system. Specific relevant sections as outlined in the Solid Waste Management Plan (Government of Nunavut, 2014) include:

- Section 1, which defines “waste disposal ground” as any place used for the disposal of garbage, refuse, excreta or other waste material.
- Section 8, which states that no building used for human habitation shall be nearer than 450 m to a waste disposal ground or on any site where the soil has been made up of any refuse, unless the refuse has been removed from the site, consolidated, or the site has been disinfected in every case and approved by a Health Officer.

- Section 24, which requires incorporated municipalities to provide a scavenging system for the general public for the collection and disposal of garbage and refuse, and that the system is operated and maintained to the satisfaction of a Medical Health Officer.
- Section 25, which requires that homes and other buildings such as schools, churches and businesses provide an adequate number of containers for the reception of garbage and refuse.
- Section 26, which provides rules around the construction and placement of garbage and refuse containers.
- Section 27, which requires that incorporated municipalities provide adequate waste disposal grounds for the disposal of all garbage, refuse, excreta and other waste matter and that waste materials are either burned, buried or covered as necessary to reduce odour and prevent the breeding of flies.
- Section 28, which requires that waste disposal grounds be located: at least 90 m from any public road allowance, railway, right-of-way, cemetery, highway or thoroughfare; at least 450 m from any building used for human occupancy or for the storage of food; and situated at such a distance from sources of water or ice for human consumption or ablution that the sources will not become polluted.

5.2.4 *Nunavut Wildlife Act*

The *Nunavut Wildlife Act* (NWA) was created to establish help with the management of wildlife and habitat in Nunavut, including the conservation, protection and recovery of Species at Risk. The Act came into force July 9, 2005. The key sections of the NWA, as outlined in the Solid Waste Management Plan (Government of Nunavut, 2014) include:

- In Section 2, “attractant” is defined to include food, food waste, compost or garbage that could attract wild animals.
- Section 66, which prohibits persons from storing, disposing of or allowing the accumulation of any waste within a critical habitat
- Section 67, which prohibits depositing waste or litter in or near any habitat.

6.0 Design and Construction Options Analysis

This section presents the summary of findings of the Design and Construction Options Analysis Technical Brief, which is presented in **Appendix E** and which also includes the Solid Waste Landfill, Waste Transfer Station and Northwest Aggregate Deposit Road – 30% Submission drawings as 11 x 17.

6.1 Waste Transfer Station

6.1.1 Weigh Scale

The scale weights all waste handling vehicles that arrive to the WTS. The scale length is 23 m to accommodate a 40 foot container and trailer instead of a waste compactor vehicle. The scale is not contained in a building.

6.1.2 Office Trailer

The office trailer is remote from the WTS building to minimize the potential for dust and mold to be present. The building contains and the office for the Facility Supervisor, a unisex barrier free washroom, a unisex locker room and a lunch room.

6.1.3 Waste Transfer Station Building

The building is a pre-engineered steel system with metal walls and roof panels that uses standard metal components, which are designed to minimize materials that are quick and efficient to construct. Tilt-Up concrete structures are typically more expensive to construct. Shipment of raw materials is a concern and repairing issues can be costly. Wood construction was not be considered due to the height and spans required.

LED lighting is recommended due to its efficiency and a low wattage versus incandescent lighting.

A front end loader is recommended instead of a skid steel vehicle, as the floor will become wet and slimy, limiting the ability of a skid steel vehicle to have enough traction to maneuver.

A portable vehicle lift is recommended, as a less dedicated floor space is required and the lift components can be moved when not in use.

A concrete tip wall is recommended to allow for storage of materials in the structure against concrete versus a thin metal sheathing.

A passive thermosyphon is recommended, as no electricity is required. The building has a heavy floor loading and is less expensive than a pile supported structural floor.

Due to the building being heated, the sprinkler system will be a wet system instead of a dry system that is normally used in buildings that are not heated.

A biomass boiler and an oil-fired hydronic boiler will provide heat for the building. The biomass boiler will be the main source of heat with the oil-fired boiler will serve as backup and for peak heating loads.

The ventilation system will include carbon dioxide and nitrogen oxide detectors, and provide ventilation for internal combustion engine vehicles.

Space for a future Sludge Room is not included.

The building does not contain any floor drains.

6.1.4 Baler

The baler is a two ram with approximate peak capacity of 20 tonnes per hour of MSW. A trench drain will collect and transfer drippings to a sump and storage tank.

6.1.5 Shredder

The shredder is designed for 6 tonnes per hour versus the 10 tonnes per hour noted in the RFP, due to the required capacity of the biomass boiler.

A hopper instead of an infeed conveyor will be utilized.

6.1.6 Logger

The logger shall bale end-of-life vehicles, white goods and miscellaneous material separately to maximize the sale value of the metals.

6.1.7 Site Features

External to the WTS space is identified for:

- Snow storage
- Tire storage
- Miscellaneous metals and white goods
- Bale storage
- HHW depot
- Future greenhouse and composting areas

6.1.8 Site Drainage

The site will be graded to drain predominately to the drainage ditch, along the eastern property boundary and Qaqqamiut Road, and to the northern boundary along the unnamed road.

