Solid Waste Management Facility
Operation and Maintenance (O&M) Plan
Hamlet of Rankin Inlet

Prepared by

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1.0 Introduction

1.1 Overview

This Operation and Maintenance Plan has been prepared to assist the Hamlet of Rankin Inlet in the operation of their new Solid Waste Management Facility. It provides a description of the regular operating procedures as well as monitoring requirements.

1.2 Infrastructure

The Hamlet of Rankin Inlet is located on Rankin Inlet, on the west coast of Hudson Bay. It is 96-air km southwest of Chesterfield Inlet and 1088 air km east of Yellowknife, at 62° 49'N latitude and 92° 05' W longitudes, as shown on Figure 1. The Hamlet has been growing substantially in the past 10 years. Economic activities now include government, commercial fishing, transportation/communications, carvings/handicrafts, trapping, hunting, and tourism. The community has a population of approximately 2,358 residents.

The Government of Nunavut operated the water supply and distribution system, as well as the sewage collection and treatment system, on behalf of the Hamlet under a separate NWB License.

The Hamlet provides solid waste collection for the residents, businesses and institutions, as per NWB Water License NWB3RAN0207 (Appendix A). The water, wastewater, and solid waste systems include the following facilities and services:

- A water intake plant, which draws water from Nipissar Lake and treats it by chlorination
- A waste water treatment plant that provides primary treatment of sewage with use of a mechanical screen
- A current (old) solid waste disposal facility, which includes a bulky metals disposal area and a waste oil and liquid waste storage area
- A landfarm facility
- A new Solid Waste Management Facility that has not been commissioned yet.

Key features of the community are shown on Figure 2.

1.3 Climate

Rankin Inlet is affected by Arctic air masses, and experiences a maritime Arctic climate characterized by short cool summers, and long cold winters. The Rankin Inlet area receives an average of 18.1 cm of rainfall and 107 cm of snowfall per annum. Mean annual precipitation totals 29.7 cm per annum. July mean high and low temperatures are 14.9°C and 5.9°C, respectively. January mean high and low temperatures are -28.3°C and

-35.5°C, respectively. Winds are generally north-west, and average 23 km/h (Rankin Inlet Weather Station, Climate Normals 1991-2000, Environment Canada, 2008).

1.4 Geology and Morphology

Surface materials consist mainly of exposed volcanic or sedimentary Precambrian rock and various types of re-worked ground moraine, notable marine terraces. The soil is a mixture of organic materials, gravel, sands and fines. Numerous eskers provide a good source of granular material. The shoreline is composed of recently deposited sands and silts.

The Hamlet is within the continuous permafrost zone, with an estimated permafrost thickness of 300 m. The active layer of permafrost is very shallow, extending 0.3 m to 1.2 m below the ground surface depending on surface conditions.

Areas with developed soil layers support hardy grasses, while rock outcrops support lichens. Clusters of small willow bushes grow in well-sheltered areas.

1.5 Nunavut Water Board License

The current (old) Solid Waste Management Facility operates under Nunavut Water Board License Number NWB3RAN0207 issued December 01, 2002. The license expired November 30, 2007 (Appendix A). The licence does not refer to the landfarm as it was built after the licence was issued. An application for a renewal and amendment of the licence has been submitted by Nuna Burnside which will include the landfarm facility.

This O&M Plan has been prepared for the new Solid Waste Management Facility that has not yet been commissioned. Amendments to this document may be required once the Nunavut Water Board issues a revised license. Amendments may be required to address any site modifications made when the site is commissioned.

This O&M Plan includes items outlined in the requirements of the current license such as:

- Operation and Maintenance Plans
- Environmental Emergency Contingency Plan (Spill Contingency Plans) – separate document
- Environmental Monitoring Program and Quality Assurance/Quality Control Plan – separate document.

This O&M Plan should be updated when the amended NWB license is issued.

1.6 Health and Safety

Health and Safety of workers and the public is the first priority during the operation of the Solid Waste Management Facility. The requirements of the Nunavut Safety Act must be followed at all times. All actions and operations must be undertaken with safety as the first priority.

1.7 Training

Staff training is an important aspect of operating a Solid Waste Management Facility. Staff must be adequately trained to follow this O&M Plan and operate the facility. This O&M Plan depends on effective site specific training.

2.0 Solid Waste Management Facility Design

2.1 Construction, and Operation History of Solid Waste Disposal Area

Currently all waste is being disposed of at the original Rankin Inlet Landfill. The solid waste management site (55,000 m^2) is located 1 km southeast of the community. The current (old) Solid Waste Disposal Site has been in use for approximately 15 years, and currently operates under Water Board License NWB3RAN0207 issued December 01, 2002. The license expired November 30, 2007. A copy is included in Appendix A. The community had several issues with the current (old) landfill. The landfill did not meet several current standards such as Nav Canada's 3 km setback from an airstrip and the Department of Health's 450 m setback from residential dwellings. Scavenging and unauthorized fires in the solid waste disposal area is common because of the close proximity to the community. The site is also impeding the community's use and enjoyment of a prime costal recreational area.

The old Solid Waste Disposal Site reached its maximum capacity in 2002 and a new garbage dump was planned in 2003. A study performed by Stanley and North Tech Consulting identified a suitable site for the landfill and construction of the new landfill was started in 2003 and completed in 2006. In 2007, the Hamlet decided to commission the new landfill and approved the environmental assessment of the current landfill for its abandonment and restoration. The Hamlet has obtained Gartner Lee and Associates to complete the abandonment and restoration (A&R) plan for the old landfill.

The new landfill was sited, designed, and constructed prior to the preparation of this O&M Plan. There is no record of an O&M Plan prepared by the original designer or constructor, and there is no documentation available indicating how they planned the facility to operate. This O&M Plan has been prepared to maximize the use of the site in the most safe and environmentally sound manner as possible.

Before commissioning of the landfill, the following should be completed:

- Background sampling of soil and water quality of the site should be completed
- Effective drainage of water surrounding the landfill should be designed and constructed
- A hazardous waste storage area should be constructed
- Top soil in the fill area should be removed and piled to be used as cover material

Solid waste projections for the Hamlet were calculated using population projections (Appendix B). The calculated annual volume of solid waste is the volume after burning and compaction. In our calculations we assume that 20% of the garbage is combustible and that the volume of garbage will decrease by 30% after compaction. Cover material will increase the volume of the waste by 20%.

2.2 Detailed Design of the New Solid Waste Management Facility

The new landfill is located approximately 6.0 km from the community's centre. The location of the Solid Waste Management Facility is displayed on Figure 2. The layout of the facility is displayed on Figure 3. In Figure 3, the Solid Waste Disposal Area is identified, including a potential area for expansion of the landfill. In addition, a contaminant attenuation area is identified down gradient of the landfill site for a distance of approximately 1 km within the drainage basin. This area provides a buffer zone for any landfill generated contaminated surface water and groundwater (in the active layer). The contaminant attenuation zone is considered off limits for any type of conflicting land use (recreation, residential, etc.) for the protection of human health.

As-built drawings of the Solid Waste Management Facility are included in Figure 4. Photographs of the site are included in Appendix C.

The constructed landfill is a total area of 85,000 m^2. A berm and road was constructed along the north and east edges of the site. A fence encloses the landfill along all edges except for 152 m of outcrop on the southwest side. The landfill has total waste area of 74,000 m^2 and a lay down area of 11,000 m^2. The lay down area is split up in sections to deal with specific waste types that should be segregated from the general waste. These areas are identified by signs and include areas for animal carcasses, hazardous waste, metal bulky waste, non-metal bulky waste and sewage screenings.

No reports or documents were available from Hamlet or Government of Nunavut, outlining how the landfill site was selected or how the site waste be operated. This O&M Plan is based on maximizing the use of the site as constructed.

2.3 Landfarm Design, Construction and Operation History

The Rankin Inlet Landfarm was constructed by Dillon in 2005. The landfarm is located 5 km northwest of the Hamlet, 300 meters northwest of the new landfill. The landfarm is 35 m x 60 m with a total area of 2100 m^2. Detailed design plans produced by Dillon before construction are provided in Appendix D. There is no documentation that the design proposed was constructed as planned. From the surface, the current layout of the landfarm is shown in Figure 11.

Currently the soil depth is 1.8 metres. A granular berm surrounds the landfarm. The edge of the berm has a 2:1 slope. According to Dillon design drawings, a geotextile liner was installed at the base. The floor of the landfarm slopes slightly towards the south east end away from the access road, so any excess surface water collects in south east corner where the leachate draining system is located. After a year the permafrost rose into the soil and provided a base.

The soil deposited in the landfarm originated from a fuel spill at the Airport Fuel Facility. There is no information on the original hydrocarbon concentrations of the soil. According to the Government of Nunavut, Community and Government Services, the soil was aerated and tilled once a year at the beginning of the summer. The soil has undergone treatment for 3 years. The most recent sampling of the soil was taken on July 31, 2008 by FSC. The methodology of this sampling is outlined in the report "Landfarm Assessment, Rankin Inlet. September, 2008". The sampling indicated that samples taken from up to 1.2 metres in depth met all criteria from the GNWT Environmental Guideline for Contaminated Site Remediation. Sample results are included in the annual report for 2008.

3.0 Operation and Maintenance

3.1 Overview

The Hamlet of Rankin Inlet new Solid Waste Management Facility consists of the following components:

- Municipal Solid Waste Disposal Area
- Hazardous Waste Storage Area
- Bulky metals disposal area
- Landfarm Facility

The Solid Waste Management Facility currently consists of a gravel lay down area and dump and cover waste disposal area. The site is designed as a natural attenuation landfill. It does not have a liner, so small amounts contaminants are able to leach from the waste and enter the natural environment. The design also relies on permafrost gradually migrating into the waste at depth as it is covered over.

In order to protect the environment, the facility is designed to divert as much waste as possible from landfilling. This is especially important for hazardous wastes such as batteries, waste oil, waste antifreeze, and other materials that could harm the environment if landfilled.

Figure 3 displays the layout of the solid waste disposal facility and surrounding area.

The total fill area of the site excluding the lay down area is approximately 74,000 m^2. Using projected waste volumes, Figures 5 through 9 were created to show the site in cross-section as it develops over time.

To enhance the life of the landfill, waste will be deposited in two layers of 1.25 m. A second berm will need to be built when the first layer is completed. With an estimated average fill depth of 2.5 metres, the new landfill will have an estimated capacity of 185,000 m^3. If the landfill begins receiving waste in 2009, it should complete its first layer of garbage in 8 years. The second layer of waste will be completed in approximately 16 years. The Hamlet will need to evaluate options for expansion of the landfill or a new site.

Site operations must comply with the Nunavut Safety Act. The health and safety of workers and the public must be the first priority.

3.2 Airport Impact Mitigation Measures

A bird hazard assessment for the landfill site was completed by LGL in 2002 to address issues of birds interfering with the flying of aircraft from the Rankin Inlet airport

(Appendix E). The new Solid Waste Management Facility site is located 2.2 km from the northwest end of the runway and offset from the airplane approach path by a perpendicular distance of 650 m. In the LGL report, the current site which is referred to as S1, was determined to be the best option however mitigation measures were recommended due to its close proximity to the airport. The following measures were recommended to ensure that the landfill does not create a bird hazard to planes coming from the airport:

- Sufficient cover of waste should be applied at least four times during the period when gulls are present in Rankin Inlet (June through September). The initial cover should occur in late May to cover waste before the gulls return in the spring. Subsequently, cover should be applied in late June, late July and late August

- Compaction and levelling of the waste should also occur during the months of June, July and August

- Gull nesting colonies on "Nesting Lake" and "Loafing Lake" should be discouraged. Any eggs in present nests should be destroyed. If gulls persist in the area, a small number of them should be killed to encourage others to abandon area. This will require a permit from the Canadian Wildlife Service

- An expert in bird hazard to aircraft safety should review the operation plans to ensure that there are no further safety hazards.

3.3 Material Arrival

Material will arrive at the facility either by a small dump garbage truck owned by the Hamlet or by private residential drop-off.

After Hamlet staff collects waste, the collection vehicles will progress to the landfill, where wastes will be tipped into the burn pile. After being tipped (or during collection), staff will perform an inspection of the waste to ensure that it does not contain visible hazardous waste or bulky metals. If such waste is noted, it will be segregated in the appropriate locations of the approved Hazardous Waste Storage area or the Bulky Metals Disposal Area.

Members of the community may drop off materials directly at the facility. The public should be encouraged to place materials in the appropriate location; generally bulky metals within the Bulky Metals Disposal Area, and hazardous waste in the Hazardous Waste Storage Area. Wood in the wood pile, etc.

Effective placement of bilingual signage encourages diversion and directs the public to the appropriate areas within the facility. Materials should be assessed prior to disposal in

the landfill. If the material is something other than municipal solid waste, it is assessed according to the following criteria:

- Canadian Environmental Quality Guidelines (Appendix F)
- Environmental Guideline for Industrial Waste Discharges.

If the material meets the industrial landuse criteria for disposal in the landfill, it is landfilled. If not, it must be treated (landfarmed) or stored as hazardous waste. Suitability for land farming will be based on the volume, type of contaminants, and concentration of contamination. A cost/benefit analysis is done to determine if landfarming is a better alternative than storage as hazardous waste and eventually shipped out of the community.

The staff will record the number of trips to the Solid Waste Disposal Facility per day and estimate the approximate quantity in cubic metres on the Waste Placement Forms included as Appendix G. If waste is present on site that has been tipped by others, an estimate of the quantity shall be made and recorded. Records are to be delivered to the Hamlet office once per week, were they will be retained on file for inclusion in the Annual Report.

3.4 Wood

Wood materials that may have reusable value are placed in the wood pile in the reuse/recycle area that is part of the Bulky Metals Disposal Area. The wood pile should be burned on occasion when quantities build up. Burning should take place when wind and climate conditions are favourable.

3.5 Bulky Waste

Designated areas are identified for Bulky Metals Waste and Non-metal Bulky Waste within the laydown area of the landfill. This area is a segregation area for reuse and recycling of materials such as metals, tires, vehicles, and equipment. Bulky metals are segregated and stockpiled until there is a sufficient quantity that warrants a burial event.

3.5.1 Regular Operation

Staff should inspect the bulky metals disposal area on a regular basis to check for new materials. Fluids (oil, antifreeze) should be drained from vehicles, batteries should be removed and transferred to the Hazardous Waste Storage Area. Bulky metals should then be tagged to indicate that they have been inspected and cleaned.

Bulky metals should be moved to the appropriate location to maximize segregation of the materials. These groupings can be developed by the operation staff based on needs and

materials, but are anticipated to consist of tires, appliances, bicycles, ATV's, snowmobiles and miscellaneous materials.

3.5.2 Regular Maintenance

Although reuse of the material is possible, there are materials that will have no potential future life. It is recommended that periodically (i.e., every 3 to 5 years), bulky metals with no further recyclable value be removed and buried in the landfill area.

3.6 Hazardous Waste Storage Area

There is currently no hazardous waste storage area constructed at the Solid Waste Management Facility. It is recommended that a fenced in hazardous waste storage area be constructed prior to commissioning of the facility. A suggested location for the area is shown in Figure 4. Detailed design for the area is shown in Figure 10.

3.6.1 Operations

During regular operations work on the facility, any hazardous materials placed on site should be transferred to the Hazardous Waste Storage Area. Batteries must be stored upright. Oils, lubricants and antifreeze may be bulked together in common drums, preferably remaining in their original packaging. Unknown substances should remain in their packages and placed into drums.

Hazardous wastes will be labelled and assigned for removal from the community to a licensed receiver in the south when the storage area nears capacity or when a cost effective volume to warrant shipping was accumulated. Based on historical accumulation notes, this is expected to be once every five years. One alternative to shipping oils, fuels and glycol is to bring in a portable incinerator to treat the materials on-site. An appropriately licensed contractor should be retained to conduct the work.

Only persons with the appropriate skills and training are permitted to handle hazardous wastes.

3.6.2 Maintenance

The area should be inspected on a regular basis for signs of spillage or leaks. Degraded containers (i.e., rusted drums) should be replaced as required.

When materials within the facility have accumulated to quantities that constitute a load, the Hamlet should arrange for them to be removed from site by a licensed hauler who will remove them from the community and dispose of them in a licensed facility.

3.7 Landfarm Wastes

Any soils that are contaminated with concentrations that exceed the Canadian Environmental Quality Guidelines for Industrial Landuse should be place in a landfarm facility for treatment. It is expected that the majority of the soils requiring landfarming will be impacted by petroleum hydrocarbons such as gasoline, diesel, heating oil, and lubricants.

Soil contaminated with petroleum hydrocarbons should be tested and meet two conditions before it can be placed in a Landfarm Facility for remediation:

- The soil must not be contaminated with waste engine oils or petroleum hydrocarbon mixtures containing waste engine oil. Waste engine oil contains metals from the engine. These metals are usually toxic to the soil microbes that biodegrade the petroleum hydrocarbons
- The level of hydrocarbon contamination must not exceed 30,000 mg/kg soil as measured by assessing either Total Petroleum Hydrocarbons (TPH) or Total Extractable Hydrocarbons (TEH). Any soil with a petroleum hydrocarbon concentration greater than 3% by weight (30,000 mg/kg) is considered a "special waste" and requires special treatment and/or disposal. If the soil is not special waste but still contains high levels of hydrocarbons, lab scale or pilot tests (sometimes referred to as treatability studies) may need to be done to determine the feasibility of remediating the soil to an acceptable level.

Sewage sludge can also be placed in the landfarm for treatment if the quality of the sludge removed from the lagoon is unsuitable for direct placement as landfill cover.

The landfarm may be used to contain the sewage sludge while it dries and, with some treatment, bio-degradation of the sewage is possible.

The landfarm can be used in an active mode, which involves maintaining moisture and nutrients, regular tilling, and monitoring, or a more passive mode involving only occasional tilling and monitoring. This will be up to the Hamlet to decide which method is preferred.

3.7.1 Landfarm Operation

The following outlines the soil treatment operations and methods to be used at the Landfarm Treatment Facility. It is assumed that conventional construction equipment will be used and experienced operators will be conducting the soil mixing and moving operation.

- If the soil is to be placed in the Landfarm Treatment Facility to a depth exceeding 0.15 m, the soil should be tilled at least once per month during the warm season.

Tilling aerates the soil, which increases the rate of microbial breakdown of the petroleum hydrocarbons

- The impacted soil should be placed up to a maximum thickness of 0.6 m for treatment
- The facility will remain dormant over the winter periods until the ambient temperatures are favourable for treatment. No hydrocarbon-contaminated soils should be applied to the active cells of the Landfarm Treatment Facility outside the operational season, during rainfall periods, or at any other time when the soil is saturated with water, ice covered, snow covered or frozen
- A small sump area should be left open in the south east corner and not filled with impacted soil
- Liquid fertilizer should be sprayed over the impacted soil prior to soil turning and mixing. Site staff should determine the best type of fertilizer, the optimum concentration, and application quantity for the soil treatment. Spraying should not be conducted in windy conditions to prevent off site impacts
- The hydrocarbon impacted soil should be turned and mixed immediately after the fertilizer application. The soil is to be turned with an excavator to expose the soil from below. The mixing process should be conducted with care such that the underlying liner is not disturbed or damaged
- Low ground-pressure equipment (i.e., Bobcat; back-hoe) should be used to move the soil while operating inside the landfarm. Equipment should not travel directly on the liner until a minimum of 300 mm of impacted soil is placed. No sharp turning of equipment is allowed directly on the liner
- Objects that have the potential to puncture the underlying liner, such as metals, sharp rocks, and scrap wood should be removed from the impacted soil before it is transported to the landfarm for treatment
- The impacted surface water and leachate collected from the collection sump (down slope berm face) should be stored temporarily in a tank. The liquid can be mixed with the impacted soil for treatment, provided the soil requires additional liquid for treatment. Soil moisture should be monitored to optimise and monitor the treatment process
- The liquid level shall be monitored to avoid overflow
- Any large accumulation of snow shall be removed as necessary, without removing any of the impacted soil, to prevent flooding or excessive soil moisture

- Mixing and turning of overly dry soil should be kept to a minimum to prevent dust generation

- Site staff will have to undergo appropriate training and be provided with the appropriate personal protective equipment.

3.7.2 Re-Use of Remediated Soil

Depending on the type of contaminants and the clean-up criteria achieved by the landfarming process, the soils could be suitable for re-use as landfill cover. This assumes the material can meet the Canadian Environmental Quality Guidelines as outlined in Chapter 7 for Soil Industrial Land use criteria, which are the threshold limits for disposal in the landfill (Appendix F). Once this is achieved, the material can be used for interim cover or part of final cover.

3.8 Special Wastes

On occasion, the Hamlet may be faced with determining if a waste material is of an unusual nature (contaminated soil, ship ballast, sand blasting waste, etc.). Since the landfill is designed and licensed to accept only municipal waste, an assessment process is followed to determine if the special waste is suitable for disposal at the site. As a general protocol, any solid material which meets the Canadian Environmental Quality Guidelines for Soil – Industrial landuse Criteria is likely acceptable. If the material cannot be sampled and tested in this fashion, outside expertise should be brought in to make an evaluation and recommendation to the Hamlet. When in doubt the safest practice is to store the material in the Hazardous Waste Storage Area, or if the quantity is too great in the landfarm area, as both areas are lined.

3.9 Reuse/Recycle

A reuse/recycle area will be established in the bulky metals area. An on-site operator will make sure that the area is used by the public safely and effectively. The purpose of the area will be to reduce the amount of garbage that is disposed and to prevent scavenging in the main landfill area.

3.10 Solid Waste Disposal Area

The solid waste disposal area of the landfill is shown in Figure 4. Operational procedures for the area are presented below:

3.10.1 Operation

Site operations include potentially hazardous practices such as burning and operation of heavy equipment. All work is to be conducted only by staff with the appropriate training

to conduct the work safely. The health and safety of workers and the public takes precedence.

It has been indicated that the burning of waste is a necessity to prevent odour, eliminate flies, and to reduce potential problems with scavengers, such as bears and foxes (since the ability to cover waste is limited due to the short operational season). In order to minimize the potential for impacts from fires the following rules are to be followed:

- Burn only in the established burn area
- If possible, materials should not to be tipped directly onto burning or smoldering waste; it is preferable to not ignite the waste until it has all been collected for the day
- Ensure that the weather is acceptable for burning. The following guidelines are recommended:
  - Wind speed should be checked. If loose paper or debris can be lifted and carried off site (moderate breezes or greater), burning shall be avoided
  - The wind direction should be checked, to ensure that smoke does not drift towards the Hamlet, or workers in the vicinity
  - If heavy rain is present, burning should be avoided (as it may result in poor combustion and greater potential to generate deleterious by-products).

The site operators shall stay upwind of the fire at all times.

Prior to waste handling, the equipment operator will confirm that the waste is no longer hot or burning. As required, using a dozer or a loader, the ash and unburnt municipal wastes will be pushed away from the burn pit and along the active face, observing the following operating principles:

- All waste shall be removed from the tipping and burn areas
- The waste shall be pushed and spread along the disposal area at a maximum 3:1 grade (shallower grades result in the need for too much cover, steeper grades are typically not stable).

The operational procedures are as follows:

- Divert hazardous material, bulky metals, and reusable/recyclable materials
- Drop off waste at the designated area within the lay down area
- Conduct burning on a regular basis when climate conditions are favourable – Figure 12
- Scrape the burned waste off the lay down area and move it into the fill area – Figure 13
- Compact and layer the waste 250 mm to 300 mm thick – Figure 13
- Gradually build up waste layers across the fill area to achieve final site grades over the designed waste footprint – Figure 14
- Close the fill area once final grades (maximum 3:1 slopes) are achieved – Figure 14

- Apply the final 600 mm of cover and stabilize the surface with cobbles – Figure 14.

The year 1 through 20 advancement to contour is shown on Figures 5 though 9. The site is designed so landfill staff have the flexibility to progressively fill the landfill in different patterns that is most suitable to their equipment and preferences. For example, the landfill can be progressively filled from one side to the other in a side to side cell fashion.

3.10.2 Maintenance

Operations staff will perform weekly site inspections and maintenance. During these inspections, weekly site inspection forms (Appendix G) will be completed. These forms are designed to note the standard items requiring inspection and maintenance at the site, as well as other relevant information, such as weather. Health and safety concerns will also be noted. They are also used to document the response to any incidents that affect site operations such as accidents, injuries, fires, flooding, or chemical spills.

- The tipping area and roadways shall be maintained by snow clearing in the winter and grading in the summer, and repaired as necessary
- Ditches and drainage channels shall be inspected for erosion, and repaired as necessary
- Site warning signage, which identifies the boundaries of the Solid Waste Management Facility (which includes the landfill, Hazardous Waste Storage Area, and the Bulky Metals Disposal Area) shall be inspected, and repaired or replaced as necessary
- Any airborne litter outside of the litter-control fences (which are located on top of the berm at the Facility) shall be removed, and deposited in the landfill
- Litter that has accumulated against the fences shall be removed and placed into the landfill
- After rain events and following the spring thaw, the site shall be inspected for leachate breakout. If leachate breakouts are identified, cover the face if possible and ensure that leachate is being contained
- The berms and final cover at the landfill shall be inspected for erosion and settlement
- The fences shall be inspected for damage, and repaired as necessary.

All details of any repairs shall be reported in the Annual Report.

Staff will place hazardous materials, such as oil or solvents into drums located in the Hazardous Waste Storage Area. Materials should be left in their original container and placed into the drums, sorted according to contents (i.e., waste oils stored with oils, solvents with solvents, cleaners with cleaners). Drums will remain sealed within the compound.

3.11 Health and Safety

Health and safety of the public and site staff is to be considered the first priority all the times. Site staff must conduct their jobs on site safely and in accordance with the Nunavut Safety Act.

Close attention should be given to the unique hazards of this site including:

- Scavenging bears and other wildlife
- Open burning
- Moving equipment
- Adverse weather conditions
- Hazardous materials (in the waste and in the storage area).

Staff must be aware of these issues and operate the site in a manner that protects other staff and the public. Complaints from the public should be recorded and reported to the Public Works foreman. Complaints and the responses to complaints should be documented in the Annual Report for the site.

3.12 Site Closure and Restoration

The closure plan for the landfill area is displayed on Figure 14, assuming the site is filled in year 20. There is available land around the landfill which may permit site expansion and continued use beyond the current design. A potential expansion area is shown in Figure 3. Post closure care will include:

- Creation of a closure plan and post closure monitoring plan at least two years prior to closure, for which a new submission for a water license amendment will be required
- Long term monitoring
- Surficial inspections and cover maintenance as required
- Restoration of the surface to match the surrounding natural tundra.

4.0 Contingency Measures

4.1 General Contingencies

Contingency plans are designed so that site operators are prepared in the event of an accident or occurrence. The contingency measures described below are generic in nature since they must address a wide variety of issues.

4.1.1 Environmental Emergency Contingency Plan

A separate document entitled Environmental Contingency Plan, Hamlet of Rankin Inlet, dated December 2008, was prepared as part of a submission for renewal of the NWB license. Refer to that document for the response to spills and environmental contingencies.

4.1.2 Injuries

In the event of an injury to workers or members of the public:

- Apply first aid
- Seek medical assistance, if necessary
- Report the injury to the supervisor
- Document the incident and all response measures on the Weekly Waste Management Facility Inspection Form (Appendix G).

4.1.3 Fires

In the event of a fire, assess the situation. Do not attempt to fight a fire if it cannot be done safely. Standard fire fighting equipment that can manage most small fires is available in a shed near the Hazardous Waste Storage area. Alternatively, cover soils can be thrown onto the fire either by hand, or by using available equipment (i.e., bulldozer). Obtain help as necessary. Document the incident and all response measures on the Weekly Site Inspection Form (Appendix G).

4.1.4 Erosion

Erosion may become a problem if runoff rates exceed expectations or cover soils and vegetation are not well established. The preferred contingency measure for this is to repair the area of erosion with available materials and cover with blast rock.

4.2 Accumulation of Impacted Water

At some point, for a variety of reasons, impacted water may accumulate in the landfill, hazardous waste storage area or landfarm.

The water may or may not be impacted by leachate, hazardous wastes or contaminants from land farmed soil. Given the climate and current lack of issues with respect to accumulation of impacted water, this is not anticipated to be a significant problem, however, in the event this occurs, the following procedures will be followed:

- Collect samples as outlined in the Monitoring Program and QA/QC Program document
- Analyze samples for parameters of concern and compare the results to the recent criteria (Nunavut Guidelines, Canadian Water Quality Guidelines, etc.)
- Dispose of the water. Disposal options are dependent on the water quality and could include:
  - Transportation and disposal to community sewage treatment system – only mechanical treatment is carried out at treatment plant (removal of solids)
  - Pre-treatment (filter, chemical, etc.) prior to discharge to the wastewater treatment system
  - Containment and storage of hazardous waste.

5.0 Solid Waste Management Facility Monitoring Procedures

As outlined in the NWB water license, regular monitoring of runoff from the Solid Waste Management Facility is required. The Monitoring Program should be completed as described in the Environmental Monitoring Program and QA/QC Plan (Nuna Burnside, 2008). Results of analytical testing and monitoring are to be recorded on a regular basis by the staff. Monitoring results will be compared to the Canadian Environmental Quality Guidelines (CCME, 2007), specifically the Chapter 4 Criteria for Water: Aquatic Life – Freshwater (Appendix F). Copies of the Certificates of Analysis and Chain of Custody forms are to be kept for future reference. Monthly and annual quantities of solid waste offloaded will be estimated and recorded on the Waste Placement Form (Appendix G).

5.1 Landfarm Facility Monitoring Procedures

A regular monitoring program should be done for all soil being treated. Whenever contaminated soils are tested, care must be taken to ensure that representative samples are collected. At a minimum, samples should be collected at several points and composited over the depth of soil, at each point. The Environmental Programs Branch has prepared a protocol that must be used when characterizing contaminated soils.

Records must be kept for the Landfarm Facility, including:

- The origin of all contaminated soil
- The current location of soil within land treatment facility
- The volume of soil being remediated
- All soil analysis results
- Transportation details of any special waste
- Nutrient information (type, dates, quantity) for any fertilizers added to the soil
- Details of all tillage activities.

Records should be kept for a minimum of three years or for as long as a particular load of contaminated soil is being remediated in the Landfarm Facility (whichever is longer). Forms to assist in record keeping at the landfarm are included in Appendix G.

5.1.1 Landfarm Soil Monitoring

Approved industry standards and methods for sampling, shipping, and handling procedures must be followed to ensure that representative soil samples are taken, and chemical integrity of the soil samples is maintained during transportation. A work plan including sampling frequency, sampling location, and sampling methods should be prepared and implemented prior to the operation. Soil samples may be taken once every month during the period of active soil treatment depending on the remedial program. A record of sampling and chemical analysis shall be maintained to monitor the performance of the treatment.

A health and safety plan should be developed specific for the work involving soil sampling and handling. The plan should include personal protective equipment and an emergency response plan.

Monitoring of the soil will be specific to the material emplaced (hydrocarbon impacted, sewage sludge, etc.).

5.1.2 Comparative Criteria

The Canadian Environmental Quality Guideline (CCME, 2007) are recommended as the most appropriate comparative criteria, to determine when landfarmed soil can be removed from the landfarm and used as cover material at the landfill. The Industrial land use criteria as outlined in Chapter 7 for soil in the Canadian Environmental Quality Guidelines must be met in order for the soil to be placed in the landfill (Appendix F).

The following guideline criteria are the most typical hydrocarbon fraction thresholds that must be achieved in order to use the soil in the landfill.

Clean-up Criteria for Contaminated Soil at Landfarms

	Criteria (mg/kg)
Petroleum Hydrocarbon Fraction-1 (F1)	310
Petroleum Hydrocarbon Fraction-2 (F2)	760
Petroleum Hydrocarbon Fraction-3 (F3)	1700
Petroleum Hydrocarbon Fraction-4 (F4)	3300

6.0 Reporting

6.1 New Solid Waste Management Facility

The Nunavut Water Board License, Part B: General Conditions includes the requirement to file an Annual Report with the NWB no later than March 31st of the year following the calendar year reported, which shall include:

- Tabular summaries of all data generated under the "Monitoring Program"
- The monthly and annual quantities in cubic metres of fresh water obtained from all sources
- The monthly and annual quantities in cubic metres of each and all waste discharged
- A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities
- A list of unauthorized discharges and summary of follow-up action taken
- A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year
- A summary of any studies, reports and plans (i.e. Operation and Maintenance, Abandonment and Restoration, QA/QC) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned
- Any other details on water use or waste disposal requested by the Board by November 1st of the year being reported.

The format of the NWB Annual Report is included in Appendix H.

The creation of the report can be greatly simplified by the regular filling in and handling of the Site Forms included in Appendix G. The forms include:

- Form 1 – Waste Placement Form – describing the day to day delivery of waste and site activities
- Form 2 – Weekly Solid Waste Management Facility Inspection Form – to document the weekly inspection and observation of the site operation and infrastructure

- Form 3 – Solid Waste Planning – which provides a list of items to be discussed by the site foreman and Hamlet Council related to short term and long term solid waste decision making

- Form 4 – Landfarm Soil Deposal Record Form – describing the soil deposited into the landfarm

- Form 5 – Monthly Landfarm Inspection Form – to document the monthly inspection, record all activities on the site and observation of the site operation and infrastructure

- Form 6 – Landfarm Facility Planning – which provides a list of items to be discussed by the site foreman and Hamlet Council related to short term and long term landfarm waste decision making.

In addition to the context of these forms, there would be sampling information and analytical data. Using the forms and following the procedures provided herein should make submitting the annual monitoring report relatively straight forward.

6.2 Old Landfill Site

An Abandonment and Restoration Plan for the old landfill site is being prepared by another consultant. The Plan will include requirements for post closure monitoring and reporting. These requirements need to be included in the Annual Report.

7.0 Summary

This Operation and Maintenance Plan has been prepared for the Hamlet of Rankin Inlet, to assist Hamlet staff to operate the Solid Waste Management Facility as effectively as possible, based on the design and construction layout.

A Solid Waste Planning form has been included in Appendix G, to allow the Hamlet to track and evaluate the various aspects of their Solid Waste Management Facility. The form is designed to be used by the site foreman and Hamlet Council, when evaluating and planning Solid Waste Management over both the short term (1 to 5 years) and long term (5 to 20 years). It will assist in identifying issues and developing the strategies and budgets to deal with them.

The Operation and Maintenance Plan has been prepared to allow operational flexibility, so site staff can maximize efficiency with the changing seasons and available equipment.

Appropriate training for site staff is necessary as part of the implementation of this O&M Plan. This document should be reviewed and updated annually, and whenever the NWB Water License is amended or new relevant legislation is issued.

8.0 Reference Documents

The following documents provide a resource of information to deal with specific issues:

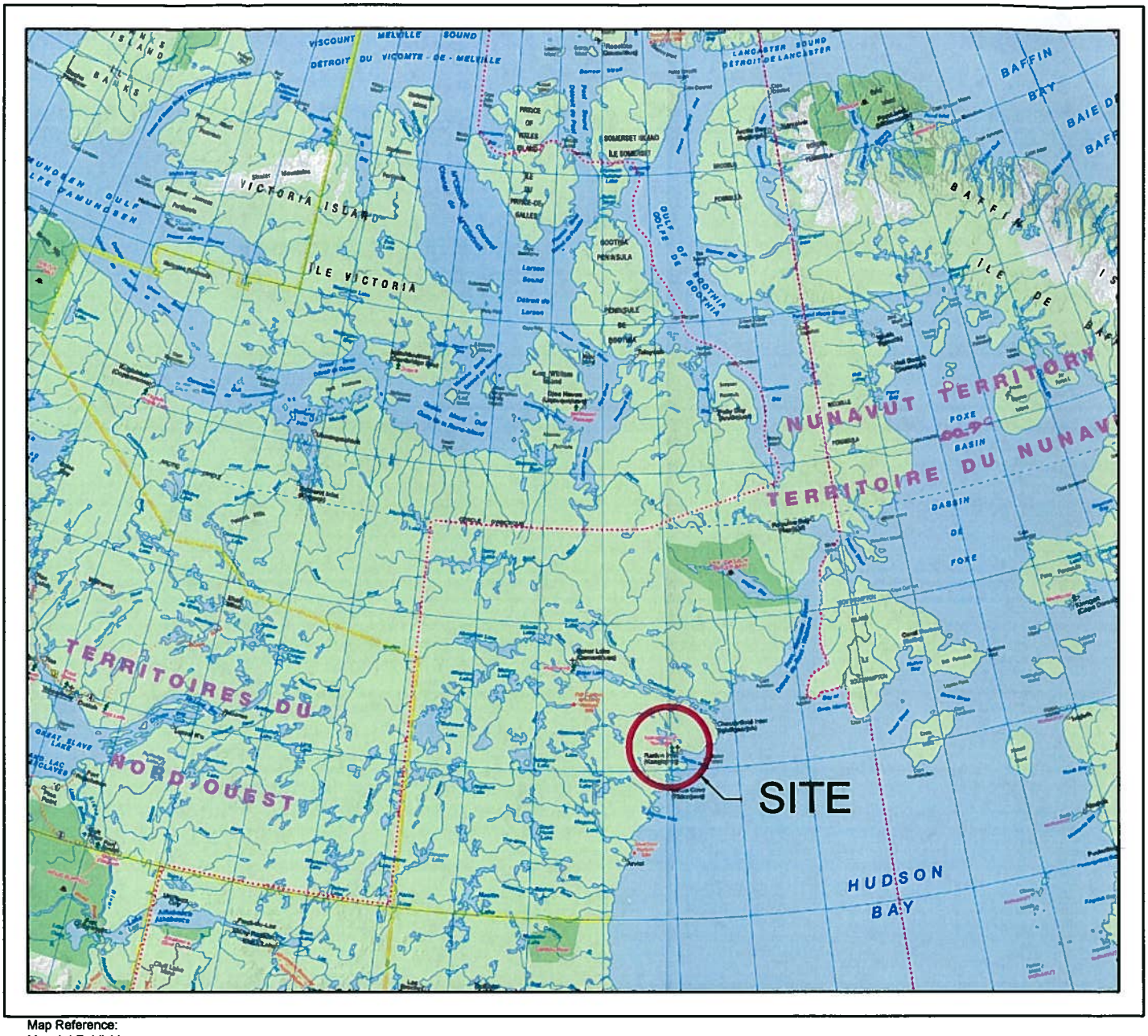
- Canadian Council of Ministers of the Environment (CCME), *Canadian Environmental Quality Guidelines,* Update 7.0, August 2007
- *Guidelines for the Planning, Design, Operations, and Maintenance of Modified Solid Waste Sites in the Northwest Territories*, prepared by Northwest Territories, Municipal and Community Affairs
- *Consolidation of General Sanitation Regulations* under the Public Health Act
- *Nunavut Safety Act*
- *Nunavut Waters and Nunavut Rights Tribunal Act*
- The following guidelines prepared by the Department of Sustainable Development:
  - *General Management of Hazardous Waste*
  - *Environmental Guidelines for Waste Antifreeze*
  - *Environmental Guidelines for Dust Suppression*
  - *Environmental Guideline for Industrial Waste Discharges*
  - *Environmental Guidelines for Ozone Depleting Substances*
  - *Environmental Guidelines for Waste Asbestos*
  - *Environmental Guidelines for Waste Batteries*
  - *Environmental Guidelines for Waste Paint*
  - *Environmental Guidelines for Waste Solvent*
- The following polices prepared by the Government of Nunavut:
  - *Waste Lead (Draft)*
  - *Policies Regarding Open Burning*
  - *Management of Fluorescent Lamp Tubes*
- *Spill Contingency Planning and Reporting Regulations*, Government of the Northwest Territories, 1998
- *Code of Practice for Land Treatment of Soil Containing Hydrocarbons*, Alberta Environment, October 2005
- Yukon Government, Environment Yukon. *Land Treatment Facilities (Guidelines for Construction, Operation and Decommissioning)* <<http://environmentyukon.gov.yk.ca/pdf/ltfguidelines2007.pdf>> Accessed Oct 14 2008.

Hamlet specific documents include:

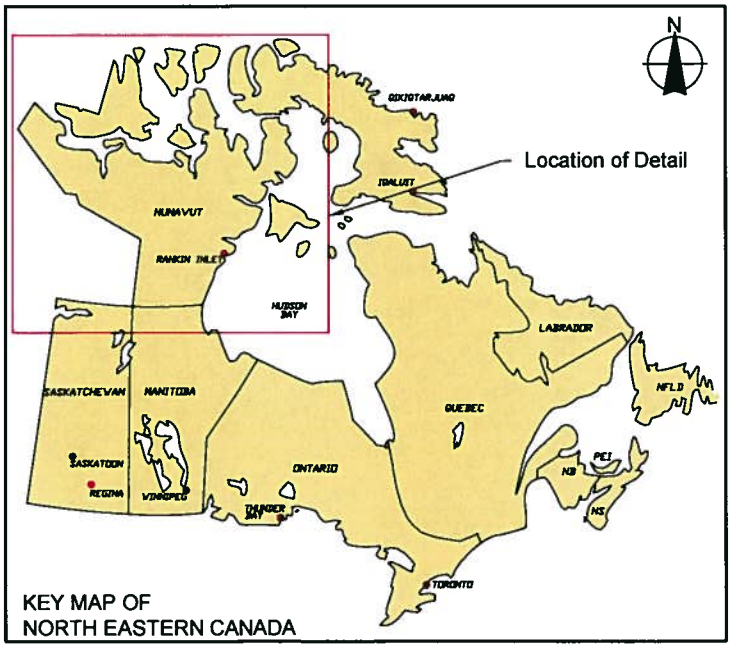
- The amended *Nunavut Water Board License* which may have additional specific requirements
- *Environmental Emergency Contingency Plan, Hamlet of Rankin Inlet* Nuna Burnside Engineering and Environmental Ltd. 2008
- *Environmental Monitoring Program and QA/QC Plan, Hamlet of Rankin Inlet.* Nuna Burnside Engineering and Environmental Ltd. 2008

- *Assessment of Potential Bird Hazards to Aircraft Safety Associated with the Proposed New Solid Waste Site – Rankin Inlet, Nunavut*, LGL Ltd. September, 2002
- *Canadian Climate Normals 1971-2000, Rankin Inlet A Weather Station*, Environment Canada <*http://climate.weatheroffice.ec.gc.ca/climate_normals/results_e.html?StnID=1721&autofwd=1*>. Accessed Nov 10, 2008
- *Landfarm Assessment, Rankin Inlet*. EBA Engineering Consulting Ltd.for the Government of Nunavut, 2008
- *Jet Fuel Spill Assessment, Rankin Inlet*. EBA Engineering Consulting Ltd. for the Government of Nunavut, 2008.

Figures



Map Reference:
Map Art Publishing



KEY MAP OF
NORTH EASTERN CANADA

FIGURE 1 - SITE LOCATION MAP

HAMLET OF RANKIN INLET
HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY OPERATION & MAINTENANCE PLAN

December 2008
Project Number: N-O14850

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET SL.dwg

Plot Time: Mar 05, 2009 - 12:39pm

FIGURE 2

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

COMMUNITY PLAN

Satellite Image Source:
Background 2006 satellite image covering the immediate community area obtained from MDA Geospatial Services.
Background colour satellite image covering the area beyond the immediate community obtained from the Google Earth Pro website.