6.2 Landfill

6.2.1 Waste Stream

A 1.416% growth in the population is added to the 1.0% growth of waste materials.

6.2.2 Baled Waste and Placed Construction and Debris Material

The material will be placed in the same cell to allow the C&D material to infill voids due to the “stepped” placement of the bales that would normally be filled with granular material.

6.2.3 Liner

One 80 mil textured HDPE geomembrane is recommended, as low permeability soil is not available and the Landfill is presumed to function as a “freeze-back” landfill after five or six years. Also, the production of leachate is expected to be minimized by the wrapping of the bales.

6.2.4 Leachate Treatment

The proposed treatment system of lagoons and wetland is based on the anticipated strength and volume of the leachate. The lagoons will be lined with an 80 mil HDPE geomembrane liner.

6.2.5 Daily and Intermediate Cover

Daily and intermediate cover soils will not be required due to the wrapping of the bales.

7.0 Conceptual Design Information

7.1 Waste Transfer Station

Site Entrance

The entrance of the WTS will be from Kakivak Court. Design elements of the entrance will include:

- Entrance sign
- Design vehicle will be the Transportation Association of Canada WB-24
- Electric horizontal sliding gate with security card access

Weigh Scale

All vehicles entering the site will be directed to the scale. The scale will include:

- One steel deck electronic weigh scale
- Nominal size 3 m x 23 m
- Digital load cells
- Side rails
- Red/green traffic signals at both ends with manual controller
- Recording/transaction software
- Utilized to record inbound materials as well as weighing outgoing, empty vehicles
- Potential intercom for exiting commercial vehicles
- Side skirts to limited snow buildup under the scale
- Concrete pad
- Asphalt entrance and exit ramps

Scale House

A scale house will be located adjacent to the scale will include:

- A raised prefabricated portable structure located on a gravel pad
- Steel siding and roof
- Vinyl floor tiles
- Nominal size 1.5 m x 2.4 m
- Window security bars
- Security system with autodialer
- Communication/internet system
- Door with security bars
- Electric baseboard heating and overhead cooling
- Enclosed crawlspace
- Intercom system
- Scale to be used for billing. A remote scale weight display (required to allow the driver to view the weight reading)
- Electrical distribution to be 100 amp, 120/240 VAC, single phase

- Lighting will be LED
- Dark sky friendly exterior lighting fixture above entrance door with photocell

Office Trailer

The office trailer design will be based on:

- Raised prefabricated portable structure located on a gravel pad
- Nominal size 4 m x 15 m
- Steel siding and roof
- Vinyl floor tile
- Drywall walls
- Office for the Site Supervisor
- Locker room for nine employees
- Lunch room
- Unisex washroom
- Maintenance closet
- Window security bars
- Security system
- Communication/internet system
- Door with security bars.
- Electric baseboard heating and air conditioning (office and lunch room)
- Water supply tank and associated pump inside
- Hot water tank
- Septage tank in crawlspace
- Crawlspace
- Electrical distribution to be 100 amp, 120/208 VAC, three phase
- Lighting will be LED
- Dark sky friendly exterior lighting fixture above entrance door with photocell

Waste Transfer Station

The WTS will consist of:

- Pre-engineered building with metal roof and siding
- Concrete slab on grade floor
- Thermosyphon for temperature control under the slab
- No water supply
- No septic system
- Trench drains with screens, sump pit and grinder pump
- Holding tank for liquid from baler
- Electrical room
- Mechanical room

- Fire suppression system
- Biomass boiler
- Portable emergency eyewash station
- Ventilation system with heat recovery
- Space to process end-of-life vehicles prior to crushing
- Concrete push walls
- Concrete aprons
- Exterior pad mount utility transformer with feeder cables to electrical room
- Electrical distribution to be 1200 amp, 347/600 VAC, three phase
- Lighting will be LED and designed for low temperature operation
- Emergency power

Municipal Solid Waste Baler

The baler will process MSW and will be based on:

- A peak process tonnage of 20 tonnes/hour
- Annual tonnage of 8,000 tonnes
- American Baler Model W858-T50 or equal
- Steel apron pan conveyor
- Automatic wire tier
- Bale wrapper (Cross Wrap)
- Perimeter liquid collection channel and tank

Shredder/Pellitizer

- Feedstock cardboard, clean wood
- Sized to accommodate 6 tonne per hour
- Initially five hour per day operation
- Nominal pellet size 6 to 8 mm diameter, 40 m length

Biomass Boiler

- Main/Base heating source for WTS
- Oil-fired boilers for partial backup and peak heating loads
- Boiler system for hydronic heating to unit heaters/air handling unit (to heat and ventilate the WTS)

End-of-Life Vehicles/Metal Logger

The logger will process vehicles and miscellaneous metals and white goods and will be based on:

- Located on a gravel pad
- Nominal 200 Hp baler/logger
- Knucle boom material handler

Household Hazardous Wastes Depot/Reuse Storage Area

The HHW Depot will consist of:

- Three pre-manufactured shipping container depots to deliver the site
- Shipping container on a gravel pad
- Shelving
- Containment flooring
- LED lighting
- Natural ventilation
- Electrical distribution to be 100 amp, 120/240 VAC, single phase
- Portable (heated/insulated) eyewash station

The Reuse Storage Area will consist of:

- A 40 foot shipping container on a gravel pad
- Unheated
- Shelving
- Solar lighting
- Natural ventilation

Site Security

A 2.4 m chain link fence will be located at the perimeter of the site. The entrance gate will be card coded. The bale transfer truck gate will be manually operated at Qaqqamiut Road. Closed circuit security cameras will be positioned to view and record:

- Gate/scale area
- General site area
- Interior of the office trailer and WTS
- Arriving and exiting vehicles

Site Lighting

Site lighting will be provided by:

- LED dark sky friendly compliant fixtures with photo cell control
- Fixtures mounted on 6 m galvanized steel poles
- Lighting designed to illuminate the site with an average of 10 lux

Parking

Gravel parking stalls for 10 vehicles. All stalls would be 2.8 m x 5.6 m plus 1.2 m on each side. Power receptacles will be provided.

Site Exterior Features

Space will be identified for:

- Exterior wrapped bale storage

- Temporary storage of processed end-of-life vehicles, miscellaneous metals and white goods
- Temporary storage of C&D debris, prior to delivery to the Landfill
- Tire storage
- Logger
- Snow storage
- Bollards and boulders for building, etc.

Snow Storage

Areas for snow storage will be located on the site. Boulders, nominal size 1 m^3, will be spaced on the interior of the perimeter fence to protect the fence from stored snow.

Organics Processing

An area will be identified for potential future organic composting.

7.2 Landfill

Landfill Entrance

The entrance of the Landfill will be the North West Aggregate Deposit Road. Design elements of the entrance will include:

- Entrance sign
- Design vehicle will be the Transportation Association of Canada WB-24
- Manual horizontal sliding gate

Access Road

The function of the access road is to provide access to the Landfill. Traffic will consist of:

- Vehicles to transport and place baled waste
- Authorized vehicles to delivery C&D debris
- Authorized visitors

The road will be:

- Two 4.5 m travel lanes
- 0.5 m width shoulder
- Gravel surface
- Designed to limit rock removal to “knobs”
- Stop sign
- Signs to direct and regulate road usage and traffic movement

Part-time Attendants Shelter

The shelter for the attendant will consist of:

- Prefabricated portable structure located on a gravel pad

- Steel siding and roof
- Nominal size 2.4 m x 1.5 m
- Window security bars
- Door with security bars
- Lavatory with composting toilet
- Electric baseboard heating
- Exterior gravel pad for a temporary generator(to provide power while an attendant is on-site)
- Emergency wood stove with insulated chimney (¼ cord of pallet/ woodpellets/ stored in the shelter)
- Emergency communication device
- Lock

Site Ditching/Stormwater

Ditching will consist of runon, runoff and access rod ditches. Ditches will be designed for:

- 1:100 design event
- 3:1 slide slopes
- Nominal bottom width 1.0 m
- Nominal depth 1.0 m
- Rock lining (where required to address slope, velocity and erosion concerns)

Surface water runoff control plan will be developed to:

- Minimize erosion potential
- Collect (if required) sediment runoff prior to discharge off property
- Culverts will be corrugated HDPE
- Nominal culvert cover will be 0.5 m

Landfill

Design elements of the Landfill will include:

- All infrastructure will be set back a minimum of 30 m from the property line
- An assumed 75 year life
- Designed based on a “freeze-back” landfill
- Accommodations for baled and wrapped MSW, and C&D debris
- Liner system consisting on an 80 mil HDPE geomembrane
- No perorations in the geomembrane liner
- Baled MSW and C&D debris will be co-placed in one landfill
- 4:1 berm side slopes
- 4:1 exterior landfill side slopes
- 1:20 (5%) landfill top slopes
- Base of the landfill cells will be sloped nominally from 0.7 to 8.0 %

- A 600 mm thick granular layer of 75 mm clear stone placed under the water material (to collect and convey leachate)
- The Hydrologic Evaluation of Landfill Performance Model utilized (to predict leachate generation rates)
- Perforated HDPE pipes, designed to accommodate the depth of material and operational equipment traffic and forecasted leachate flow
- Duplex pump station located in a sump in the Landfill (to periodically remove and via a forecemain direct the leachate to the holding ponds) powered by a portable generator
- Leachate production/flow to typically occur from June 1 to September 30
- Nominal 18 m depth of waste material in the Landfill
- Developed in stages or cells, with the first two, cells designed in detail
- Periodic placement of daily cover material
- No litter control fencing

Landfill Gas

The United States Environmental Protection Agency (USEPA) Landfill Gas Emission Model (LandGEM) will be utilized to predict the emission rates for landfill gas (LFG) and the need for a passive or active LFG collection and treatment system. Parameters for the model will be based on published information from Environment and Climate Change Canada.