N

0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4

Kilometres

1:30,000
August 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET CP.dwg

Plot Time: Mar 05, 2009 - 12:41pm

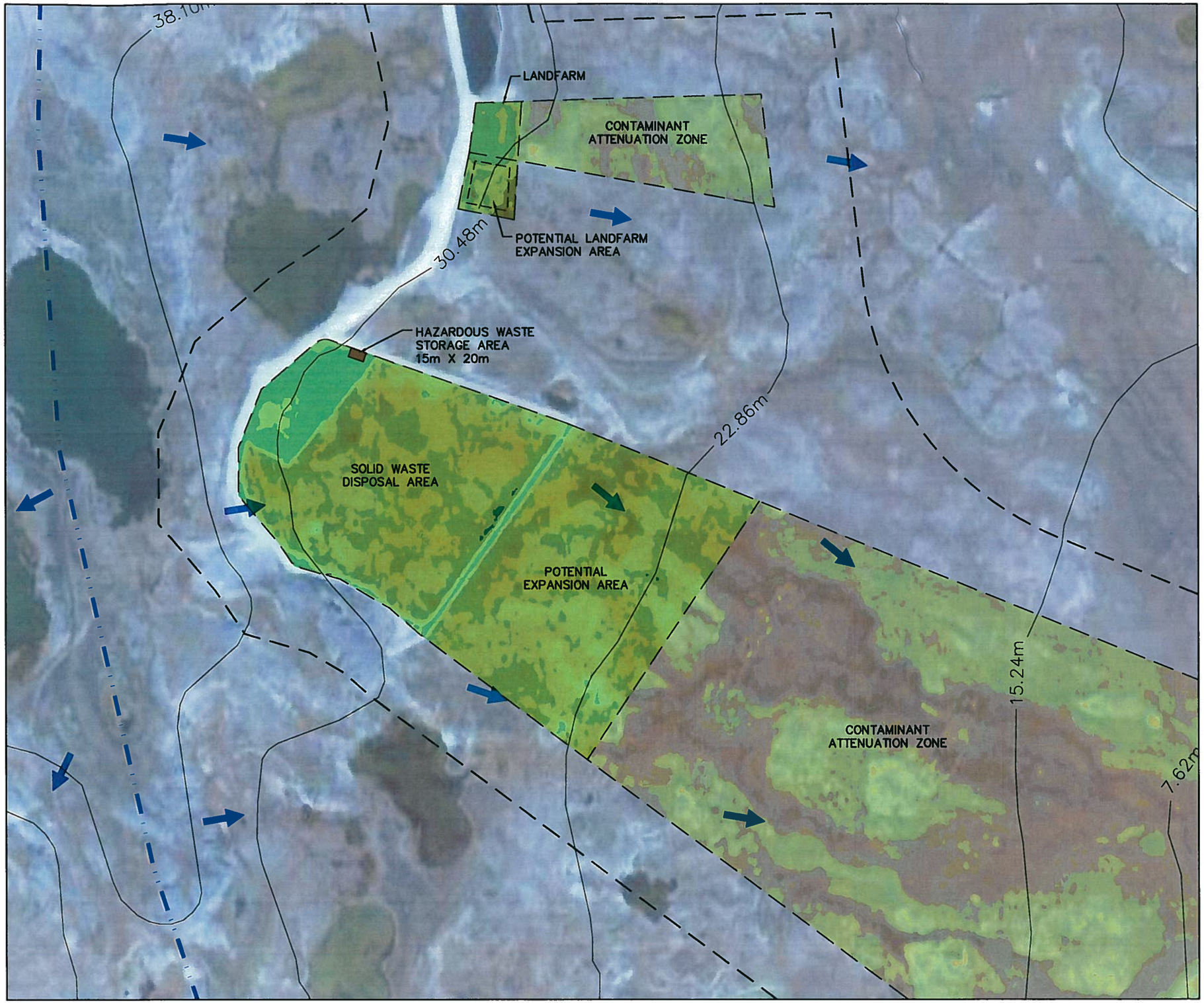


FIGURE 3

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

SOLID WASTE MANAGEMENT FACILITY LAYOUT

LEGEND

- 22.86m — 7.62m (25 foot) INTERVAL CONTOUR LINES (m amsl) (Obtained from National Topographic Digital Database)
- INTERPRETED SURFACE WATER DRAINAGE DIVIDE
- INTERPRETED SURFACE WATER FLOW DIRECTION
- WASTE MANAGEMENT AREA
- SOLID WASTE DISPOSAL AREA
- LANDFARM AREA
- CONTAMINANT ATTENUATION ZONE
- HAZARDOUS WASTE AREA

Satellite Image Source:
Background colour satellite image obtained from the Google Earth Pro website.

N

0 50 100 150 200 250 300 350 400

Metres

1:5,000
August 2008
Project Number: N-014850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-014850 SOLID WASTE O&M PLAN - HAMLET SWMF LAYOUT.dwg

Plot Time: Mar 05, 2009 - 12:44pm

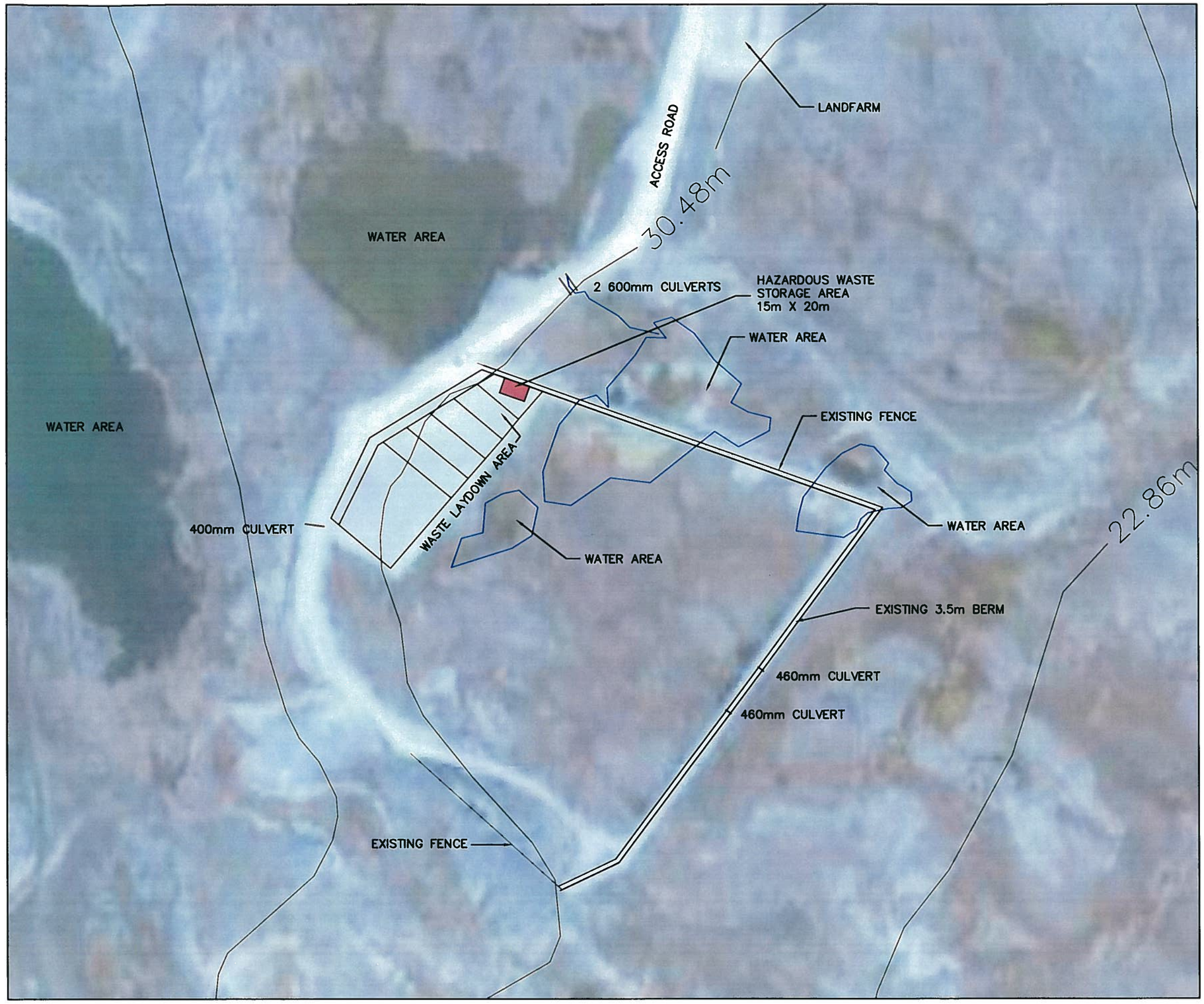


FIGURE 4

HAMLET OF RANKIN INLET
HAMLET OF RANKIN INLET, NUNAVUT
SOLID WASTE MANAGEMENT FACILITY O&M PLAN

SOLID WASTE MANAGEMENT FACILITY DESIGN

LEGEND

—22.86m— 7.62m (25 foot) INTERVAL CONTOUR LINES (m amsl)
(Obtained from National Topographic Digital Database)

Data Source:
Background colour satellite image obtained from the Google Earth Pro website.

Landfill plan obtained from the Government of Nunavut, Department of Community Government and Transportation - Kivalliq Region.

N

0 20 40 60 80 100 120 140 160 180 200 220 240
Metres

1:3,000
August 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET SWMF DESIGN.dwg

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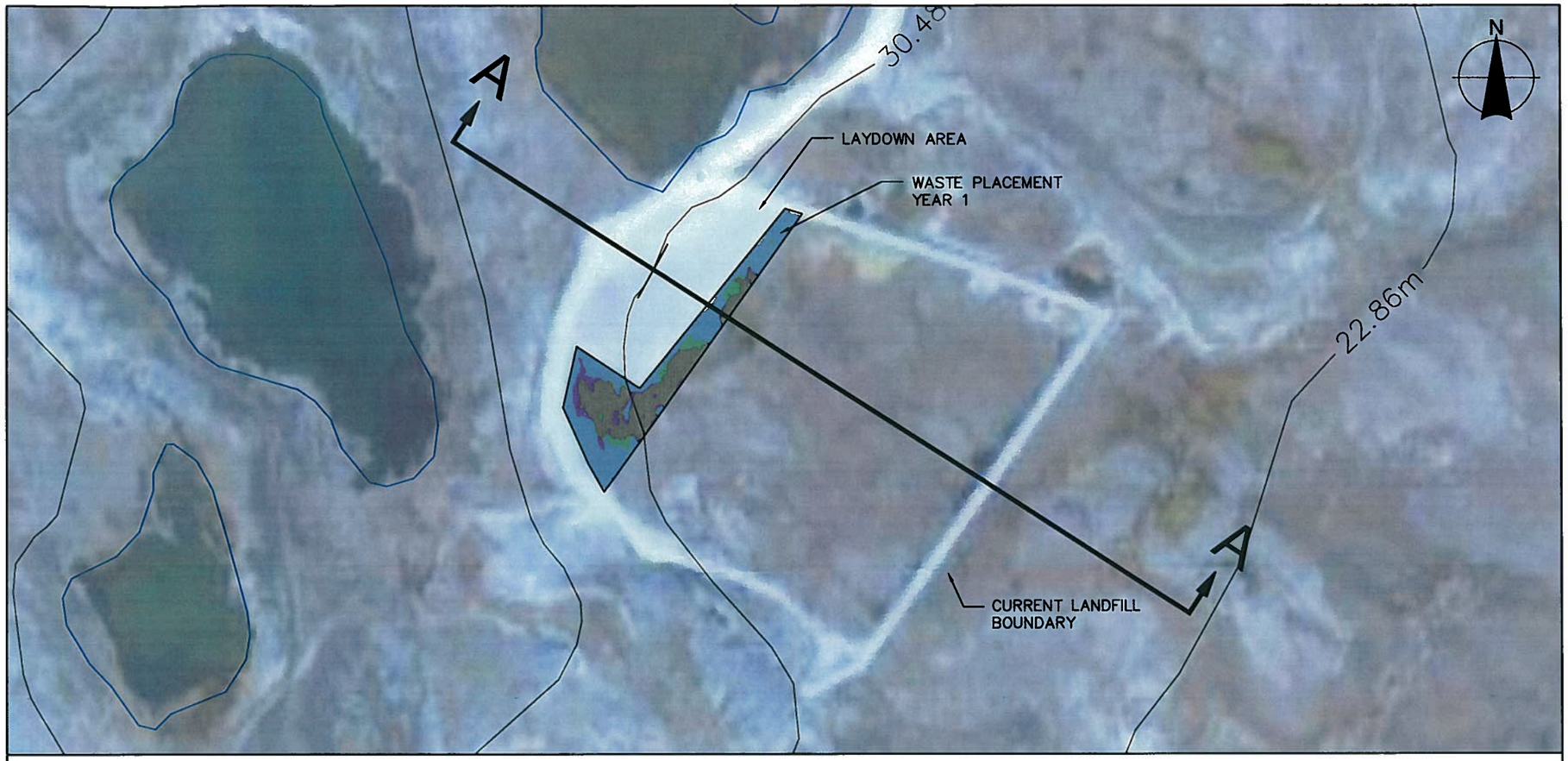

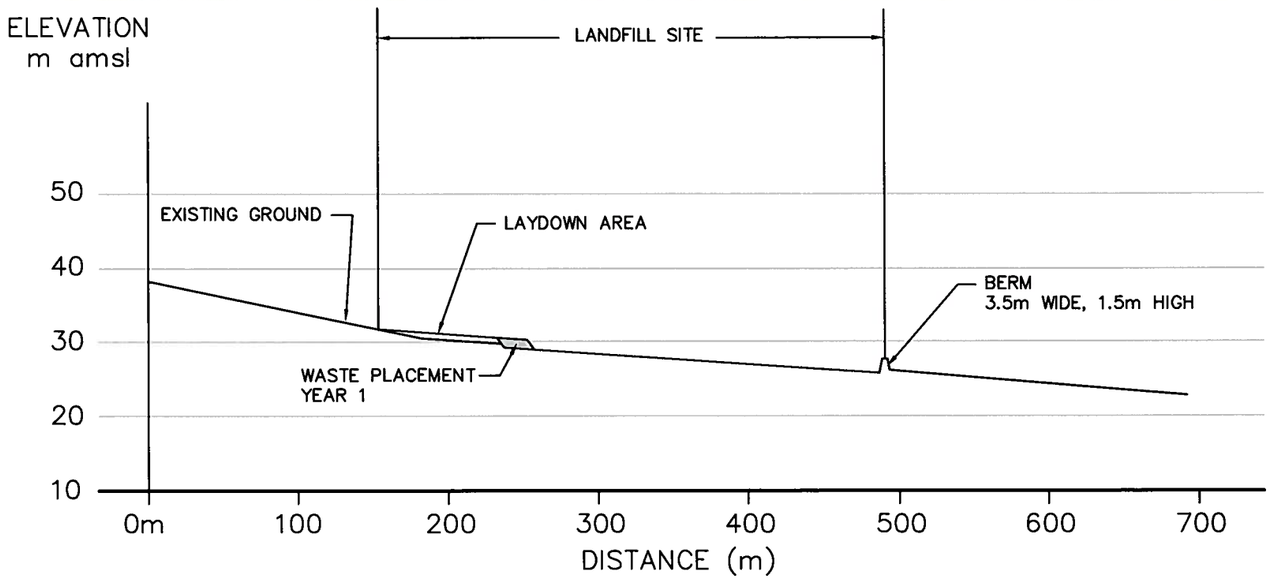

CROSS SECTION A–A

FIGURE 5

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

LANDFILL DEVELOPMENT YEAR 1

LEGEND

WASTE PLACEMENT

Satellite Image Source:
Background colour satellite image obtained Google Earth Pro website.

0 40 80 120 160 200 240 280 320
Metres

1:4,000
December 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET LF YR 1.dwg

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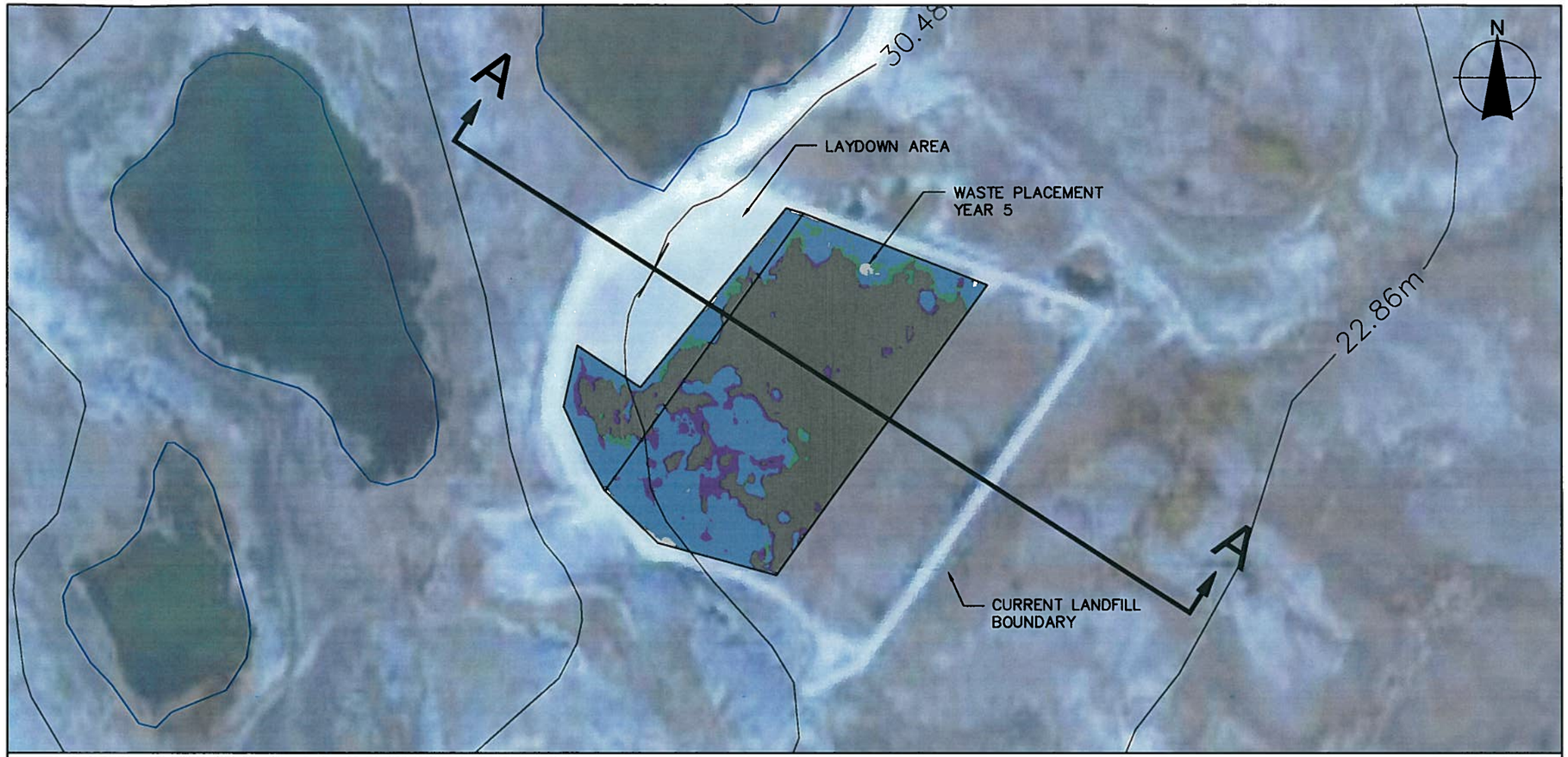

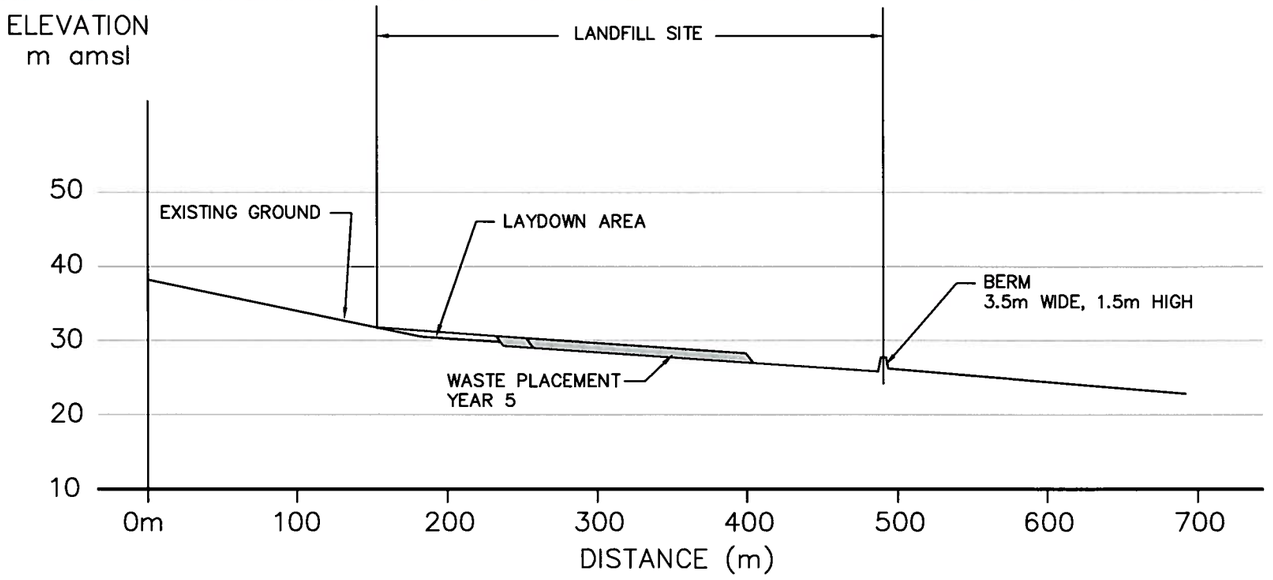

CROSS SECTION A–A

FIGURE 6

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

LANDFILL DEVELOPMENT YEAR 5

LEGEND

WASTE PLACEMENT

Satellite Image Source:
Background colour satellite image obtained Google Earth Pro website.