Leachate Treatment System

The leachate treatment system will consist of:

- Ponds lined with an 80 mil HDPE geomembrane
- Engineered wetland for treatment

7.3 Class D Costing

Class D costing for the Landfill and WTS (i.e., Cell 1, Cell 2 and Leachate Treatment System) are provided in **Table 7–1** and **Table 7–2**.

Table 7-1: Waste Transfer Station – Class D Opinion of Probable Capital Budget

Item	Description	Quantity	Units	Unit Price	Budget
1	Mobilization/Demobilization (2%)	1	lump sum	$475,000	$475,000
2	**Site Works**				
1	Site Grading	10,000	m^2	$50	$500,000
2	Perimeter Fencing	500	m	$325	$162,500
3	Entrance Gate	2	m^3	$40,000	$80,000
4	Yard Lighting	15	each	$4,000	$60,000
5	Access Road to Qappamiut Road	1	lump sum	$150,000	$150,000

Item	Description	Quantity	Units	Unit Price	Budget
3	**Waste Transfer Station**				
1	Site Preparation	1	lump sum	$50,000	$50,000
2	Excavation	3,100	m^3	$100	$310,000
3	Backfill	1,500	m^3	$150	$225,000
4	Foundation/Slab	1,200	m^3	$2,500	$3,000,000
5	Rigid Insulation	2,500	m^2	$100	$250,000
6	Thermosyphon	1	lump sum	$975,000	$975,000
7	Pre-Engineered Building	1	lump sum	$1,850,000	$1,850,000
8	Pushwalls	100	m^3	$2,500	$250,000
9	Electrical Service	1	lump sum	$150,000	$150,000
10	Electrical	1	lump sum	$1,200,000	$1,200,000
11	Emergency Power Generator	1	each	$1,200,000	$1,200,000
12	Fire Alarm System	1	lump sum	$100,000	$100,000
13	Mechanical	2,200	m^2	$100	$220,000
14	Heating System	2,200	m^2	$375	$825,000
15	Security	1	lump sum	$50,000	$50,000
16	Ventilation	2,200	m^2	$230	$506,000
17	Communications	1	lump sum	$50,000	$50,000
18	Fire Protection	2,200	m^2	$160	$352,000
4	**Material Processing Equipment**				
1	MSW Baler	1	lump sum	$1,200,000	$1,200,000
2	Baler Conveyor	1	lump sum	$250,000	$250,000
3	Bale Wrapper	1	lump sum	$610,000	$610,000
4	Baler Spare Parts	1	lump sum	$100,000	$100,000
5	Shredder	1	lump sum	$980,000	$980,000
6	Pellitizer	1	lump sum	$2,500,000	$2,500,000
5	Office Trailer	1	lump sum	$200,000	$200,000
6	Scalehouse Kiosk	1	lump sum	$25,000	$25,000
7	**Weigh Scale**				
1	Portable Weigh Scale	1	lump sum	$125,000	$125,000
2	Concrete slab	50	m^3	$2,500	$125,000
3	Excavation	50	m^3	$100	$5,000
8	End-of-Life Vehicle/Metals Logger/Baler	1	lump sum	$775,000	$775,000

Item	Description	Quantity	Units	Unit Price	Budget
9	HHW Depot/Storage Containers	3	each	$125,000	$375,000
10	Reuse Depot	1	lump sum	$50,000	$50,000
11	Portable Vehicle Hoist	1	lump sum	$40,000	$40,000
12	Cargo Shipping Insurance	500	tonne	$30	$15,000
				Subtotal	**$19,890,500**
				Contingency Allowance (20%)	**$3,978,100**
				Opinion of Probable Budget	**$23,868,600**

Table 7-2: Landfill – Class "D" Opinion of Probable Capital Budget

Description	Quantity	Units	Unit Price	Budget
Mobilization/Demobilization (2%)	1	lump sum	$261,839	$261,838.62
Access/Perimeter/Maintenance Road				
Entrance and Gate	1	lump sum	$40,000	$40,000
Perimeter Road Cut	4,500	cm	$30	$135,000
Perimeter Road Fill	6,600	cm	$50	$330,000
Perimeter Road Gravel (450mm)	4,700	sm	$25	$117,500
Ditching	1,200	m	$200	$240,000
Maintenance Road Cut	225	cm	$30	$6,750
Maintenance Road Fill	1,100	cm	$30	$33,000
Maintenance Road Gravel (450 mm)	1,100	sm	$25	$27,500
Landfill Cell 1				
Excavation	383	cm	$30	$11,475
Fill	24,225	cm	$50	$1,211,250
Under Cell Thermisters	1	lump sum	$100,000	$100,000
Geotextile 1 (allowance)	16,320	sm	$5	$81,600
Grading Pad	13,770	sm	$40	$550,800
Geotextile 2	16,320	sm	$7	$114,240
80 mil HDPE Geomembrane Liner	16,320	sm	$20	$326,400
Geotextile 3	16,320	sm	$7	$114,240
Leachate Collection Granular Layer (600 mm)	15,300	sm	$75	$1,147,500
Leachate Sump	1	lump sum	$25,000	$25,000
Leachate Collection Piping (150 mm)	51	m	$300	$15,300
Leachate Header Piping (200 mm)	153	m	$325	$49,725