0 40 80 120 160 200 240 280 320
Metres

1:4,000
December 2008
Project Number: N-014850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-014850 SOLID WASTE O&M PLAN - HAMLET LF YR 5.dwg

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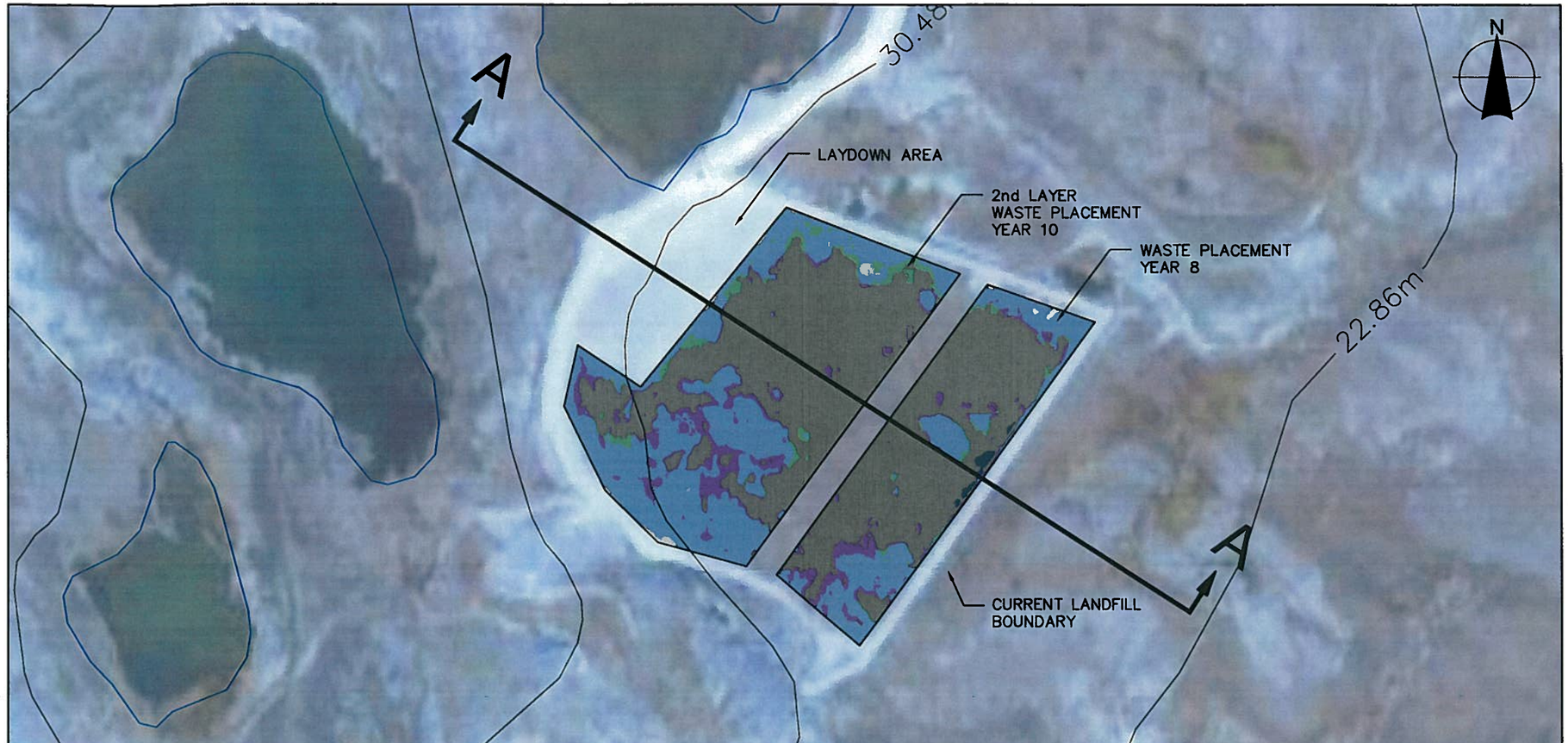
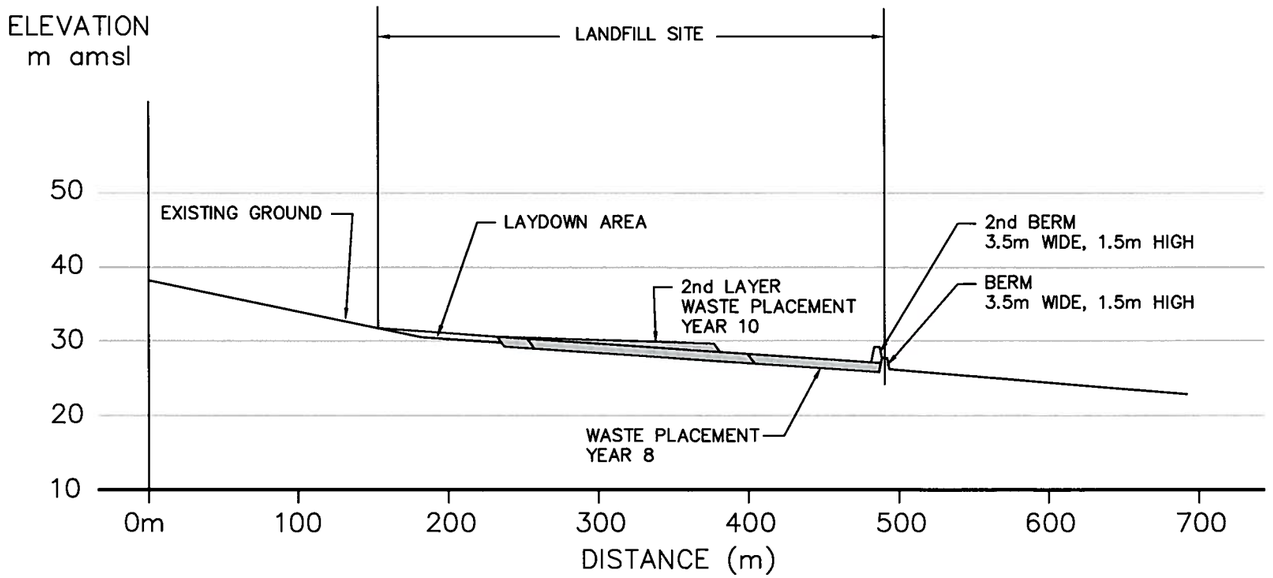




CROSS SECTION A–A

FIGURE 7

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

LANDFILL DEVELOPMENT YEAR 10

LEGEND

WASTE PLACEMENT

Satellite Image Source:
Background colour satellite image obtained Google Earth Pro website.

0 40 80 120 160 200 240 280 320
Metres

1:4,000
December 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

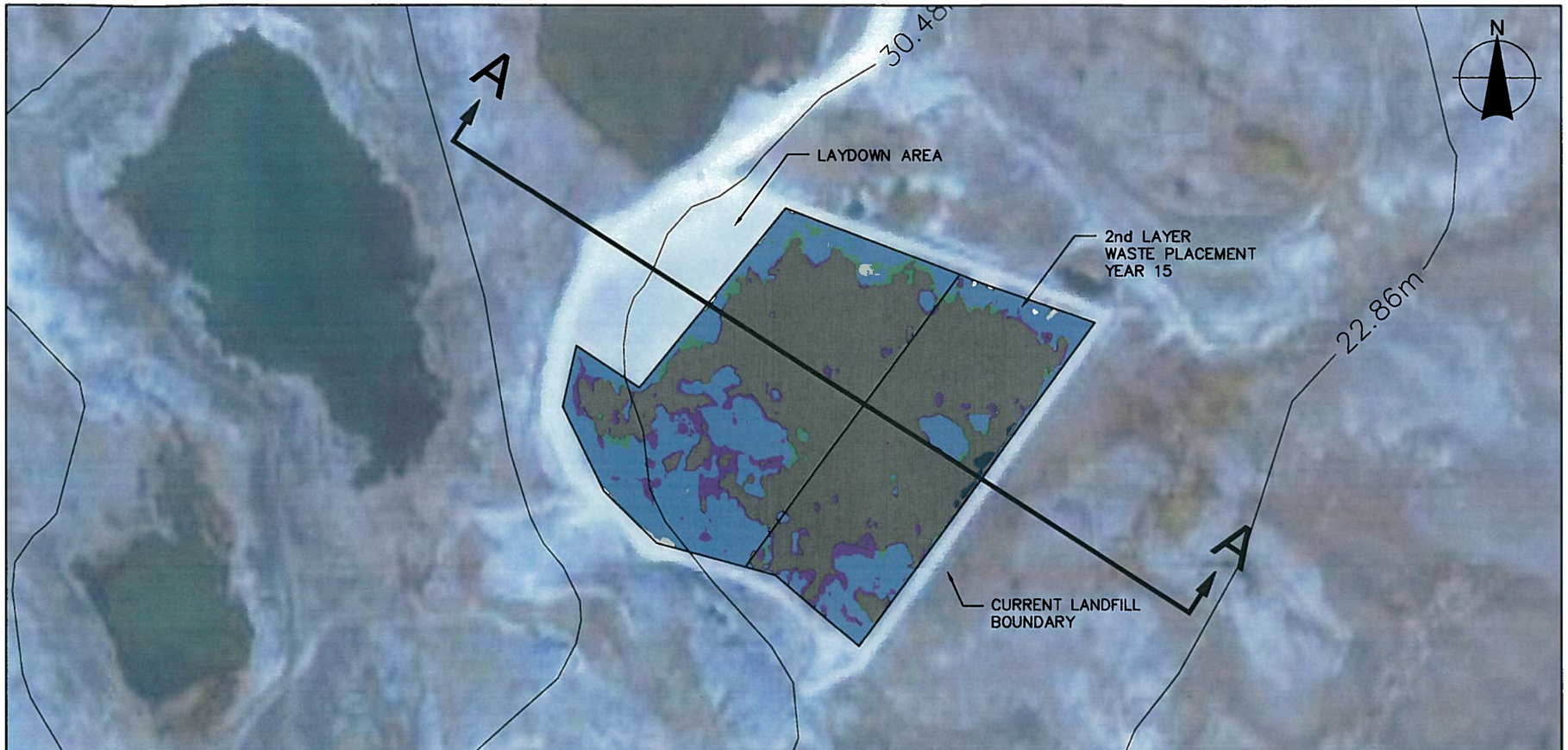
Prepared by: C. Sheppard

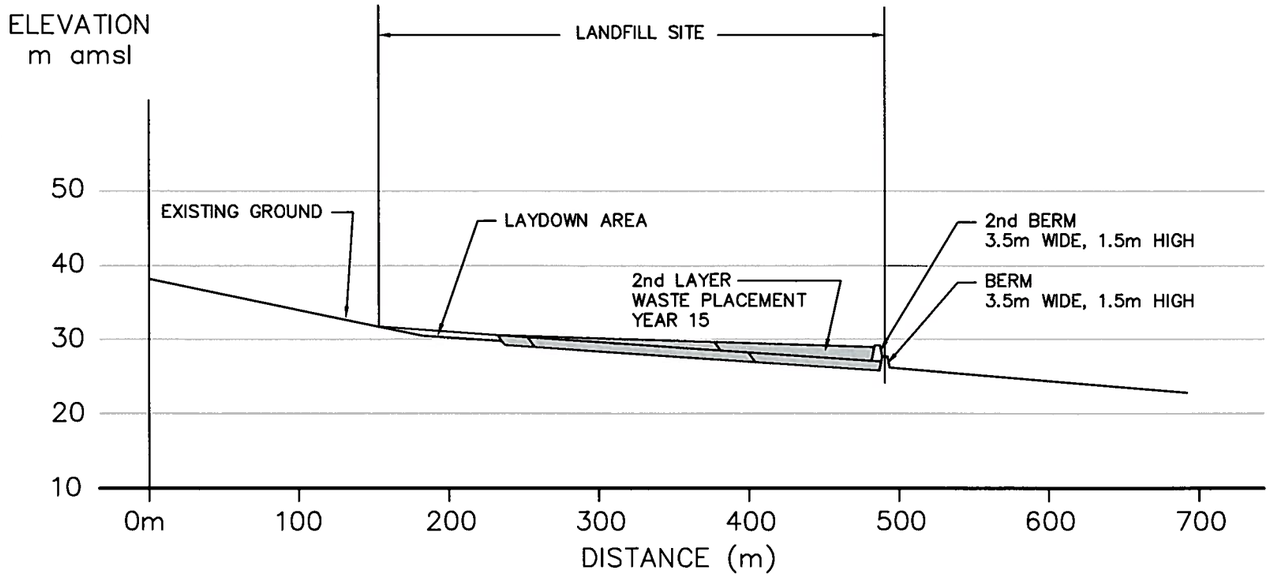
Verified by: J. Walls

BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET LF YR 10.dwg

Plot Time: Mar 05, 2009 - 12:49pm





CROSS SECTION A–A

FIGURE 8

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

LANDFILL DEVELOPMENT YEAR 15

LEGEND

WASTE PLACEMENT

Satellite Image Source:
Background colour satellite image obtained Google Earth Pro website.

0 40 80 120 160 200 240 280 320
Metres

1:4,000
December 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET LF YR 15.dwg

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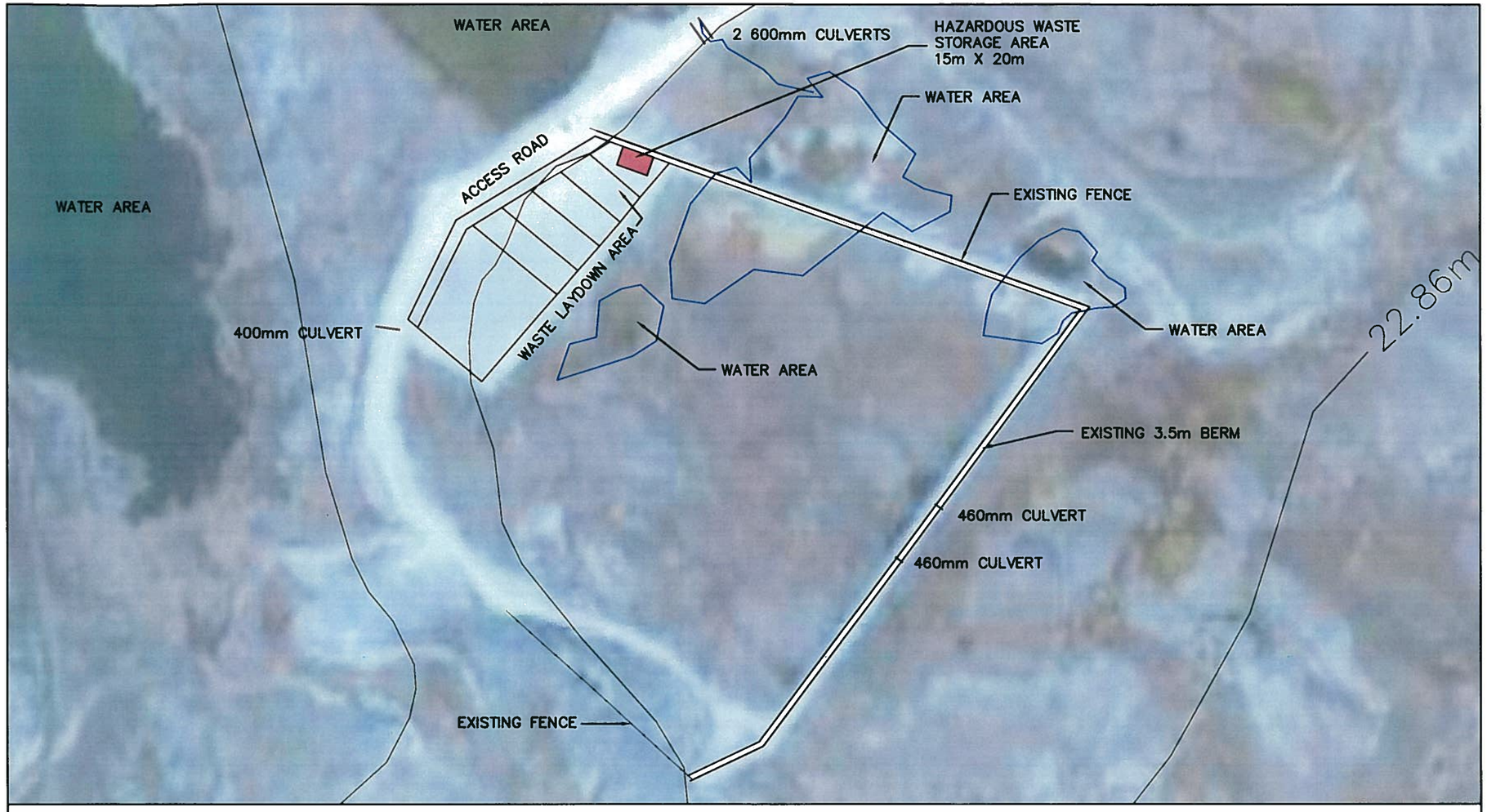
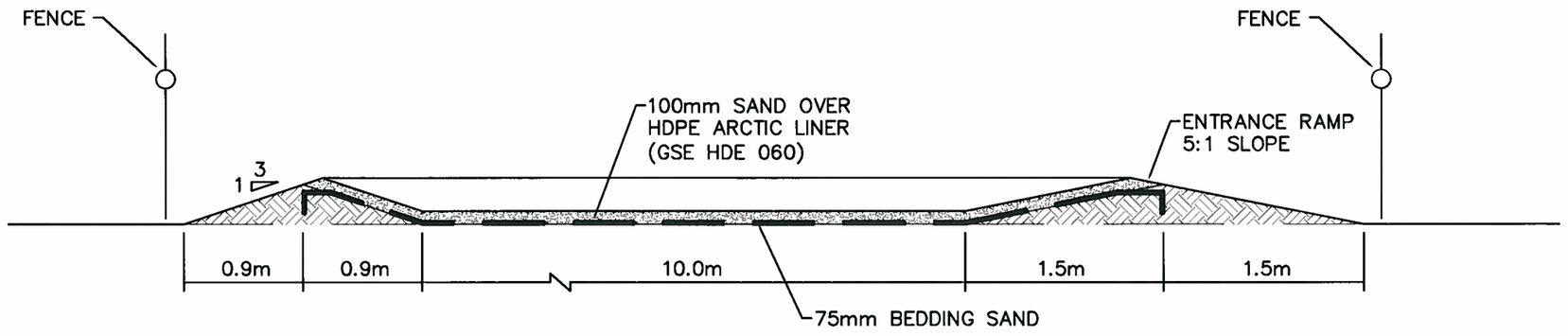




HAZARDOUS WASTE AREA TO INCLUDE:
1. SPILL KIT STORAGE LOCKER (SECURED TO FENCE)
2. 6m WIDE DOUBLE GATE
3. ENTRANCE RAMP 3.0m WIDE WITH 5:1 SLOPE

HAZARDOUS WASTE STORAGE AREA CROSS SECTION

FIGURE 9

HAMLET OF RANKIN INLET

HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

HAZARDOUS WASTE STORAGE AREA

LEGEND

—22.86m— 7.62m (25 foot) INTERVAL CONTOUR LINES (m amsl) (Obtained from National Topographic Digital Database)

Data Source:
Background colour satellite image obtained from the Google Earth Pro website.

Landfill plan obtained from the Government of Nunavut, Department of Community Government and Transportation - Kivalliq Region.

N

0 20 40 60 80 100 120 140 160 180 200 220 240

Metres

1:3,000
December 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET HAZARDOUS.dwg

Plot Time: Mar 05, 2009 - 1:33pm

FIGURE 10

HAMLET OF RANKIN INLET
HAMLET OF RANKIN INLET, NUNAVUT
SOLID WASTE MANAGEMENT FACILITY O&M PLAN

LANDFARM FACILITY

Satellite Image Source:
Background colour satellite image obtained from the Google Earth Pro website.

N

0 50 100 150 200 250 300 350 400
Metres

1:750
December 2008
Project Number: N-O14850

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-O14850 SOLID WASTE O&M PLAN - HAMLET LFARM.dwg

Plot Time: Mar 05, 2009 - 1:37pm

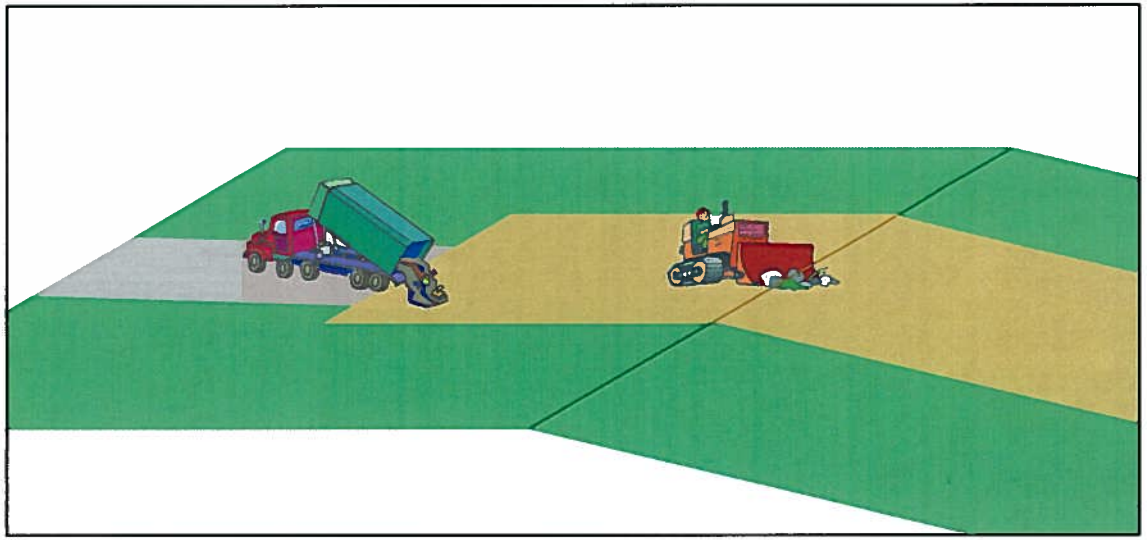
FIGURE 11

HAMLET OF RANKIN INLET

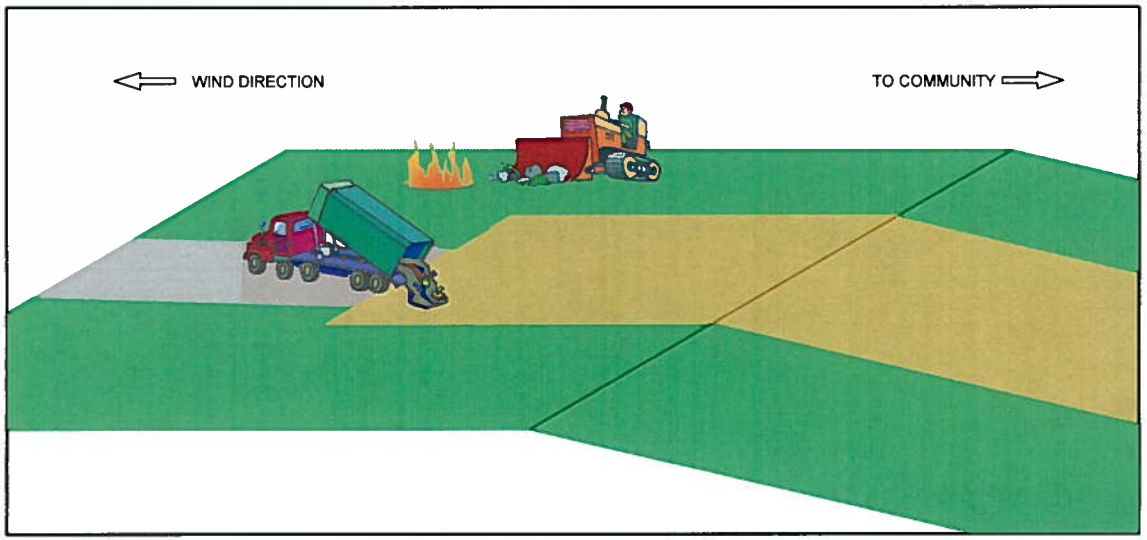
HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

DROP OFF & BURNING



WASTE IS DUMPED IN THE DROP OFF AREA. THE GARBAGE TRUCK SHOULD NOT DRIVE ONTO AREAS WITH EXPOSED WASTE THAT COULD DAMAGE THE TIRES.



WOOD, CARDBOARD & BURNABLE MATERIALS ARE PUSHED INTO THE BURN PILE

WASTE IS BURNED IN AN OPEN PILE OR WITHIN A BURN PIT. BURNING SHOULD TAKE PLACE WHEN THE WIND IS NOT BLOWING TOWARDS THE COMMUNITY

OTHER WASTE IS PUSHED OVER THE TIPPING FACE

November 2008
Project Number: N-O14850

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

REVISION #: 1

N-O14850 SOLID WASTE O&M PLAN DROP OFF.DWG

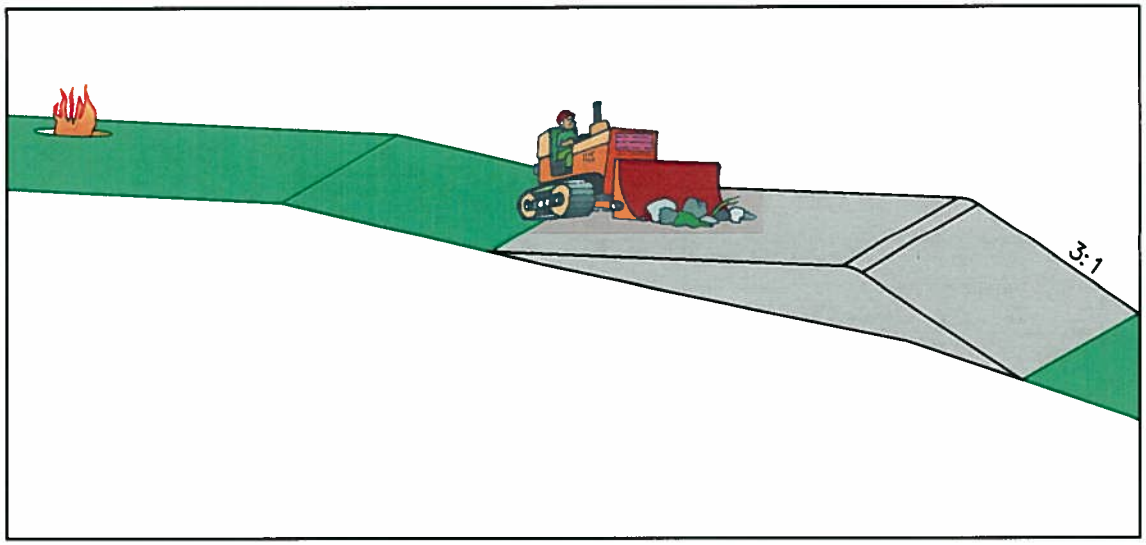
FIGURE 12

HAMLET OF RANKIN INLET

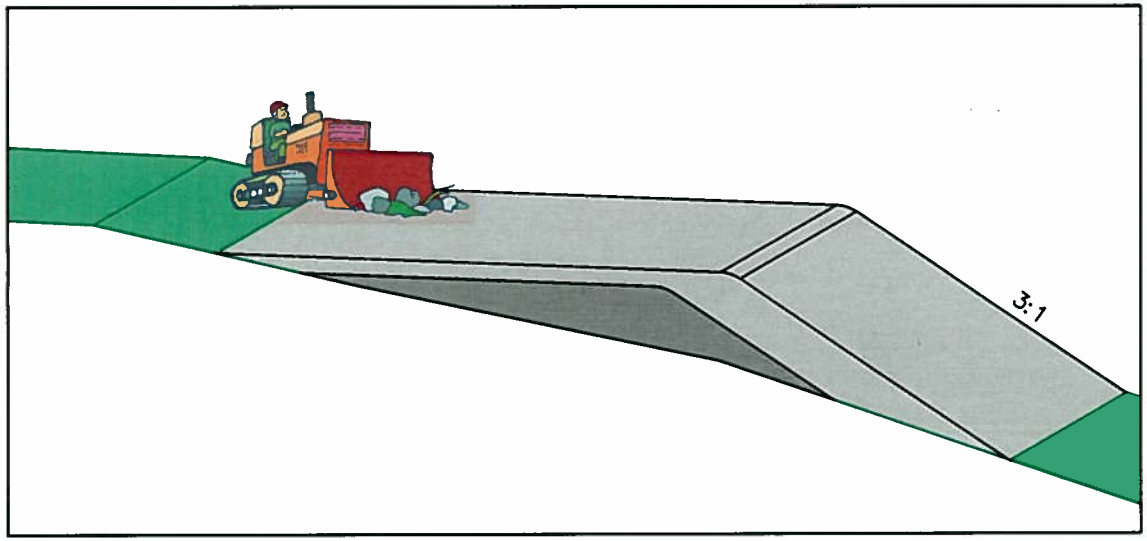
HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

COMPACTION



BURNED WASTE IS PUSHED ONTO THE FILL AREA.



WASTE IS SPREAD OVER A SMALL AREA AND COMPACTED BY MAKING SEVERAL PASSES WITH THE EQUIPMENT. LAYERS SHOULD BE 250mm TO 300mm (10 TO 12 inches) FOR OPTIMAL WASTE COMPACTION. 50mm TO 100mm (2 TO 4 inches) OF COVER SOIL IS ADDED WHEN AN AREA (cell) HAS BEEN FILLED PRIOR TO ADVANCING THE TIPPING FACE.

0.3m COVER BASE FOR ADVANCING

November 2008
Project Number: N-O14850

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

REVISION #: 1

14850 SOLID WASTE O&M PLAN COMPACTION.DWG

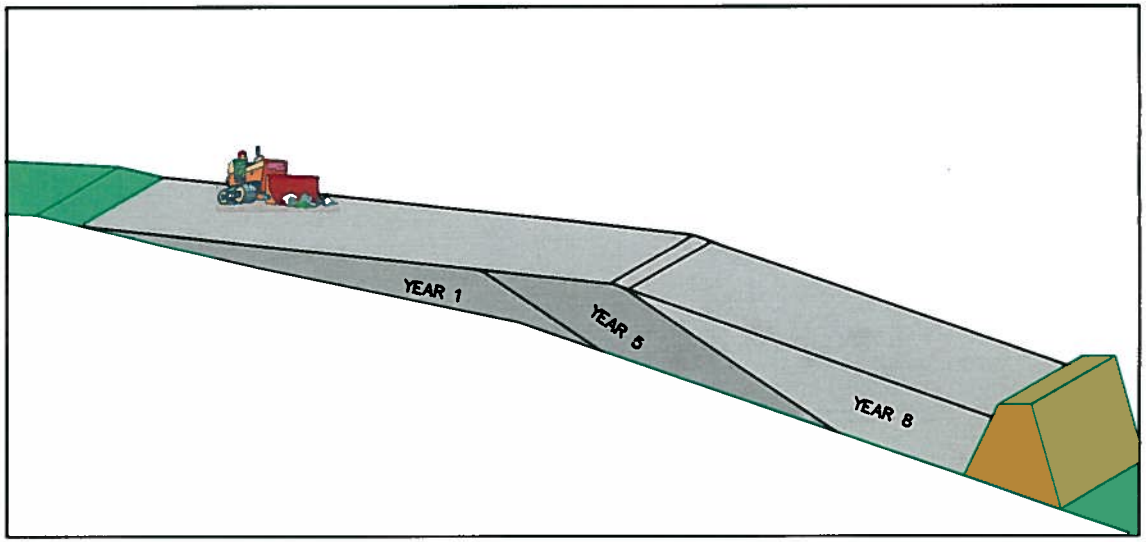
FIGURE 13

HAMLET OF RANKIN INLET

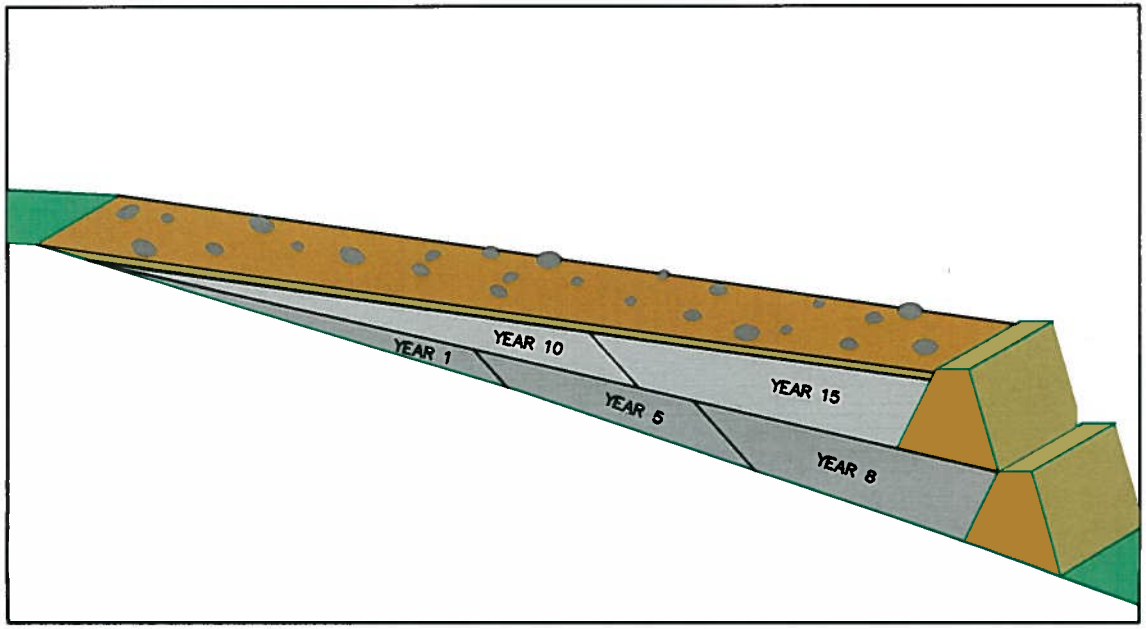
HAMLET OF RANKIN INLET, NUNAVUT

SOLID WASTE MANAGEMENT FACILITY O&M PLAN

PROGRESSIVE WASTE DEPOSITION & FINAL GRADING & CLOSURE



WASTE IS BUILT UP PROGRESSIVELY ACROSS THE SITE IN COMPACTED LAYERS MAINTAINING AN EVEN WORKABLE SLOPE NEVER EXCEEDING 3:1



THIS PROCESS CAN CONTINUE PROVIDED ENGINEERING REVIEWS ARE DONE TO CONFIRM STABILITY AND ENVIRONMENTAL CONDITIONS.

SITE CLOSURE WILL CONSIST OF 600mm OF THE MOST IMPERMEABLE COVER SOIL LOCALLY AVAILABLE . MAXIMUM SLOPE 3:1. THE SURFACE CAN BE STABILIZED WITH COBBLES AND ROCK TO RESEMBLE THE APPEARANCE AND CONDITION OF THE SURROUNDING TUNDRA.

November 2008
Project Number: N-O14850

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

REVISION #: 1 14851 SOLID WASTE O&M PLAN PROGRESSIVE DEPOSITS.DWG

BURNSIDE

Appendix A

Nunavut Water Board License

NWB3RAN0207

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

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYINKATIMAYINGI

DECISION

LICENCE NUMBER: NWB3RAN0207

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence dated 06 June, 2002 made by:

Hamlet of Rankin Inlet

to allow for the use of water and the disposal of waste at the Hamlet at Rankin Inlet, Nunavut.

With respect to this application, the NWB gave notice to the public that the Hamlet had filed an application for a water licence.

DECISION

After having been satisfied that the application was exempt from the requirement for screening by the Nunavut Impact Review Board in accordance with S. 12.3.2 of the *Nunavut Land Claim Agreement* (NLCA), the NWB decided that the application could go through the regulatory process.

Based on the review of the comments and concerns, it was noted that the issue of the operation of Water Treatment and Sewage Treatment Facilities in Rankin Inlet by the Department of Public Works and Services (Government of Nunavut) prevented the issuance of water licence to the Hamlet of Rankin Inlet for the operation of these Facilities. It was determined that the most appropriate action was to issue a water licence to the Hamlet of Rankin Inlet for the operation of the Solid Waste Disposal Facility, while the Department of Public Works and Services would be licensed for the operation of the Water Treatment and Sewage Treatment Facilities, on behalf of the Government of Nunavut.

Applications reflective of this division of activities were received from both the Hamlet of Rankin Inlet and the Department of Public Works and Services. Notice of these applications was posted with local organizations in Rankin Inlet. As the technical information previously reviewed remained unchanged, the Nunavut Water Board accepted written concerns and comments on these applications until December 6, 2002.

After reviewing the submission of the Applicant and written comments expressed by interested parties, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *Nunavut Land Claims Agreement*

and of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), decided to waive the requirement to hold a public hearing and furthermore to delegate its authority to approve the application to the Chief Administrative Officer pursuant to S. 49(a) of the NWNSRTA and determined that:

Licence Number NWB3RAN0207 be issued subject to the terms and conditions contained therein. (Motion #: 2002-21)

SIGNED this 1st day of December, 2002 at Gjoa Haven, NU.

Original signed by:

_____

Philippe di Pizzo
Chief Administrative Officer

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I. INTRODUCTION

Following an application filed by Ferguson Simek Clark on behalf of the Hamlet of Rankin Inlet on 6 June 2002 to the Nunavut Water Board, the Board conducted an initial assessment of the Hamlet's request for a municipal water licence for water use and waste disposal activities within the Hamlet. The assessment was conducted so that the Nunavut Water Board could make a fully informed decision on the application. The application was referred for review and comments to Federal, Territorial and local organizations. Based upon the results of this initial assessment and the technical review, including consideration of any potential accidents, malfunctions, or cumulative environmental effects that the overall project might have in the area, the Board concluded that this application was complete and could go through the regulatory process.

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 55.1 and Article 13 of the *Nunavut Land Claims Agreement*, public notice of the application was posted. No public concerns were expressed, and the NWB waived the requirement to hold a public hearing for the application. Authority to approve the application was delegated to the Chief Administrative Officer pursuant to S. 13.7.5 of the *Agreement*. After considering and reviewing the comments submitted by interested parties, the NWB has issued licence NWB3RAN0207.

II. GENERAL CONSIDERATIONS

Term of the Licence

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 45, the NWB may issue a licence for a term not exceeding twenty-five years. The NWB believes that a term of five years is appropriate. Because this is the first licence issued to the Hamlet by the Nunavut Water Board, a 5-year licence will allow enough time for the Hamlet to establish a consistent compliance record. The 5-year licence will allow the Licensee to properly carry out the terms and conditions of the licence and to ensure that sufficient time is given to permit the Licensee to develop, submit, and implement the plans required under the licence to the satisfaction of the NWB.

Annual Report

The requirements imposed on the Licensee in this licence are for the purpose of ensuring that the NWB has an accurate annual update of municipal activities during a calendar year. This information is maintained on the public registry and is available to any interested parties upon request. Refer to attached standard form for completing Annual Report (see Attachment I).

Regulated Parameters

Effluent quality criteria imposed in this Licence are consistent with the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* (Northwest Territories Water Board; 1992), and follow advice received from both the Department of Indian and Northern Affairs and Environment Canada.

Operation and Maintenance Manual (O&M)

The purpose of an Operation and Maintenance Manual is to assist Hamlet staff in the proper operation and maintenance of their waste disposal facilities. The manual should demonstrate to the Nunavut Water Board that the Hamlet is capable of operating and maintaining all waste disposal sites adequately. The Plan should be completed using the *Guidelines for the Preparation of an Operations and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996; see Attachment II).

Abandonment and Restoration (A&R)

To ensure that all future abandoned facilities are reclaimed in an appropriate manner, the NWB has imposed the requirement for the submission of Abandonment and Restoration Plans. These plans should be submitted when the Licensee files preliminary design drawings for the construction of new facilities to replace existing ones.

Monitoring Program

The Monitoring Program is a monitoring program established to collect data on water quality to assess the effectiveness of treatment for protection of public health and to assess potential impacts to the environment associated with the municipal facilities. As this is the first Municipal Water Licence issued to the Hamlet by the Board, minimum requirements have been imposed, but additional sampling may be required by an Inspector.

Quality Assurance/Quality Control (QA/QC) Plan

The requirements to develop a QA/QC Plan imposed on the Licensee in this licence are for the purpose of ensuring the NWB that samples taken in the field as part of the Monitoring Program will maintain a high quality, so as to accurately represent the physical and chemical nature of the samples being taken.

LICENCE NWB3RAN0207

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

HAMLET OF RANKIN INLET
(Licensee)

of **RANKIN INLET, NUNAVUT, X0A 0S0**
(Mailing Address)

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

Licence Number **NWB3RAN0207**

Water Management Area **NUNAVUT 05**

Location **RANKIN INLET, NUNAVUT**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to be Exceeded **400,000 CUBIC METRES ANNUALLY**

Date of Licence **DECEMBER 1, 2002**

Expiry Date of Licence **NOVEMBER 30, 2007**

Dated this 1st of December 2002 at Gjoa Haven, NU.

Original signed by:
Philippe di Pizzo
Chief Administrative Officer

PART A: SCOPE AND DEFINITIONS

1. Scope

a. This Licence allows for the use of water and the disposal of waste by the Hamlet of Rankin Inlet for municipal undertakings at the Hamlet of Rankin Inlet, Nunavut (64°49'N, 92°05'W);

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

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

2. Definitions

In this Licence: **NWB3RAN0207**

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

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

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

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

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

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

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

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

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

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

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

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

"Licensee" means the holder of this Licence;

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

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

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

"Sewage" means all toilet wastes and greywater;

"Sewage Treatment Facility" comprises the area and engineered lagoon and decant structures operated by the Department of Public Works on behalf of the Government of Nunavut which are designed to contain sewage as described in the Application for Water Licence;

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

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

"Water Supply Facility" means the area and associated intake infrastructure at Nipissar Lake, operated by the Department of Public Works on behalf of the Government of Nunavut, as described in the Application for Water Licence.

PART B: GENERAL CONDITIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7. The Licensee shall ensure a copy of this Licence is maintained at the Municipal office and at the site of operation at all times. Any communication with respect to this Licence shall be made in writing to the attention of:

(i) Chief Administrative Officer:

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

(ii) Inspector Contact:

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

(iii) **Analyst Contact:**

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

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

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from Nipissar Lake using the Water Supply Facilities operated by the Department of Public Works and Services on behalf of the Government of Nunavut, or as otherwise approved by the Board.

2. The annual quantity of water used for all purposes shall not exceed 400,000 cubic metres.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all solid waste to the Solid Waste Disposal Facility or as otherwise approved by the Board.

2. The Solid Waste Disposal shall be maintained and operated in such a manner as to prevent the entry of waste into water.

3. The Licensee shall maintain the Solid Waste Disposal Facility to the satisfaction of an Inspector.

4. The Licensee shall direct all sewage to the Sewage Treatment Facility operated by the Department of Public Works on behalf of the Government of Nunavut

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

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

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

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

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

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

   iv. the Board has not rejected the proposed modifications.

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

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

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall, before December 1, 2003 submit to the Board for approval, a plan for the Operation and Maintenance of the Solid Waste Disposal Facility in accordance with *"Guidelines for preparing an Operation and Maintenance Manual for Sewage and solid Waste Disposal Facilities"* (October 1996).

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

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

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

   i. employ the appropriate Contingency Plan as provided for in the Operation and Maintenance Plan;

   ii. report the incident immediately *via* the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and

   iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

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

   i. The Solid Waste Disposal Facility;

   ii. petroleum and chemical storage areas;

   iii. any site affected by waste spills;

   iv. leachate prevention;

   v. an implementation schedule;

   vi. maps delineating all disturbed areas, and site facilities;

   vii. consideration of altered drainage patterns;

   viii. type and source of cover materials;

   ix. future area use;

   x. hazardous wastes; and

   xi. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

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

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

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

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain a Monitoring Station at the following location:

Station Number	Description
RAN-2	Runoff from the Solid Waste Disposal Facility

2. The Licensee shall sample monthly at Monitoring Station RAN-2 during the months of May to August, inclusive.

3. The Licensee shall analyze samples collected at Station Number RAN-2 for the following parameters:

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

4. Additional sampling and analysis may be requested by an Inspector;

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

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

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

8. The Licensee shall record in cubic metres the monthly and annual quantities of water obtained from the Water Supply Facility for all purposes;

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

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

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

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Appendix B
Waste Quantity Calculations

Waste Quantity Calculations - Rankin Inlet, Nunavut

Waste Generation Rates Table
Key Assumptions

Starting Year: 2006 | Starting Population: 2358 | Population Growth Rate: 1.4%

% of waste that is combustible	20%	% of combustible waste remaining after burning	30%	% Decrease in volume of waster after compaction	30%	Cover Material Required per volume of garbage.	20%

Planning Year	Calendar Year	Projected Population [people]	Annual Volume of Solid Waste [m^3]	Cumulative Volume of Solid Waste [m^3]	Annual Volume of Combustible Solid Waste [m^3]	Annual Volume of Combustible Solid Waste After Burning [m^3]	Annual Volume of Uncombustible Solid Waste [m^3]	Total Annual Volume of Uncombustible and Combusted (Burned) Solid Waste [m^3]	Annual Volume of Compacted Waste [m^3]	Annual Volume of Cover Material [m^3]	Total Annual Volume of Compacted Waste and Cover Material [m^3]	Cumulative Landfill Volume [m3]
	2006	2358	12049.4	12049.4	2409.9	1686.9	9639.5	11326.4	7928.5	1585.7	9514.2	
	2007	2392	12223.1	24272.5	2444.6	1711.2	9778.5	11489.7	8042.8	1608.6	9651.4	
	2008	2426	12396.9	36669.4	2479.4	1735.6	9917.5	11653.0	8157.1	1631.4	9788.6	
0	2009	2460	12570.6	49240.0	2514.1	1759.9	10056.5	11816.4	8271.5	1654.3	9926	9,926
	2010	2495	12749.5	61989.4	2549.9	1784.9	10199.6	11984.5	8389.1	1677.8	10067	19,993
	2011	2530	12928.3	74917.7	2585.7	1810.0	10342.6	12152.6	8506.8	1701.4	10208	30,201
	2012	2566	13112.3	88030.0	2622.5	1835.7	10489.8	12325.5	8627.9	1725.6	10353	40,554
	2013	2602	13296.2	101326.2	2659.2	1861.5	10637.0	12498.4	8748.9	1749.8	10499	51,053
5	2014	2639	13485.3	114811.5	2697.1	1887.9	10788.2	12676.2	8873.3	1774.7	10648	61,701
	2015	2676	13674.4	128485.8	2734.9	1914.4	10939.5	12853.9	8997.7	1799.5	10797	72,498
	2016	2714	13868.5	142354.4	2773.7	1941.6	11094.8	13036.4	9125.5	1825.1	10951	83,449
	2017	2752	14062.7	156417.1	2812.5	1968.8	11250.2	13219.0	9253.3	1850.7	11104	94,553
	2018	2791	14262.0	170679.1	2852.4	1996.7	11409.6	13406.3	9384.4	1876.9	11261	105,814
10	2019	2831	14466.4	185145.5	2893.3	2025.3	11573.1	13598.4	9518.9	1903.8	11423	117,237
	2020	2871	14670.8	199816.3	2934.2	2053.9	11736.6	13790.6	9653.4	1930.7	11584.1	128,821
	2021	2912	14880.3	214696.7	2976.1	2083.2	11904.3	13987.5	9791.3	1958.3	11749.5	140,570
	2022	2953	15089.8	229786.5	3018.0	2112.6	12071.9	14184.4	9929.1	1985.8	11914.9	152,485
	2023	2995	15304.5	245090.9	3060.9	2142.6	12243.6	14386.2	10070.3	2014.1	12084.4	164,570
15	2024	3037	15519.1	260610.0	3103.8	2172.7	12415.3	14587.9	10211.5	2042.3	12253.9	176,824
Landfill Capacity Filled												
	2025	3080	15738.8	276348.8	3147.8	2203.4	12591.0	14794.5	10356.1	2071.2	12427.4	189,251
	2026	3124	15963.6	292312.4	3192.7	2234.9	12770.9	15005.8	10504.1	2100.8	12604.9	201,856
	2027	3168	16188.5	308500.9	3237.7	2266.4	12950.8	15217.2	10652.0	2130.4	12782.4	214,638
	2028	3213	16418.4	324919.4	3283.7	2298.6	13134.7	15433.3	10803.3	2160.7	12964.0	227,602
20	2029	3258	16648.4	341567.7	3329.7	2330.8	13318.7	15649.5	10954.6	2190.9	13145.6	240,748

Landfill Capacity

Large waste area excluding laydown area	74000 m2
Avg depth of first layer of waste	1.25 m
Avg depth of second layer of waste	1.25 m
Total Depth of Waste	2.5 m
Volume of Landfill Area	185,000 m^3

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Appendix C

Site Photographs

Photo 1: Gate and road into landfill

Photo 2: SWF area from top of outcrop. Looking North.