Description	Quantity	Units	Unit Price	Budget
Perimeter Berm	196	m	$500	$98,175
Temporary Cell Separation Berm	201	m	$400	$80,580
Access Ramp	18	m	$500	$8,925
Leachate Forcemain (75 mm)	230	m	$300	$69,000
Leachate Pump Station/Generator	1	lump sum	$250,000	$250,000
Leachate Level Monitor Standpipe	1	each	$5,000	$5,000
Sediment Control Plan	1	lump sum	$50,000	$50,000
Erosion Control Plan	1	lump sum	$50,000	$50,000
Security	17	week	$6,000	$102,000
Miscellaneous	1	lump sum	$50,000	$50,000
Landfill Cell 2				
Excavation	358	cm	$30	$10,731
Fill	23,030	cm	$50	$1,151,500
Under Cell Thermisters	1	lump sum	$50,000	$50,000
Geotextile 1 (allowance)	15,680	sm	$5	$78,400
Grading Pad	13,230	sm	$40	$529,200
Geotextile 2	15,680	sm	$7	$109,760
80 mil HDPE Geomembrane Liner	15,680	sm	$20	$313,600
Geotextile 3	15,680	sm	$7	$109,760
Leachate Collection Granular Layer (600 mm)	14,700	sm	$75	$1,102,500
Leachate Collection Piping (150 mm)	49	m	$300	$14,700
Perimeter Berm	189	m	$500	$94,325
Temporary Cell Separation Berm	194	m	$400	$77,420
Access Ramp	17	m	$500	$8,575
Sediment Control Plan	1	lump sum	$35,000	$35,000
Erosion Control Plan	1	lump sum	$35,000	$35,000
Security	26	week	$6,000	$156,000
Miscellaneous	1	lump sum	$50,000	$50,000
Leachate Treatment System				
Cascade Aerator	1	lump sum	$45,000	$45,000
Lagoons - Excavation	1,800	m^3	$30	$54,000
Lagoons - Fill	19,000	m^3	$50	$950,000
Under Lagoon Thermisters	1	lump sum	$45,000	$45,000

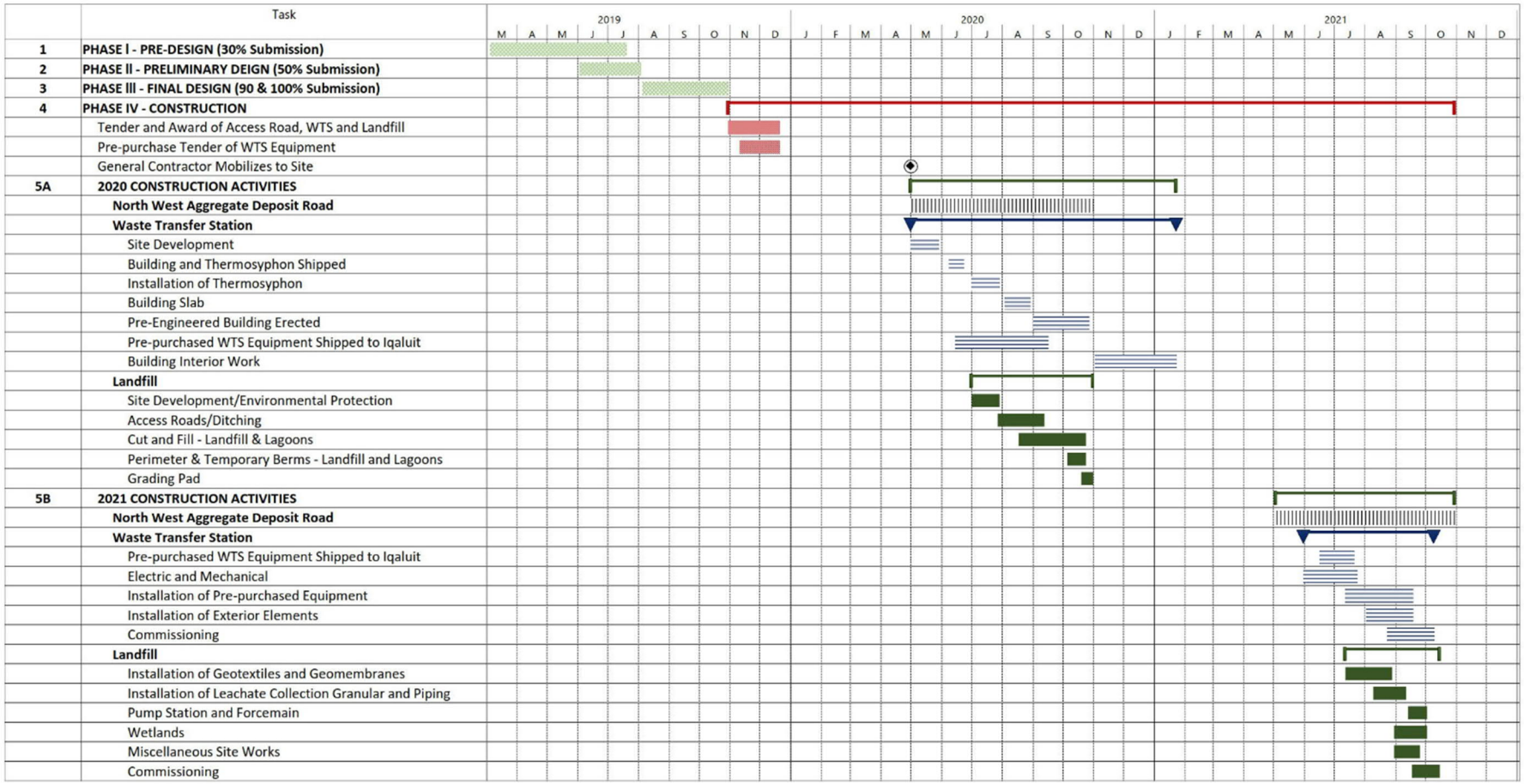
Description	Quantity	Units	Unit Price	Budget
Geotextile 1 (allowance)	13,000	m^2	$5	$65,000
Grading Pad	13,000	m^2	$40	$520,000
Geotextile 2	14,000	m^2	$7	$98,000
80 mil HDPE Geomembrane Liner	14,000	m^2	$20	$280,000
Lagoon fencing (c/w gates)	600	m	$325	$195,000
Lagoon Mechanical Aeration System	1	lump sum	$250,000	$250,000
Wetland Treatment Area (WTA) Fine Grading	18,000	m^2	$20	$360,000
Level Control Structures	3	each	$35,000	$105,000
Decant Pump and Generator	2	each	$85,000	$170,000
WTA Gravel Flow Control Berms	1,100	m	$275	$302,500
Chemical Feed System (allowance)	1	lump sum	$125,000	$125,000
Site Trailer	1	lump sum	$50,000	$50,000
Site Portable Generator	1	lump sum	$10,000	$10,000
Miscellaneous	1	lump sum	$100,000	$100,000
			Subtotal	**$13,353,770**
			Contingency Allowance (20%)	**$2,670,754**
			Opinion of Probable Budget	**$16,024,524**

7.4 Schedule

The proposed project schedule is presented in **Figure 7–1**. The design aspects of the project identified as Phase 1 to 4 follows the schedule presented in the RFP. We have assumed that exterior construction actives would begin in May and be completed by the end of October. The exception would be if the WTS was sufficiently constructed and weather tight, and that materials and equipment were on-site for interior work to continue into November and beyond. There are concerns with the North West Aggregate Deposit Road being tendered at the same time as the Landfill. Presently, there is no access road to the Landfill and the construction of the Landfill is expected to require two full construction seasons.

The schedule identifies the Landfill work commencing in July 2020, allowing work on the Aggregate Deposit Road to begin. Also, we have assumed that the Contractor would have a dedicated construction crew for the Landfill, and that equipment would be mobilized to the Landfill in July and would remain on-site, with security, until the end of October.

Figure 7-1: Proposed Project Schedule



8.0 Project Support Documents

Consistent with requirements identified in the RFP for the City Landfill and WTS assignment, a number of supporting documents were prepared to support the development of the Phase I Pre-Design package. These documents included:

- Facility Operations and Maintenance Manual
- Facility Risk Assessment Report
- Investing in Canada Infrastructure Program (ICIP) Reports (**Appendix H**)
    - ICIP Greenhouse Gas (GHG) Emissions Assessment and Report
    - ICIP Climate Change Resilience (CCR) and Report
- Closure and Decommissioning Plan
- Environmental Management, Environmental Protection and Emergency Response Plans

The following sections provide the highlights of each of these supporting documents and refer the reader to the relevant appendix at the end of the document for additional details.

Acknowledging that the overall Landfill and WTS design effort is currently at the 30% completion point, further refinements to the supporting documents are anticipated (and in select instances, are specifically identified), as the assignment moves forward through subsequent design phases.

8.1 Facility Operations and Maintenance Manual

At the Kick Off meeting for the Landfill and WTS project, the City requested that the development of an Operations and Maintenance Manual, originally proposed as a component of Phase II, be moved forward for completion as part of Phase I Pre-Design activities. An initial draft version of the Operations and Maintenance Manual is provided in **Appendix F** and incorporates information on the following Landfill and WTS components:

- Personnel
- Site Structures
- Site Equipment (Mobile and Stationary)
- Landfill Liner Development and Sequencing
- Waste Receiving, Placement and Sequencing
- Nuisance Control
- Surface Water Management
- LFG Management
- Leachate Management
- Site Monitoring
- Facility Records
- Schedule of Activities
- Emergency Response Plan

8.2 Facility Risk Assessment Report

Provided in **Appendix G**, a Facility Risk Assessment (FRA) was conducted to identify environmental, health and safety (H&S), geotechnical, facility infrastructure, and operational risks and potential mitigation measures for the Landfill and WTS. As part of the pre-design stage, the underlying goal of the FRA is to inform decision making regarding the following deliverables:

- Pre-Design Report
- Closure and Decommissioning Plan
- Draft plans and reports to support funding
- Emergency Response Plan
- Environmental Protection Plan (EPP)

Dillon worked with the City to define the scope, context and criteria, which formed the basis to conduct the risk assessment. A standardized, systematic, and transparent risk assessment and management process, with reference to ISO3100:2018 Risk Management – Guidelines, was adopted to identify, analyze and evaluate relevant risks.