Photo 3: SWF elevated lay down area and fill area

Photo 4: Culvert on west side of landfill

Photo 5: Looking at north edge of SWF area from gate.

Photo 6: East side of landfill, wetlands outside of bermed area.

Photo 7: Culvert on east side of landfill, discharge point.

Photo 8: Wetlands outside of landfill on east side of fence.

Photo 9: Wetlands down gradient of landfill

Photo 10: Wetlands on north side of landfill berm

Photo 11: Animal Carcasses area

Photo 12: Sewage Screenings Sign

Photo 13: Non-Metal Bulky Waste Sign

Photo 14: Metal Bulky Waste Sign

Photo 15: Landfarm looking east.

Photo 16: Leachate drainage pipe, looking northwest.

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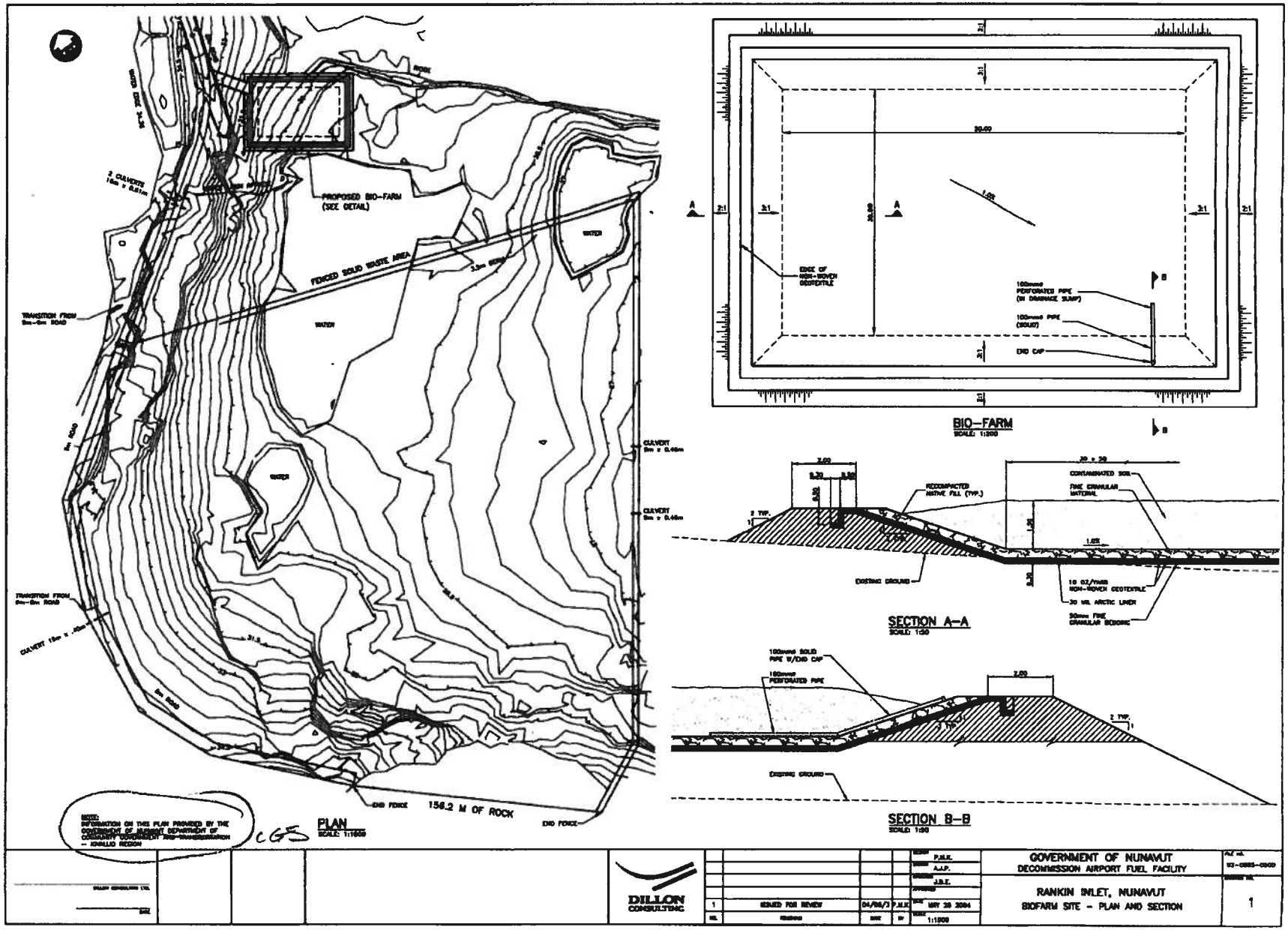
Appendix D

Landfarm Design Drawing

(Dillon Consulting)



NOTE:
INFORMATION ON THIS PLAN PROVIDED BY THE GOVERNMENT OF NUNAVUT DEPARTMENT OF COMMUNITY GOVERNMENT AND TRANSPORTATION – KIVALLIQ REGION

CGS

DILLON CONSULTING

1	ISSUED FOR REVIEW	04/06/3	P.M.K.	MAY 28 2004
			P.M.K.	
			A.J.P.	
			J.B.T.	

GOVERNMENT OF NUNAVUT
DECOMMISSION AIRPORT FUEL FACILITY

RANKIN INLET, NUNAVUT
BIOFARM SITE – PLAN AND SECTION

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BURNSIDE

Appendix E
Assessment of Potential Bird Hazards to Aircraft Safety Associated with the Proposed New Solid Waste Site

ASSESSMENT OF POTENTIAL BIRD HAZARDS TO AIRCRAFT SAFETY ASSOCIATED WITH THE PROPOSED NEW SOLID WASTE SITE — RANKIN INLET, NUNAVUT

by

Ross E. Harris and Rolph A. Davis

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for

Department of Community Government and Transportation
Government of Nunavut
P.O. Box 490
Rankin Inlet, Nunavut X0C 0G0

LGL Report No. TA2765-1

16 September 2002

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EXECUTIVE SUMMARY

The Government of Nunavut is proposing to re-locate the solid waste landfill at Rankin Inlet. Three locations for the new landfill have been proposed. The preferred location, Site S3, is approximately 2.7 km from the western end of the runway at the Rankin Inlet Airport and almost directly under the take-off/approach paths of aircraft. Landfills can attract large numbers of birds and create significant hazards to aircraft safety. Because of the close proximity and relative position of the proposed new landfill, the potential for it to create bird hazards to the safety of aircraft using the Rankin Inlet Airport needed to be addressed. LGL Limited, a specialist in the field, was retained by the Government of Nunavut to assess the potential safety risk. LGL Limited is one of the leading Canadian firms in the assessment of bird hazards to aircraft safety having over 30 years of experience with the issue.

LGL's conclusion is that the preferred site, S3, is potentially hazardous and is <u>not</u> acceptable for a landfill having regard for potential bird hazards to aircraft safety. Of the two alternate proposed sites, Site S1, the most southerly, is the preferred option with regard for potential bird hazards. However, it is still relatively close to the airport and therefore we recommend that some mitigation measures be undertaken.

INTRODUCTION

The Government of Nunavut is proposing to re-locate the solid waste landfill at Rankin Inlet. The existing landfill is located about 1.1 km from the east end of the main runway at the Rankin Inlet Airport. The proposed location for the new landfill is approximately 2.7 km from the western end of the runway at the Rankin Inlet Airport and almost directly under the take-off/approach paths of aircraft (Figure 1). Landfills can attract large numbers of birds, which can in some circumstances create significant hazards to aircraft safety. Because of the close proximity and relative position of the proposed new landfill, the potential for it to create bird hazards to the safety of aircraft using the Rankin Inlet Airport needed to be addressed. LGL Limited, a specialist in the field, was retained by the Government of Nunavut to assess the potential safety risk. LGL Limited is one of the leading Canadian firms in the assessment of bird hazards to aircraft safety having over 30 years of experience with the issue.

Bird hazards to aircraft safety occur when birds and aircraft occupy the same airspace at the same time. When birds are struck by aircraft they can damage the aircraft, particularly if flocks of birds are ingested into jet engines. In the latter case, the safety of the aircraft and its passengers can be jeopardized. However, not all birds create important hazards to aviation safety. Although impacts with individual small birds can damage aircraft, these strikes are less likely to create a safety risk. The most critical risks involve birds that either are large enough, and/or that occur in flocks in sufficient numbers, to interfere with the operation of the aircraft, if struck. Safety hazards are often created when high-risk birds cross aircraft flight routes as the birds fly between a feeding area (such as a landfill site) and a loafing area, nesting colony, or night roost. Those areas can be many kilometres apart. Consequently, the sources of hazardous birds can be near or distant from the airport itself.

This report presents the results of a field study at Rankin Inlet conducted by LGL Limited to assess the potential bird hazards to aircraft safety associated with the proposed new landfill site and two alternate sites.

STUDY AREA

The Hamlet of Rankin Inlet is a community of approximately 2,500-3,000 people situated along the west-central coast of Hudson Bay. The town is located near the end of the Kudlulik Peninsula and is surrounded by numerous bays and offshore islands (Figure 1). Much of the coastline is exposed bedrock or gravel beach. The land around Rankin Inlet is low-arctic tundra. The rolling landscape consists of sparsely-vegetated rocky ridges, outcrops and eskers interspersed with more richly-vegetated, wet lowlands. Lakes and ponds are scattered throughout the lowlands. Below are descriptions of those features around Rankin Inlet that are pertinent to this study. Their locations are mapped on Figure 1.

Rankin Inlet Airport

The Rankin Inlet Airport is situated along the western edge of the community (Figure 1) and serves jet as well as turboprop and piston-engined fixed-wing aircraft, and helicopters. The 6,000–ft long paved and insulated runway is oriented approximately northwest-southeast (310°-130°). There are approximately 800 jet (B727 and B737), and 6,500 turboprop and piston-

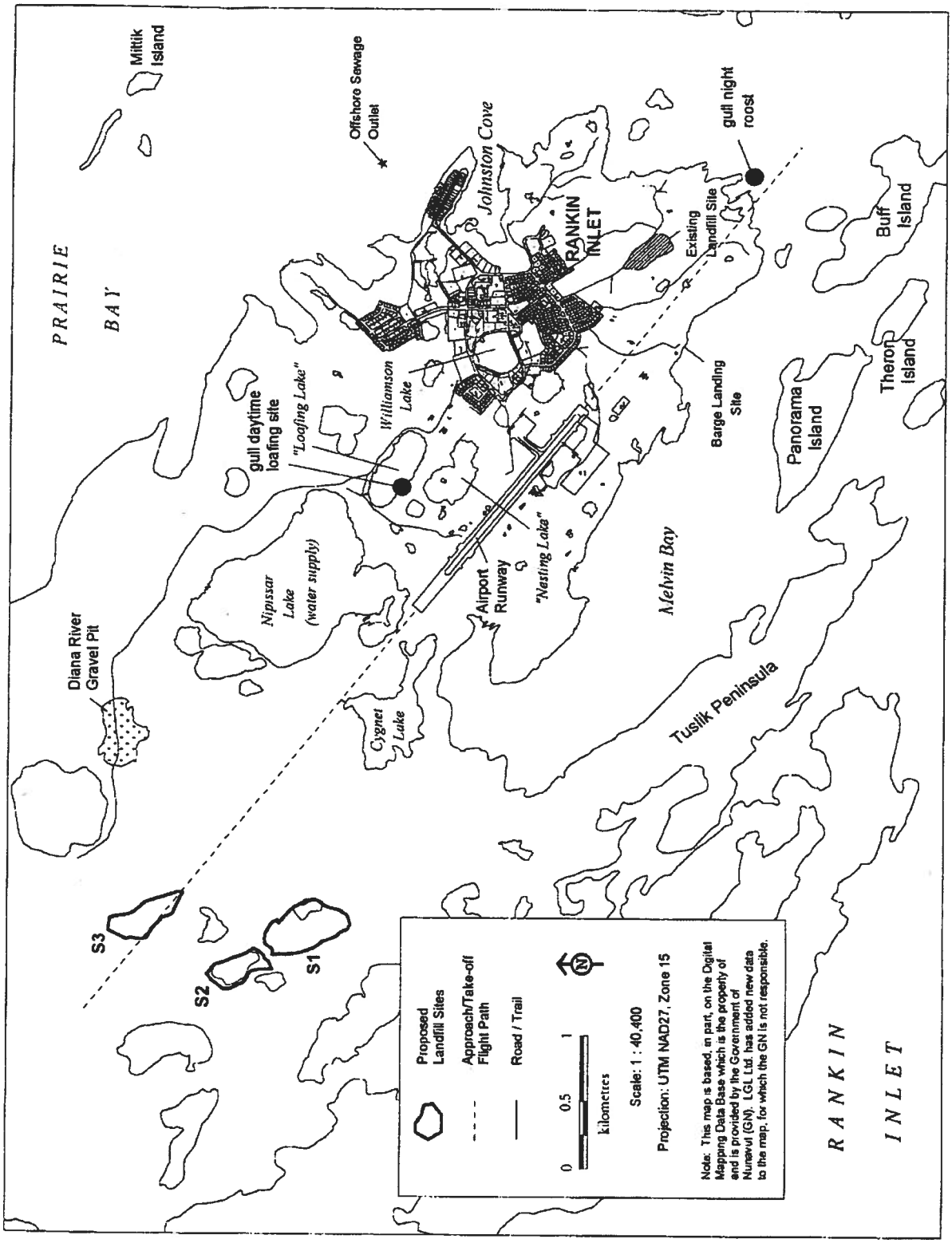

Figure 1. Map of the study area showing the existing and proposed landfill sites, the Rankin Inlet Airport, and gull daytime loafing site and night roost.

engined aircraft movements per year (J. Corbeil, Department of Community Government and Transportation, Government of Nunavut, pers. comm.). (A landing or a take-off is one aircraft movement.) The majority of aircraft (70-80%) take-off and approach into the prevailing wind, on runway 31 to the northwest (Jake Punshon, Nav Canada, pers. comm.).

Existing Landfill Site

The solid waste site in current use is situated approximately 1 km south of the residential area of the community (Figure 1). The nearest edge of the landfill is about 1,062 m southeast of the south end of the runway, and 242 m perpendicular from the approach/take-off flight paths of aircraft using the Rankin Inlet Airport. The 5 ha modified solid waste landfill is bermed and fenced. Domestic waste is collected and deposited at the landfill by Hamlet vehicles five days per week, Monday to Friday. Residents also have 24-hour/7-day per week access to the site to drop off garbage. Although the site is described as a modified landfill, with periodic but not daily compaction and cover, apparently very little is done to manage the landfill site. The waste is occasionally compacted and covered, and has been burned at times over the years. However, the public scavenges through the waste. This means that much of the waste still is exposed and there is plenty of food waste available for birds to feed on.

The current plan is for the existing landfill site to be de-commissioned by late August 2003. That process will include the removal of hazardous wastes and complete coverage of the waste with gravel (Ron Roach, Senior Administrative Officer, Rankin Inlet, pers. comm.).

Sewage Treatment

Most sewage is collected by the town's system of underground pipes and treated at an indoor sewage treatment facility. There the sewage is screened. The screened solids are disposed of in a separate pit at the existing landfill site; the remainder is pumped offshore through a pipe and released approximately 450 m out in Prairie Bay at about 10 m depth. There is some upwelling of the outflow at that point offshore. There are no outdoor sewage ponds at Rankin Inlet.

PROPOSED NEW LANDFILL SITE

The process of re-locating the solid waste disposal facility initially considered what disposal option–landfilling, incineration, or baling–should be recommended. Based primarily on cost issues, landfilling was the selected option. Site selection for the new landfill was constrained by several factors before the aircraft safety issue was addressed. These were the need (1) to keep the landfill out of the same watershed as the Hamlet's water supply (Nipissar Lake), (2) to avoid watersheds that drained into nearby Prairie Bay (because of concerns regarding fisheries from the Department of Fisheries and Oceans), (3) to avoid areas to the north and northwest where many residents had cabins and where the Territorial park was located, and (4) to minimize construction and operational costs.

Three sites were selected as potential locations for the new landfill (Figure 1; Stanley and NorthTech. 1999). [Sites S1 and S2 are labelled on Figure 1 to match the labelling used in the

Stanley and NorthTech report. In mapping prepared by Ferguson Simek Clark, the labelling of S1 and S2 is reversed.] All three are to the northwest of the airport and are clearly visible from the airport. All are in the watershed draining into Cygnet Lake and Melvin Bay. The terrain at the proposed sites is similar to the surrounding landscape—rocky ridges and outcrops interspersed with wet lowlands, lakes and ponds. Other features of the three proposed sites are summarized in Table 1, below.

Table 1. Areas, and distances relative to the airport and aircraft flight paths, for the three proposed landfill sites and the existing landfill site at Rankin Inlet.

Site	Surface Area (ha)	Distance from nearest edge to nearest end of runway (m)	Perpendicular distance from centre-line of aircraft take-off/approach flight path (m)
S1	14.3	2,206	654
S2	4.97	2,687	503
S3	7.6	2,707	0
Existing	5.0	1,062	242

Site S3 was selected as the preferred site. This was based primarily on it having the lowest capital and operational costs. The recommendation was for this site to be managed as a modified solid waste landfill. A modified landfill differs from a sanitary landfill in the frequency of application of cover material. Cover is applied daily at a sanitary landfill site. For Site S3 it was recommended that waste be covered with a 0.3 m thick granular cover twice per year, in the spring and autumn. Ten additional times per year one day is taken to level and compact material using earthmoving equipment (Stanley and NorthTech 1999).

It is planned that the new site will begin accepting waste in early August 2003 and will operate for the next 20 years. Access to the new site will be controlled. Unlike at the existing landfill site where the public can enter the site at any time to deposit garbage and to scavenge, access to the new landfill site will be limited to Hamlet waste vehicles and to the public on a supervised basis only (Ron Roach, pers. comm.).

STUDY METHODS

Bird use of the proposed new landfill likely will be similar to bird use of the existing landfill. Consequently, our field study focussed on documenting the types and numbers of birds that used the existing landfill and those birds' daily movement patterns. It was conducted at Rankin Inlet during 25-29 August and 2-3 September 2002. The field study documented bird use of the existing landfill site, identified other sites used by landfill-related birds, and determined the pertinent movement patterns of those birds. Most attention was given to the larger and

flocking species that could be attracted by the waste. Large flocking species such as geese can cause significant risks to aircraft but they were not considered during our study because they are not attracted to the waste at landfills. Because bird use of the landfill site changes seasonally, this field study provided only a snapshot of the annual cycle of bird use. Information on other periods of the year, for example during the spring migration and summer nesting periods, was sought through discussions with local naturalists and observers.

Existing Landfill Site

Visits were made to the existing solid waste facility during 25-28 August 2002 as follows—25 August: 15:47-17:00; 26 August: 11:00-11:18, 19:38-21:30; 27 August: 10:00-11:14, 21:00-21:28; and 28 August: 08:42-10:54. Counts were made of the numbers, species and ages of gulls at the landfill site and nearby, and the movement patterns of gulls to and from the landfill site were documented.

Proposed New Landfill Site

The site and surrounding area of the proposed new landfill (Site S3) were visited during 26 and 28 August 2002. The general habitat of all three possible landfill sites was documented.

Rankin Inlet Airport

Two tours of the Rankin Inlet airfield were conducted, during 26 August (10:30-10:55) and 3 September (approximately 14:00-14:15). Those consisted of drives along the runway and scans of adjacent lakes, ponds, and land. Additional information on bird use of, and existing bird hazards at the Rankin Inlet Airport was obtained from Allyn Burrill, Airport Maintenance Foreman. Jake Punshon, with Nav Canada at the Rankin Inlet Flight Service Station, was interviewed regarding aircraft movements at the airport.

Other Areas

Several other areas around Rankin Inlet were surveyed during 25-29 September. These included Prairie Bay and Johnstone Cove along the east side of the Kudlulik Peninsula (27 and 28 August), Melvin Bay along the west side of the peninsula (29 August), waters and islands offshore from the tip of the peninsula (25-28 August), Williamson Lake in town (27-29 August), and areas inland along the road system north and northwest of the community (25-29 August). Late-day observations, from approximately sunset to dark, were made to determine where gulls stayed overnight, the night roost. These included observations from the existing landfill (26 August: 19:38-21:30; 27 August: 21:00-21:28), and from a regular daytime gull resting area (27 August: 20:08-20:53; see below). All gulls in an area tend to gather at dusk and stay in a tight flock overnight, usually on a large body of water.

Interviews

Discussions were held with several people to collect more information and to gain a better understanding of airport operations, local bird hazards to aircraft safety, bird migration,

bird numbers and distribution; waste collection and sewage treatment. These people are listed in the Acknowledgements.

RESULTS

At Rankin Inlet, gulls and Common Ravens are the birds that frequent the landfill. Gulls are present each year in the Rankin Inlet area during the period from late May/early June to freeze-up, which occurs usually about early October. They are most abundant around Rankin Inlet during the spring migration in June (D. McLarty, pers. comm.). Ravens are present most commonly and abundantly during the winter months. It is unclear how many ravens generally are present at the existing landfill and around Rankin Inlet during winter. However, the number may be low—only 10 Common Ravens were counted during the first Christmas Bird Count at Rankin Inlet on 30 December 2001 (website: www.birdsource.org). Gulls were seen during our late summer field study but no Common Ravens were recorded. Two species of gulls were observed—Herring Gulls and a Great Black-backed Gull. Herring Gulls are the most abundant gull in the region. A very similar-looking species, Thayer's Gull, also occurs in the region and may have been present in small numbers but undetected. The Great Black-backed Gull was a rare and unexpected discovery, seen only on 27 August. Almost all gulls (>95%) were in adult plumage or within a year of adult plumage. (Herring Gulls attain their adult plumage when four years old. This is the plumage they will retain for the rest of their lives. Herring Gulls younger than four years have plumages that are distinct from that of adults and that differ with each year of age, gradually becoming more adult-like. Almost all gulls seen at Rankin Inlet during this field study were at least three years old.)

Existing Landfill Site

Observations of gulls and other birds at the existing landfill site were made every day during 25-28 August 2002. Gulls were observed to feed and loaf at the landfill site itself, and to loaf adjacent to the landfill on rocky outcrops and along the coast directly to the southeast. (Loafing refers to gulls that are resting, sleeping, preening, bathing, and/or drinking. This behaviour typically is seen in flocks of gulls that are gathered at a particular resting site.) There was a regular movement of small numbers of gulls (usually 1-3 gulls at a time) between those loafing sites and the landfill site, and of small numbers of gulls to and from the northwest, throughout the day. Those gulls flew at altitudes above ground level (agl) ranging from about 50 to 100 feet (~17-33 m). Occasionally gulls were observed to flush from the landfill and circle above and adjacent to the landfill at approximately 50-100 feet agl.

Counts of gulls at and near the landfill, including gulls at the adjacent loafing sites (gulls which were also using the landfill), during the 25-28 August period averaged 204 gulls, and ranged from 140 to 282. Also recorded at the landfill site were flocks of migrating Horned Larks, American Pipits, and Lapland Longspurs. It was difficult to estimate accurately the total numbers of these small songbirds in and adjacent to the landfill site, but there were approximately 40-60 birds at any one time.

Other Day-Use Areas

Aside from the existing landfill site, there was only one other site where a concentration of gulls was observed regularly during the daytime. This was a loafing site on the shore of a lake near the airport (see "Loafing Lake" on Figure 1). A flock of gulls was observed there consistently during the daytime during the 25-29 August period. Gulls rested, slept, bathed, preened, swam, and drank at "Loafing Lake". Seven counts of gulls at "Loafing Lake" during the study period averaged 46 gulls and ranged from 30 to 59. Gulls were observed on several occasions arriving from the southeast and departing from that group to the southeast. Those gulls flew low, usually at altitudes of 50-100 ft. The existing landfill site is situated southeast of the "Loafing Lake".

Although gulls regularly were observed elsewhere throughout the area in and around Rankin Inlet, no other regular concentration areas were discovered. Only on 27 August, 20 gulls were seen on Buff Island offshore to the south of Rankin Inlet. Prairie Bay was scanned specifically to see whether gulls were attracted to the offshore sewage outflow, but very few gulls (maximum count 3 Herring Gulls) were seen anywhere in Prairie Bay or Johnstone Cove. However, Wade Lovell (Municipal Technical Officer, Department of Community Government and Transportation, pers. comm.) said that he had seen small numbers of gulls (<5) occasionally in the vicinity of the sewage outflow. A total of six gulls, all flying overhead, were seen from the barge landing site at Melvin Bay on 29 August; no gulls were observed on the water or shorelines. No gulls were seen at Williamson Lake in the centre of the community.

The area of the proposed new landfill site (S3) and the two alternate sites (S1 and S2) was visited during 26 and 28 August 2002. During these visits very few gulls were detected (<10 each visit, all flying low over the area). One or two gulls were seen occasionally on some of the inland lakes to the north and northwest.

Allyn Burrill (pers. comm.) reported that there had been a nesting colony of gulls on a small, low, grassy island on a lake immediately north of the runway (see "Nesting Lake" on Figure 1). During 2002, he had his staff destroy all nests (~70-80) on that island to reduce the risks to aircraft safety at the airport. Only small numbers of gulls (4 counts: range 0-4 gulls) were observed at "Nesting Lake" during the study period. It is possible that the gulls that used "Loafing Lake" (see above) were the same birds that had been nesting on the adjacent "Nesting Lake" before their nests were destroyed.

Gull Night Roost

Observations were made at dusk at the existing landfill site (26 and 27 August) and at "Loafing Lake" (27 August) of gulls flying to their night roost. During the evening of 26 August (19:38-21:30), gulls were seen departing the landfill and flying southeast the short distance to the coast. There the gulls gathered on the shore and on a small rocky islet just offshore (Figure 1). At dark, when the gulls were barely visible through binoculars, all gulls appeared to have moved to the rocky islet. Also during this observation period, small groups of gulls were observed flying from the northwest over the landfill toward the group of gulls gathering on the coast.

During the evening of 27 August (20:08-20:53), 59 gulls were loafing at "Loafing Lake". Occasionally one or two gulls departed from the group toward the southeast. At 20:53 all remaining gulls took off and flew southeast toward the coast, toward the tip of the peninsula where the gulls from the landfill were seen gathering the previous evening. A subsequent drive to the landfill revealed that gulls were once again gathered on the coast and the rocky islet immediately to the southeast of the landfill.

Rankin Inlet Airport

During the two tours of the Rankin Inlet airfield, small numbers of geese, ducks and small passerines were observed. A flock of seven Mallards was swimming in the pond immediately off the end of Runway 13, and there were small flocks of migrating Horned Larks, American Pipits, and Lapland Longspurs moving through, during the airfield tour on 26 August. A flock of 14 Canada Geese flushed from a pond near the terminal building during 3 September.

Migrating waterfowl are the principal existing bird hazards to aircraft safety, particularly during the spring migration (Allyn Burrill, pers. comm.). Ducks, geese and swans use nearby lakes for staging, and often fly low through the general area. In particular, ponds immediately off the southeast end of the runway, and northeast of the southeast end of the runway attract potentially hazardous waterfowl at times (Figure 1). Flocks of small passerines—Horned Larks, American Pipits, Lapland Longspurs, and Snow Buntings—occasionally frequent the airfield, especially when the snow free runway and runway edges provide one of the few areas of bare ground early in the spring.

Only two bird strikes at the Rankin Inlet Airport have been reported to the Transport Canada birdstrike database since 1984. A Canada Goose on 28 August 1995 was struck by a Boeing 737 during its landing roll on Runway 13, and "sparrows" were struck by a Boeing 737 on approach to Runway 13 on 28 August 2001 (Bruce MacKinnon, Transport Canada, pers. comm.). ("Sparrows" probably refers to Horned Larks, American Pipits, Lapland Longspurs, and/or Snow Buntings.) Arctic Ground Squirrels possibly are responsible for more strikes than birds, but those strikes tend to go unreported (Jake Punshon, pers. comm.).

ASSESSMENT OF BIRD HAZARDS TO AIRCRAFT SAFETY

The birds that are most likely to use the proposed new landfill, and that also would pose important hazards to aircraft safety at Rankin Inlet Airport, are Herring Gulls and Common Ravens. During spring and fall migration, Thayer's Gulls and Glaucous Gulls are also likely to be present. Common Ravens would occur at the landfill primarily during the late autumn/winter/early spring period; however, it appears that the total numbers of ravens are low. Gulls occur in the area from late May/early June through freeze-up in late September/early October. Based on observations made during this field study, up to approximately 300 gulls could be attracted to the proposed new landfill and adjacent areas during summer. More are reported during migration (e.g. S.R. Johnson, LGL Limited, pers. comm., observed 430 gulls at the existing landfill in mid September 1995). Therefore, gulls are the primary bird hazard to aircraft safety at the proposed new landfill site. Gulls only create a risk to aircraft safety when they are in the same airspace as an aircraft at the same time. At a landfill site, the primary

situations when gulls can move into the same airspace as aircraft are (1) when they flush from the ground on the landfill or soar over the landfill, (2) when flying from the night roost to the landfill at dawn and returning to the night roost at dusk, and (3) when flying between off-site daytime loafing areas and the landfill site. Daytime loafing sites used by gulls associated with a landfill site usually will change if the landfill site is moved. However, a night roost tends to be more traditional and often continues to be used even if the landfill is moved.

This assessment of potential bird hazards to aircraft safety associated with the proposed new landfill site at Rankin Inlet must consider the numbers and movement patterns of hazardous birds. The assessment must also consider the planned 20-year lifespan of the new landfill site, the fact that jet and turboprop aircraft use the Rankin Inlet Airport, and the likelihood that air traffic will undoubtedly increase during the next 20 years. Jet aircraft are more susceptible to serious bird strikes than are turboprop and piston-engined aircraft. The following sections discuss the potential bird hazards associated with the preferred (S3) and alternate (S1 and S2) proposed landfill sites compared with hazards associated with the existing site.

Existing Landfill Site

The existing landfill site is located about 1.1 km off the southeast end of the runway and slightly off the approach heading to Runway 31. Most (70-80%) aircraft land and depart from the airport heading to the NW on Runway 31. Thus, most aircraft landing at Rankin Inlet pass the existing landfill at elevations of only a few hundred feet. Also, gull flights from the landfill to the night roosting area take the gulls directly into the aircraft approach path. Thus, the existing landfill site creates a bird hazard risk to the safety of aircraft using the Rankin Inlet Airport.

Proposed Landfill Site S3

The proposed new landfill site, S3, is about 2.7 km from the NW end of the runway at the Rankin Inlet Airport and effectively directly under the take-off/approach path of aircraft using the airport. Thus, Site S3 will attract several hundred gulls to a location directly under the aircraft approach/departure path to the airport. This is a potentially hazardous situation. The hazard is somewhat mitigated by the fact that only a small percentage (20-30%) of aircraft approaches are to the SE on Runway 13. Thus, relatively few descending aircraft will pass over S3 but they will be at altitudes of about 500 ft above ground, which is well within the range of flying and soaring gulls. On take-off, aircraft climb quickly and they will usually be at safe altitudes when they cross over Site S3 after a take-off from Runway 31.

If gulls continue to use the same night roost southeast of the community, they may fly en route to and from the landfill at S3 at dawn and dusk by travelling over the runway and through the aircraft approach/departure paths. When gulls at the proposed new landfill flush, perhaps in response to a sudden loud noise from a bulldozer or garbage truck, they will fly up into the approach/departure paths used by aircraft. Important hazards to aircraft safety are created in both cases—gulls en route to and from the night roost, and gulls flushed at the landfill site itself. It is unclear where gulls using Site S3 would loaf during the day. Some likely would remain on or adjacent to the landfill site itself. However, some likely would move offsite—possibly to

"Loafing Lake" but probably to a closer freshwater lake where they could bathe and drink. Flightlines used by the gulls to travel between S3 and an off-site daytime loafing area could also bring gulls into airspace used by aircraft on approach or take-off.

Alternate Sites - S1 and S2

Two alternate sites for the new landfill have been proposed (Figure 1). Site S1 is about 2.2 km from the NW end of the runway and offset from the approach path by a perpendicular distance of 650 m. Site S2 is about 2.7 km from the NW end of the runway and offset from the approach path by 500 m. Neither site is directly under the aircraft approach/departure path. Thus, gulls flushing from either site would not be flying up directly into aircraft on approach.

Gulls usually continue to use the same night roost year after year. When gulls fly to and from their roosts they generally fly the shortest and most direct route to the large waterbody that the night roost is on, then fly over that waterbody to the night roost, rather than flying directly overland to the night roost itself. Therefore, gulls feeding at a landfill at Site S1 or S2 will fly directly to the NW end of Melvin Bay and then follow that bay to the night roost. That gull flightline would keep gulls away from the runway and from the aircraft approach/departure paths.

It is not certain where gulls using a landfill at either S1 or S2 would loaf. Some would loaf at the landfill and others would probably use one of the small freshwater lakes nearby. In particular, gulls feeding at a landfill at Site S1 are most likely to loaf at the lake immediately to the southwest (Figure 1). In 2002, gulls used the "Loafing Lake". This use was thought to be related to the fact that they had nested at "Nesting Lake" before their nests were destroyed. It will be necessary to insure that no nesting occurs in the future and that gulls are harassed from the area of "Nesting Lake". If gulls continued to use "Loafing or Nesting Lake", those birds could cross the aircraft approach/depature path en route to a landfill at Site S1 or S2. However, the freshwater lakes closer to S1 and S2 are more likely to be used by loafing gulls and that would not necessitate gulls crossing aircraft flightpaths.

Recommended Landfill Site

We conclude that Site S3 is <u>not</u> acceptable for a landfill having regard for potential bird hazards to aircraft safety. Although it is the proposed site most distant from the airport, its position under the aircraft approach/departure path would attract gulls and other birds into too close proximity to aircraft.

Of the two alternate proposed sites, Site S1, the most southerly, is the preferred option with regard for potential bird hazards. Site S1, although somewhat closer to the runway, is the site most offset from the aircraft approach/departure path. This reduces the risk of birds flying up into approaching aircraft and creates a gull flight path to and from the night roost that does not impinge on the runway or aircraft approach/departure routes.

Mitigation Measures

Site S1 is the best of the three proposed sites from a bird hazard to aircraft safety perspective. However, it is still relatively close to the airport and from that perspective it is not the ideal site. Therefore, we recommend that some mitigation measures be undertaken.

It is planned that the new landfill be operated using improved techniques. This is important particularly as it relates to the application of cover material over the exposed waste. The plans call for compaction of the waste and application of 0.3 m of granular cover in the spring and the fall. The plans also call for levelling and compaction of the waste material using earthmoving equipment an additional 10 times per year. Applying cover material only twice per year will not effectively minimize the amount of food waste that is available to gulls. With respect to mitigating bird hazards, sufficient cover material should be applied at least four times during the period when gulls are present in Rankin Inlet (June through September). The initial application should occur in late May to cover the waste before the gulls return in the spring. Subsequently, cover should be applied again in late June, late July and late August. We also recommend that, with regard for mitigating bird hazards, three of the 10 levellings-and-compactions occur during the summer—mid June, mid July, and mid August.

The nesting colony on "Nesting Lake" must be discouraged. Any nests that are present should have the eggs destroyed as was done in 2002. If the gulls persist in the vicinity of "Nesting Lake" and "Loafing Lake", then it may be appropriate to kill a small number of the most persistent individuals to encourage the others to abandon this area. A permit from the Canadian Wildlife Service is necessary for this action. If these gulls persist in the vicinity, then it may be necessary to have a qualified expert in bird hazards to aircraft safety assist in their removal. Also, the expert should insure that all of the conclusions reached in this risk assessment were valid and that no safety hazards have been created that would require further mitigation measures.

Finally, it was noted that there is a small pond that is immediately adjacent to the SE end of the runway. Birds attracted to this pond create a hazard to aircraft using the main runway. Although these birds are not related to the landfill, they do create a hazard and we recommend that this pond be filled to eliminate this hazard.

ACKNOWLEDGEMENTS

Several people with the Government of Nunavut, Department of Community Government and Transportation, in Rankin Inlet, were most helpful. This study was much improved because of their assistance. First and foremost we thank Jean Corbeil (Municipal Planning Engineer - Kivalliq Region) for contacting us about the project and for providing much logistical help. Wade Lovell (Municipal Technical Officer) went out of his way to ensure that logistics were taken care of, sites visited, and questions answered during Ross Harris' stay in Rankin Inlet. Productive discussions were held with Tom Rogers (Manager Transportation Programs - Kivalliq) regarding the Rankin Inlet Airport, airport zoning, and aircraft movements. Robert Chapple (Senior Community Planner) provided mapping files and air photos that made the task of preparing maps for this report much easier. Sheila Sharp (Receptionist) arranged for a rental vehicle and patiently answered all of our many questions about where to find things.

At the Rankin Inlet Airport, Allyn Burrill (Airport Maintenance Foreman, Hamlet of Rankin Inlet), provided two tours of the airfield and kindly discussed bird hazards at the airport and the issue of landfill site selection. Jake Punshon, with NavCanada at the Rankin Inlet Flight Service Station, answered questions about aircraft movements and flight patterns at the airport. Bird strike records for the Rankin Inlet Airport were obtained from the Transport Canada database courtesy of Bruce MacKinnon. Information on local bird occurrence and abundance was kindly provided by Doug and Karen McLarty, local naturalists and photographers. Keith Pelly of the federal Department of Fisheries and Oceans discussed local fisheries and their possible influence on local gull abundance, distribution, and movements. Walter Orr and Rodney Harrington of Ferguson Simek Clark, Engineers and Architects, in Yellowknife kindly provided digital map files on short notice from their report on the Rankin Inlet landfill.

At LGL Limited, we thank Mark Fitzgerald for preparing the map and distance measurements and Anne Wright for report preparation.

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BURNSIDE

Appendix F
Canadian Environmental Quality Guidelines

Canadian Water Quality Guidelines for the Protection of Aquatic Life

SUMMARY TABLE

Update 7.0
September 2007

Summary of Canadian water quality guidelines for the protection of aquatic life.

	Freshwater		Marine	
Parameter[a]	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**
Acenaphthene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Acridine [See Polycyclic aromatic hydrocarbons (PAHs)]				
Aldicarb	1[c]	1993	0.15[c]	1993
Aldrin + Dieldrin[d]	~~0.004~~[e,f]	1987		
Aluminium[d]	5–100[g]	1987		
Ammonia (total)	see factsheet	2001		
Ammonia (un-ionized)	19[h]	2001		
Aniline	2.2[i]	1993	Insufficient data	1993
Anthracene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Arsenic[j]	5.0[k]	1997	12.5[c]	1997
Atrazine	1.8[i]	1989		
Benz*(a)*anthracene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Benzene[j]	370[c, k]	1999	110[c]	1999
Benzo*(a)*pyrene [See Polycyclic aromatic hydrocarbons (PAHs)]				
2,2-Bis(*p*-chlorophenyl)-1,1,1-trichloroethane [See DDT (total)]				
Bromacil	5.0[c,i]	1997	Insufficient data	1997
Bromoform [See Halogenated methanes, Tribromomethane]				
Bromoxynil	5.0[i]	1993	Insufficient data	1993
Cadmium	0.017[c,l]	1996	0.12[i]	1996
Captan	1.3[c]	1991		
Carbaryl	0.20[i]	1997	0.32[c,i]	1997
Carbofuran	1.8[i]	1989		
Carbon tetrachloride [See Halogenated methanes, Tetrachloromethane]				
Chlordane[d]	~~0.006~~[e,f]	1987		
Chlorinated benzenes				
Monochlorobenzene	1.3[c,k]	1997	25[c,k]	1997
1,2-Dichlorobenzene	0.70[c,k]	1997	42[c,k]	1997
1,3-Dichlorobenzene	150[c,k]	1997	Insufficient data[k]	1997
1,4-Dichlorobenzene	26[c,k]	1997	Insufficient data[k]	1997
1,2,3-Trichlorobenzene	8.0[c,k]	1997	Insufficient data[k]	1997
1,2,4-Trichlorobenzene	24[c,k]	1997	5.4[c,k]	1997
1,3,5-Trichlorobenzene[d]	Insufficient data[k]	1997	Insufficient data[k]	1997

Continued.

Parameter[a]	Freshwater		Marine	
	Concentration ($\mu g \cdot L^{-1}$)	Date[b]	Concentration ($\mu g \cdot L^{-1}$)	Date[b]
Chlorinated benzenes—Continued				
1,2,3,4-Tetrachlorobenzene	1.8[c,k]	1997	Insufficient data[k]	1997
1,2,3,5-Tetrachlorobenzene[d]	Insufficient data[k]	1997	Insufficient data[k]	1997
1,2,4,5-Tetrachlorobenzene[d]	Insufficient data[k]	1997	Insufficient data[k]	1997
Pentachlorobenzene	6.0[c,k]	1997	Insufficient data[k]	1997
Hexachlorobenzene[d]	Insufficient data[e,f,k]	1997	Insufficient data[k]	1997
Chlorinated ethanes				
1,2-Dichloroethane	100[c,i]	1991	Insufficient data	1991
1,1,1-Trichloroethane	Insufficient data	1991	Insufficient data	1991
1,1,2,2-Tetrachloroethane	Insufficient data	1991	Insufficient data	1991
Chlorinated ethenes				
1,1,2-Trichloroethene (Tichloroethylene; TCE)	21[c,i]	1991	Insufficient data	1991
1,1,2,2-Tetrachloroethene (Tetrachloroethylene; PCE)	111[c,i]	1993	Insufficient data	1993
Chlorinated methanes [See Halogenated methanes]				
Chlorinated phenols[d]				
Monochlorophenols	7	1987		
Dichlorophenols	0.2	1987		
Trichlorophenols	18	1987		
Tetrachlorophenols	1	1987		
Pentachlorophenol (PCP)	0.5	1987		
Chlorine, reactive [See Reactive chlorine species]				
Chloroform [See Halogenated methanes, Trichloromethane]				
4-Chloro-2-methyl phenoxy acetic acid [See MCPA]				
Chlorothalonil	0.18[c]	1994	0.36[c]	1994
Chlorpyrifos	0.0035	1997	0.002[c]	1997
Chromium				
Trivalent chromium (Cr(III))	8.9[c,k]	1997	56[c,k]	1997
Hexavalent chromium (Cr(VI))	1.0[k]	1997	1.5[k]	1997
Chrysene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Colour	Narrative	1999	Narrative	1999
Copper[d]	2–4[m]	1987		
Cyanazine	2.0[c,i]	1990		
Cyanide[d]	5 (as free CN)	1987		
DDAC (Didecyl dimethyl ammonium chloride)	1.5[c]	1999	Insufficient data	1999
DDT (total)[d] (2,2-Bis(*p*-chlorophenyl)-1,1,1-trichloroethane; dichloro diphenyl trichloroethane)	~~0.001~~[e,f]	1987		
Debris (litter/settleable matter)			Narrative[c]	1996

Continued.

Parameter[a]	Freshwater		Marine	
	Concentration ($\mu g \cdot L^{-1}$)	Date[b]	Concentration ($\mu g \cdot L^{-1}$)	Date[b]
Deltamethrin	0.0004	1997	Insufficient data	1997
Deposited bedload sediment [See Total particulate matter]				
Dibromochloromethane [See Halogenated methanes]				
Dicamba	10[c,i]	1993		
Dichlorobenzene [See Chlorinated benzenes]				
Dichlorobromomethane [See Halogenated methanes]				
Dichloro diphenyl trichloroethane [See DDT (total)]				
Dichloroethane [See Chlorinated ethanes]				
Dichloroethylene [See Chlorinated ethanes, 1,2-Dichloroethane]				
Dichloromethane [See Halogenated methanes]				
Dichlorophenols [See Chlorinated phenols]				
2,4-Dichlorophenoxyacetic acid [see Phenoxy herbicides]				
Diclofop-methyl	6.1	1993		
Didecyl dimethyl ammonium chloride [See DDAC]				
Diethylene glycol [See Glycols]				
Di(2-ethylhexyl) phthalate [See Phthalate esters]				
Diisopropanolamine (DIPA)[aa]	1600[c]	2005	Insufficient data	2005
Dimethoate	6.2[c]	1993	Insufficient data	1993
Di-*n*-butyl phthalate [See Phthalate esters]				
Di-*n*-octyl phthalate [See Phthalate esters]				
Dinoseb	0.05	1992		
Dissolved gas supersaturation	Narrative	1999	Narrative	1999
Dissolved oxygen	5500–9500[k,n]	1999	>8000 and Narrative[c,k]	1996
Endosulfan[d]	0.02	1987		
Endrin[d]	~~0.0023~~[e,f]	1987		
Ethylbenzene[j]	90[c,k]	1996	25[c,k]	1996
Ethylene glycol [See Glycols]				
Fluoranthene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Fluorene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Glycols				
Ethylene glycol	192 000[k]	1997	Insufficient data	1997
Diethylene glycol	Insufficient data[k]	1997	Insufficient data	1997
Propylene glycol	500 000[k]	1997	Insufficient data	1997
Glyphosate	65[c]	1989		

Continued.