Based on discussions with the City, the FRA looked at risk from the following perspectives (referred to as Risk Receptors):

- Public and employee Safety
- Financial Loss (Capital and Operational)
- Reputation
- Business Interruption/Level of Service
- Environmental
- Legal
- Technical

BowTie methodology was utilized to conduct the risk assessment. The design, construction, operation/maintenance and the closure/post-closure project elements were defined, from which various Risk Events were identified. The methodology was applied to identify and evaluate potential hazards, top events, preventive and response barriers, and consequences. A total risk score was then calculated based the likelihood and impact of each consequence on the risk receptors to determine their level of criticality. Due to its different nature, the “Technical” risk receptor was viewed as a separate category. Technical concerns and challenges based on the current level of design are provided in the FRA report.

As provided in Sections 3.2 and 3.3 of FRA, the hazard identification process is conducted with reference to the key project elements for both the Landfill and WTS under design and construction, and operations and maintenance categories. Hazards regarding the Closure and Post-Closure Phases of the Landfill are also identified and evaluated as a part of FRA.

The following results are reflected in the appended FRA report:

- Identified hazards, top risk events, consequences and applicable preventive/response barriers
- Evaluated total Risk Scores and ranking of Top Events and consequences
- Analysis of preventive and response barrier, in order to develop a robust Risk Management Plan
- A risk profile based on the individual risk scores per consequence category
- Identified Technical Risks and challenges

8.3 Investing in Canada Infrastructure Program Reports

Infrastructure Canada's Investing in Canada Infrastructure Program (ICIP) has a horizontal requirement as part of its program referred to as the Climate Lens. The Climate Lens is intended to provide meaningful insight into the climate impacts of projects and to encourage improved choices by incorporating climate change considerations into project design that are consistent with objectives outlined in the Pan-Canadian Framework for Clean Growth and Climate Change. The Climate Lens consists of two components or assessments: the GHG mitigation assessment; and the CCR Assessment (ICIP Reports). Each of these assessments are being conducted as part of this project and are described, along with a summary of their findings, in the sections below.

8.3.1 Investing in Canada Infrastructure Program Greenhouse Gas Emissions Assessment

The GHG mitigation assessment is intended to measure the anticipated GHG emission impact of the project. In this assessment, GHGs are quantified for both the project and a business-as-usual (BAU) case, which consists of the emission trajectory that is most probable in the absence of the project. In this assessment, the BAU case was the assumption that waste would continue to be handled in the manner it currently is. The GHG boundaries include direct emissions from operations, as well as indirect emissions in the form of supplied electricity. GHGs are required to be quantified for both the Construction and Operational Phases for the full lifespan of the project (75 years).

The total BAU emissions and project scenario emissions are then used to calculate a net change in GHG emissions and reductions/removals (if applicable) for the project. Finally, a financial analysis is conducted including a cost-per-tonne analysis that considers reduction estimates for year 2030 (to assess the federal component, as it relates to the Paris agreement), as well as total project cost/cumulative GHG reductions over the project lifespan. Where appropriate, GHG mitigation opportunities may be identified, where practical.

Detailed design data, such as that required for construction staging, equipment and activities, in order to properly calculate emissions, are not available at this stage. As a result, the full analysis and report for the GHG mitigation assessment will be submitted at a later date, as information becomes available.

8.3.2 Investing in Canada Infrastructure Program Climate Change Resilience Assessment and Report

The climate change resilience assessment comprises a risk management approach to assess potential future climate impacts on the infrastructure of the project. The assessment was conducted on the

development area to determine climate change related impacts on the project infrastructure and develop potential resilience options. The methodology employed follows the approach described in the Climate Lens General Guidance Document issued by Infrastructure Canada. The assessment focused mainly on the infrastructure and assets related to the construction of the Landfill, as well as the project, and were assessed for the 75 year service life.

The assessment concluded with 20 moderate risks and three high risks identified. Moderate risk resilience measures were mainly related to procedural and policy measures to implement with operational staff. Some examples included leachate monitoring to help identify leaks or issues in the leachate collection system, while others included having extra stormwater infrastructure on hand (i.e., inventory) to be prepared in the event of a failure. These risks are fairly typical and anticipated, and are being incorporated into the final design of the project.

The two climate parameters driving the three high risk interactions are increasing temperatures and potential changes in permafrost. Given the nature of the climate in Iqaluit, the two interactions related to increased temperatures were a positive improvement, related to the functionality of the engineered wetland and quality of the wetland effluent. Climate change data for the region suggests that an increase in average annual temperatures will increase the functionality of the engineered wetland by providing favourable conditions for biological treatment. The third highest risk item was identified as the risk of crack or complete failure of slab/foundation construction. This risk is exacerbated by permafrost melt and more frequent events of freeze-thaw cycles. This is a known risk to the project team, and as per the report entitled “Geothermal Modelling and Geotechnical Recommendations” produced by Wood (May 14, 2019) the design team chose to incorporate thermosyphon technology into the slab/foundation design of the WTS. The Wood report investigated the impact of the thermosyphon on the expected temperature below the slab/foundation over 75 years. The assessment found that temperatures below the slab/foundation are expected to decrease over time, which suggests that the permafrost is not expected to melt in this area over the lifespan of the building. As such, no additional or unique adaptive measures were identified to be warranted for the project.

The full FRA report is provided in **Appendix G**.

8.4 Triple Bottom Line Assessment

As a component of the predesign effort, Dillon completed a triple bottom line (i.e., financial, social and environmental) impact assessment on alternatives to manage leachate generated by the City’s new Landfill. The three leachate treatment alternatives considered as part of this assessment are:

- Aerated lagoon and WTA
- Pre-treatment and haulage to the City’s WWTP
- On-site mechanical treatment

Consistent with the methodology described in Dillon's February 2019 proposal, the assessment utilized a weighted-criteria approach to arbitrate between the costs and benefits of alternatives considered. The weighted-criteria approach allocated 'points' consistent with the percentage value attributed to the assessment area. High point scores are preferable. As a result, points are allocated for potential benefits and areas with minimal or no impact, while negative impacts reduce point scores.

A shown in **Table 8–1**, the aerated lagoon and WTA alternative was identified as the most preferred based on the financial costs and the environmental criteria. While this option was not the most preferred socio-economic option, the variance in socio-economic impacts dependent on leachate treatment alternative is minor. Considering all criteria, the aerated lagoon and WTA alternative was most preferred for:

- Financial cost
- Materials
- Energy
- Water
- Emissions, effluent, waste
- Transport
- Human health
- Indigenous Rights and Interests
- Cultural resources

Table 8-1: Triple Bottom Line Assessment

Criteria	Aerated Lagoon and WTA	Utilizing the existing City of Iqaluit WWTP	Mechanical Treatment Plant at the Landfill
Life Cycle Cost ($ million)	24.43	75.16	100.82
Annual Financial Benefits (30%)	29	12	10
Environmental Cost/Benefit Score (40%)	30	18	21
Socio-economic Cost/Benefit Score (30%)	22.5	24	20.5
Overall Score[1]	81.5	54	51.5

[1.] The overall score is the sum of the financial, environmental and socio-economic scores.

Dillon recommends the City use an aerated lagoon and WTA leachate treatment system for the site based on the Triple Bottom Line Assessment for Leachate Treatment Alternatives, as presented in **Appendix D**.

8.5 Closure and Decommissioning Plan

The design for the City's Landfill and WTS is being developed based on an assumed 75 year design life. At the end of that period, appropriate measures will be required to support the closure and decommissioning of both facilities, acknowledging the City's obligations during a subsequent 25 year

post-closure period. The Closure and Decommissioning Plan (see **Appendix I**), defines these requirements, including:

- Regulator and Public Notification
- Signage and Access Restrictions
- Building Disassembly/Demolition
- Equipment Decommissioning and Salvage
- Site Grading and Restoration
- Debris Management
- Surface Water and Leachate Management
- LFG Management
- Final Landfill Cap Installation
- Future Landfill Settlement
- Post-Closure Site Usage
- Post-Closure Inspection and Monitoring

8.6 Environmental Protection Plan, Environmental Management Plan and Emergency Response Plan Documents

The RFP for the City's Landfill and WTS project specified the requirement to prepare an Environmental Management Plan (EMP) that addressed regulatory and best practice requirements during the construction, operation, closure and post-closure of facility activities. With the EMP acting as an overarching document to define appropriate actions to support sustainable site activities throughout the 100 year operational and closure/post-closure period, further obligations and actions are detailed in the supporting EPPs (separate Construction Phase and Operations, Closure and Post-Closure documents) and Emergency Response Plan (ERP). The EMP, EPPs and ERP are all presented in **Appendix J**.

9.0 Next Steps

With reference to **Table 9–1**, the submission of the Phase I Pre-Design Report represents the second of eight key milestones in the City's Design and CCA assignment;

Table 9-1: Project Milestones

Project Milestone	Completion Date*
1. Project Kick Off Meeting	March 13, 2019
2. Phase I - Pre-Design Deliverables (30%)	May 31, 2019
3. Phase II - Preliminary Design Deliverables (50%)	July 30, 2019
4. Phase III - Final Design Deliverables (90%)	September 24, 2019
5. Phase III - Final Design Deliverables (100%)	November 5, 2019
6. Phase IV - Contractor Tendering	December 17, 2019
7. Anticipated Construction Start	May 1, 2020
8. Substantial Completion	October 31, 2021

Completed Milestone Item

* Adjusted to acknowledge change to proposal submission date to February 12, 2019

Based on comments received from the City on the content of the Phase I Pre-Design Report, and consistent with the work program presented in our proposal, Dillon will commence efforts to prepare the Phase II project documentation, with submission scheduled for July 30, 2019.