Parameter[a]	Freshwater		Marine	
	Concentration ($\mu g \cdot L^{-1}$)	Date[b]	Concentration ($\mu g \cdot L^{-1}$)	Date[b]
Halogenated methanes				
Monochloromethane (Methyl chloride)[d]	Insufficient data	1992	Insufficient data	1992
Dichloromethane (Methylene chloride)	98.1[c,i]	1992	Insufficient data	1992
Trichloromethane (Chloroform)	1.8[c,i]	1992	Insufficient data	1992
Tetrachloromethane (Carbon tetrachloride)	13.3[c,i]	1992	Insufficient data	1992
Monobromomethane (Methyl bromide)[d]	Insufficient data	1992	Insufficient data	1992
Tribromomethane (Bromoform)[d]	Insufficient data	1992	Insufficient data	1992
Dibromochloromethane[d]	Insufficient data	1992	Insufficient data	1992
Dichlorobromomethane[d]	Insufficient data	1992	Insufficient data	1992
HCBD [See Hexachlorobutadiene (HCBD)]				
Heptachlor (Heptachlor epoxide)[d]	~~0.01~~ [e,f]	1987		
Hexachlorobenzene [See Chlorinated benzenes]				
Hexachlorobutadiene (HCBD)	1.3[c, k]	1999		
Hexachlorocyclohexane (Lindane)[d]	0.01	1987		
Hypochlorous acid [See Reactive chlorine species]				
Imidacloprid[aa]	0.23[c]	2007	0.65[c]	2007
Inorganic fluorides	120[c]	2002		
3-Iodo-2-propynyl butyl carbamate [See IPBC]				
IPBC (3-Iodo-2-propynyl butyl carbamate)	1.9[c]	1999		
Iron[d]	300	1987		
Lead[d]	1–7[o]	1987		
Lindane [See Hexachlorocyclohexane]				
Linuron	7.0[c]	1995	Insufficient data	1995
MCPA (4-Chloro-2-methyl phenoxy acetic acid; 2-methyl-4-chloro phenoxy acetic acid)	2.6[c]	1995	4.2[c]	1995
Mercury[v]				
Inorganic Mercury[v]	0.026	2003	0.016[c,w]	2003
Methylmercury[v]	0.004[c,w]	2003		
Methyl bromide [See Halogenated methanes, Monobromomethane]				
Methyl chloride [See Halogenated methanes, Monochloromethane]				
2-Methyl-4-chloro phenoxy acetic acid [See MCPA]				
Methylene chloride [See Halogenated methanes, Dichloromethane]				
Methyl *tertiary*-butyl ether [See MTBE]				
Metolachlor	7.8[c]	1991		
Metribuzin	1.0[c]	1990		
Molybdenum[j]	73[c]	1999		
Monobromomethane [See Halogenated methanes]				
Monochloramine [See Reactive chlorine species]				

Continued.

	Freshwater		Marine	
Parameter[a]	**Concentration ($\mu g \cdot L^{-1}$)**	**Date**[b]	**Concentration ($\mu g \cdot L^{-1}$)**	**Date**[b]
Monochlorobenzene [See Chlorinated benzenes]				
Monochloromethane [See Halogenated methanes]				
Monochlorophenols [See Chlorinated phenols]				
MTBE (methyl *tertiary*-butyl ether)	10 000[c]	2003	5 000[c]	2003
Naphthalene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Nickel[d]	25–150[p]	1987		
Nitrate	13 000[c,u,y]	2003	16 000[c,u,y]	2003
Nitrite[d]	60[z]	1987		
Nonylphenol and its ethoxylates	1.0[c,t]	2002	0.7[c,t]	2002
Nutrients	Guidance Framework[x]	2004	Guidance Framework [aa,bb]	2007
Organotins				
Tributyltin	0.008[c]	1992	0.001[c]	1992
Tricyclohexyltin	Insufficient data	1992	Insufficient data	1992
Triphenyltin	0.022[c,i]	1992	Insufficient data	1992
Oxygen, dissolved [See Dissolved oxygen]				
PAHs [See Polycyclic aromatic hydrocarbons (PAHs)]				
PCBs [See Polychlorinated biphenyls (PCBs)(total)]				
PCE [See Chlorinated ethenes, 1,1,2,2-Tetrachloroethene]				
PCP [See Chlorinated phenols, Pentachlorophenol]				
Pentachlorobenzene [See Chlorinated benzenes]				
Pentachlorophenol [See Chlorinated phenols]				
Permethrin[aa]	0.004[c]	2006	0.001[c]	2006
pH[d]	6.5–9	1987	7.0–8.7 and Narrative	1996
Phenanthrene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Phenols (mono- & dihydric)	4.0[k]	1999		
Phenoxy herbicides[d, q]	4.0	1987		
Phosphorus	Guidance Framework[x]	2004	Guidance Framework[bb]	2007
Phthalate esters				
Di-*n*-butyl phthalate	19[c]	1993	Insufficient data	1993
Di(2-ethylhexyl) phthalate	16[c]	1993	Insufficient data	1993
Di-*n*-octyl phthalate	Insufficient data	1993	Insufficient data	1993
Picloram	29[c]	1990		
Polychlorinated biphenyls (PCBs) (total)[d]	~~0.001~~ [e,f]	1987	~~0.01~~ [e,f]	1991

Continued.

	Freshwater		Marine	
Parameter[a]	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**
Polycyclic aromatic hydrocarbons (PAHs)				
Acenaphthene	5.8[c]	1999	Insufficient data	1999
Acridine	4.4[c]	1999	Insufficient data	1999
Anthracene	0.012[c]	1999	Insufficient data	1999
Benz*(a)*anthracene	0.018[c]	1999	Insufficient data	1999
Benzo*(a)*pyrene	0.015[c]	1999	Insufficient data	1999
Chrysene	Insufficient data	1999	Insufficient data	1999
Fluoranthene	0.04[c]	1999	Insufficient data	1999
Fluorene	3.0[c]	1999	Insufficient data	1999
Naphthalene	1.1[c]	1999	1.4[c]	1999
Phenanthrene	0.4[c]	1999	Insufficient data	1999
Pyrene	0.025[c]	1999	Insufficient data	1999
Quinoline	3.4[c]	1999	Insufficient data	1999
Propylene glycol [See Glycols]				
Pyrene [See Polycyclic aromatic hydrocarbons (PAHs)]				
Quinoline [See Polycyclic aromatic hydrocarbons (PAHs)]				
Reactive chlorine species (hypochlorous acid and monochloramine)	0.5 and Narrative	1999	0.5 and Narrative	1999
Salinity			<10% fluctuation[c]	1996
Selenium[d]	1.0	1987		
Silver[d]	0.1	1987		
Simazine	10	1991		
Streambed substrate [See Total particulate matter]				
Styrene	72[c]	1999		
Sulfolane[aa]	50 000[c]	2005	Insufficient data	2005
Suspended sediments [See Total particulate matter]				
TCE [See Chlorinated ethenes, 1,1,2-Trichloroethene]				
Tebuthiuron	1.6[c]	1995	Insufficient data	1995
Temperature	Narrative[s]	1987	Not to exceed ±1°C and Narrative[c]	1996
Tetrachlorobenzene [See Chlorinated benzenes]				
Tetrachloroethane [See Chlorinated ethanes]				
Tetrachloroethene [See Chlorinated ethenes]				
Tetrachloroethylene [See Chlorinated ethenes, 1,1,2,2-Tetrachloroethene]				

Continued.

	Freshwater		Marine	
Parameter[a]	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**	**Concentration ($\mu g \cdot L^{-1}$)**	**Date[b]**
Tetrachloromethane [See Halogenated methanes]				
Tetrachlorophenols [See Chlorinated phenols]				
Thallium[j]	0.8	1999		
Toluene	2.0[c,j,k]	1996	215[c,k]	1996
Total particulate matter				
Deposited bedload sediment	Insufficient data	1999	Insufficient data	1999
Streambed substrate	Narrative	1999	Narrative	1999
Suspended sediments	Narrative	1999	Narrative	1999
Turbidity	Narrative	1999	Narrative	1999
Toxaphene[d]	~~0.008~~ [e,f]	1987		
Triallate	0.24[c]	1992		
Tribromomethane [See Halogenated methanes]				
Tributyltin [See Organotins]				
Trichlorobenzene [See Chlorinated benzenes]				
Trichloroethane [See Chlorinated ethanes]				
Trichloroethene [See Chlorinated ethenes]				
Trichloroethylene [See Chlorinated ethenes, 1,1,2-Trichloroethene]				
Trichloromethane [See Halogenated methanes]				
Trichlorophenols [See Chlorinated phenols]				
Tricyclohexyltin [See Organotins]				
Trifluralin	0.20[i]	1993		
Triphenyltin [See Organotins]				
Turbidity [See Total particulate matter]				
Zinc[d]	30	1987		

[a]Unless otherwise indicated, supporting documents are available from the National Guidelines and Standards Office, Environment Canada.

[b]The guidelines dated 1987 have been carried over from *Canadian Water Quality Guidelines* (CCREM 1987) and no fact sheet was prepared. The guidelines dated 1989 to 1997 were developed and initially published in CCREM 1987 as appendixes on the date indicated. They are published as fact sheets in this document. Other guidelines dated 1997 and those dated 1999 are published for the first time in this document.

[c]Interim guideline.

[d]No fact sheet created. For more information on this guideline, please refer to *Canadian Water Quality Guidelines* (CCREM 1987).

[e]This guideline (originally published in *Canadian Water Quality Guidelines* [CCREM 1987 + Appendixes] in 1987 or 1991 [PCBs in marine waters]) is no longer recommended and the value is withdrawn. A water quality guideline is not recommended. Environmental exposure is predominantly via sediment, soil, and/or tissue, therefore, the reader is referred to the respective guidelines for these media.

[f]This substance meets the criteria for Track 1 substances under the national CCME Policy for the Management of Toxic Substances (PMTS) (i.e., persistent, bioaccumulative, primarily the result of human activity, and CEPA-toxic or equivalent), and should be subject to virtual elimination strategies. Guidelines can serve as action levels or interim management objectives towards virtual elimination.

[g]Aluminium guideline= 5 $\mu g \cdot L^{-1}$ at pH <6.5
= 100 $\mu g \cdot L^{-1}$ at pH ≥6.5

[h]Ammonia guideline: Expressed as μg unionized ammonia$\cdot L^{-1}$. This would be equivalent to 15.2 μg ammonia-nitrogen$\cdot L^{-1}$. Guideline for total ammonia is temperature and pH dependent, please consult factsheet for more information.

[i]Guideline value slightly modified from CCREM 1987 + Appendixes due to re-evaluation of the significant figures.

[j]The technical document for the guideline is available from the Ontario Ministry of the Environment.

[k]Substance has been re-evaluated since CCREM 1987 + Appendixes. Either a new guideline has been derived or insufficient data existed to derive a new guideline.

[l]Cadmium guideline $= 10^{\{0.86[\log(\text{hardness})] - 3.2\}}$.

[m]Copper guideline
= 2 $\mu g \cdot L^{-1}$ at a water hardness of 0–120 $mg \cdot L^{-1}$ (soft to medium) as $CaCO_3$
= 3 $\mu g \cdot L^{-1}$ at a water harness of 120–180 $mg \cdot L^{-1}$ (hard) as $CaCO_3$
= 4 $\mu g \cdot L^{-1}$ at a water harness >180 $mg \cdot L^{-1}$ (very hard) as $CaCO_3$

[n]Dissolved oxygen for warm-water biota: early life stages = 6000 $\mu g \cdot L^{-1}$
other life stages = 5500 $\mu g \cdot L^{-1}$
for cold-water biota: early life stages = 9500 $\mu g \cdot L^{-1}$
other life stages = 6500 $\mu g \cdot L^{-1}$

[o]Lead guideline
= 1 $\mu g \cdot L^{-1}$ at a water harness of 0–60 $mg \cdot L^{-1}$ (soft) as $CaCO_3$
= 2 $\mu g \cdot L^{-1}$ at a water harness of 60–120 $mg \cdot L^{-1}$ (medium) as $CaCO_3$
= 4 $\mu g \cdot L^{-1}$ at a water harness of 120–180 $mg \cdot L^{-1}$ (hard) as $CaCO_3$
= 7 $\mu g \cdot L^{-1}$ at a water harness >180 $mg \cdot L^{-1}$ (very hard) as $CaCO_3$

[p]Nickel guideline
= 25 $\mu g \cdot L^{-1}$ at a water harness of 0–60 $mg \cdot L^{-1}$ (soft) as $CaCO_3$
= 65 $\mu g \cdot L^{-1}$ at a water harness of 60–120 $mg \cdot L^{-1}$ (medium) as $CaCO_3$
= 110 $\mu g \cdot L^{-1}$ at a water harness of 120–180 $mg \cdot L^{-1}$ (hard) as $CaCO_3$
= 150 $\mu g \cdot L^{-1}$ at a water harness >180 $mg \cdot L^{-1}$ (very hard) as $CaCO_3$

[q]The guideline of 4.0 $\mu g \cdot L^{-1}$ for phenoxy herbicides is based on data for ester formulations of 2,4-dichlorophenoxyacetic acid.

[r]The technical document for the guideline is available from British Columbia Ministry of Environment, Lands and Parks.

[s]Temperature: (for more information, see CCREM 1987)

Thermal Stratification: Thermal additions to receiving waters should be such that thermal stratification and subsequent turnover dates are not altered from those existing prior to the addition of heat from artificial origins.

Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded.

Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

[t]Expressed on a TEQ basis using NP TEFs, see Table 2 in factsheet.

[u]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.

[v]May not prevent accumulation of methylmercury in aquatic life, therefore, may not protect wildlife that consume aquatic life; see factsheet for details. Consult also the appropriate Canadian Tissue Residue Guideline for the Protection of Wildlife Consumers of Aquatic Biota.

[w]May not fully protect higher trophic level fish; see factsheet for details.

[x]Canadian Guidance Framework for Phosphorus is for developing phosphorus guidelines (does not provide guidance on other freshwater nutrients). It provides Trigger Ranges for Total Phosphorus (see Guidance Framework for Phosphorus factsheet):

ultra-oligotrophic <4 $\mu g \cdot L^{-1}$
oligotrophic 4-10 $\mu g \cdot L^{-1}$
mesotrophic 10-20 $\mu g \cdot L^{-1}$
meso-eutrophic 20-35 $\mu g \cdot L^{-1}$
eutrophic 35-100 $\mu g \cdot L^{-1}$
hyper-eutrophic >100 $\mu g \cdot L^{-1}$

[y]Guidelines are expressed in μg nitrate$\cdot L^{-1}$. These values are equivalent to 2900 μg nitrate-nitrogen$\cdot L^{-1}$, and 3600 μg nitrate-nitrogen$\cdot L^{-1}$, for freshwater and marine respectively.

[z]Guideline is expressed as μg nitrite-nitrogen$\cdot L^{-1}$. This value is equivalent to 197 μg nitrite$\cdot L^{-1}$.

[aa]Supporting documents are available from the Canadian Council of Ministers of the Environment at http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=125

[bb]The Canadian Guidance Framework for the Management of Nearshore Marine Systems is for developing nutrient (phosphorus and nitrogen) guidelines for nearshore marine systems. Refer to factsheet for details

Reference

CCREM (Canadian Council of Resource and Environment Ministers). 1987. Canadian water quality guidelines. Prepared by the Task Force on Water Quality Guidelines.

Reference listing:

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated September, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

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Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health

SUMMARY TABLES

Update 7.0
September 2007

Table 1. Canadian Soil Quality Guidelines (mg·kg^{-1}).

Substance[y]	Year revised/ released[a]	Land Use and Soil Texture							
		Agricultural*		Residential/ parkland*		Commercial*		Industrial*	
		Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine
Arsenic (inorganic)	1997	12[b]		12[b]		12[b]		12[b]	
Barium	2003	750[c]		500[c]		2000[c]		2000[c]	
Benzene									
Surface[w]	2004	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]
Subsoil[w]	2004	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]
Surface[x]	2004	0.0095[t,u]	0.0068[t,u]	0.0095[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]
Subsoil[x]	2004	0.011[t,u]	0.0068[t,u]	0.011[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]	0.030[t,u]	0.0068[t,u]
Benzo*(a)*pyrene	1997	0.1[e]		0.7[f]		0.7[f]		0.7[f]	
Cadmium	1999	1.4[b]		10[g]		22[b]		22[b]	
Chromium									
Total chromium	1997	64[b]		64[b]		87[b]		87[b]	
Hexavalent chromium (VI)	1999	0.4[h]		0.4[h]		1.4[h]		1.4[h]	
Copper	1999	63[b]		63[b]		91[b]		91[b]	
Cyanide (free)	1997	0.9[b]		0.9[b]		8.0[b]		8.0[b]	
DDT (total)	1999	0.7[i]		0.7[i]		12[i, j]		12[i, j]	
Diisopropanolamine (DIPA)[z]	2006	180[b]		180[b]		180[b]		180[b]	
Ethylbenzene									
Surface	2004	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]
Subsoil	2004	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]	0.082[t]	0.018[t,u]
Ethylene glycol	1999	960[k]		960[k]		960[k]		960[k]	
Lead	1999	70[b]		140[b]		260[b]		600[b]	
Mercury (inorganic)	1999	6.6[b]		6.6[b]		24[b]		50[b]	
Naphthalene	1997	0.1[d]		0.6[h]		22[h]		22[h]	
Nickel	1999	50[l]		50[l]		50[l]		50[l]	
Nonylphenol (and its ethyloxylates)	2002	5.7[p]		5.7[p]		14[p]		14[p]	
Pentachlorophenol	1997	7.6[b]		7.6[b]		7.6[b]		7.6[b]	
Phenol	1997	3.8[b]		3.8[b]		3.8[b]		3.8[b]	
Polychlorinated biphenyls (PCBs)	1999	0.5[m]		1.3[l]		33[j,l]		33[j,l]	
Polychlorinated dibenzo-*p*-dioxins/ dibenzofurans (PCDD/Fs)	2002	4 ng TEQ·kg^{-1} [q]		4 ng TEQ·kg^{-1} [q]		4 ng TEQ·kg^{-1} [r]		4 ng TEQ·kg^{-1} [s]	
Propylene glycol	2006	Insufficient information[v]		Insufficient information[v]		Insufficient information[v]		Insufficient information[v]	
Selenium	2007	1[b]		1[b]		2.9[b]		2.9[b]	

Continued

Substance	Year revised/ released[a]	Land Use and Soil Texture							
		Agricultural*		Residential/ parkland*		Commercial*		Industrial*	
		Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine
Sulfolane[z]	2006	0.8[b]		0.8[b]		0.8[b]		0.8[b]	
Tetrachloroethylene	1997	0.1[e]		0.2[f]		0.5[f]		0.6[f]	
Thallium	1999	1[n]		1[o]		1[o]		1[o]	
Toluene									
Surface	2004	0.37[t]	0.08[t]	0.37[t]	0.08[t]	0.37[t]	0.08[t]	0.37[t]	0.08[t]
Subsoil	2004	0.37[t]	0.08[t]	0.37[t]	0.08[t]	0.37[t]	0.08[t]	0.37[t]	0.08[t]
Trichloroethylene	2006	0.01[b,u]		0.01[b,u]		0.01[b,u]		0.01[b,u]	
Uranium[z]	2007	23[t]		23[t]		33[t]		300[t]	
Vanadium	1997	130[l]		130[l]		130[i]		130[i]	
Xylenes									
Surface	2004	11[t]	2.4[t]	11[t]	2.4[t]	11[t]	2.4[t]	11[t]	2.4[t]
Subsoil	2004	11[t]	2.4[t]	11[t]	2.4[t]	11[t]	2.4[t]	11[t]	2.4[t]
Zinc	1999	200[l]		200[l]		360[l]		360[l]	

Notes: SQG_E = soil quality guideline for environmental health; SQG_{HH} = soil quality guideline for human health.

*For guidelines derived prior to 2004, differentiation between soil texture (coarse/fine) is not applicable.

[a]Guidelines released in 1997 were originally published in the working document entitled "Recommended Canadian Soil Quality Guidelines" (CCME 1997) and have been revised, edited, and reprinted here. Guidelines revised/released in 1999 are published here for the first time (see Table 2).

[b]Data are sufficient and adequate to calculate an SQG_{HH} and an SQG_E. Therefore the soil quality guideline is the lower of the two and represents a fully integrated *de novo* guideline for this land use, derived in accordance with the soil protocol (CCME 1996; 2006). The corresponding interim soil quality criterion (CCME 1991) is superseded by the soil quality guideline.

[c]Data are insufficient/inadequate to calculate an SQG_{HH}, a provisional SQG_{HH}, an SQG_E, or a provisional SQG_E. Therefore the interim soil quality criterion (CCME 1991) is retained as the soil quality guideline for this land use (see table 2).

[d]Data are sufficient and adequate to calculate only a provisional SQG_E. It is greater than the corresponding interim soil quality criterion (CCME 1991). Therefore, in consideration of receptors and/or pathways not examined, the interim soil quality criterion is retained as the soil quality guideline for this land use.

[e]Data are sufficient and adequate to calculate an SQG_{HH} and a provisional SQG_E. Both are greater than the corresponding interim soil quality criterion (CCME 1991). Therefore, in consideration of receptors and/or pathways not examined, the interim soil quality criterion is retained as the soil quality guideline for this land use.

[f]Data are sufficient and adequate to calculate an SQG_{HH} and a provisional SQG_E. Both are less than corresponding interim soil quality criterion (CCME 1991). Therefore the soil quality guideline supersedes the interim soil quality criterion for this land use.

[g]The soil–plant–human pathway was not considered in the guideline derivation. If produce gardens are present or planned, a site-specific objective must be derived to take into account the bioaccumulation potential (e.g., adopt the agricultural guideline as objective). The off-site migration check should be recalculated accordingly.

[h]Data are sufficient and adequate to calculate only a provisional SQG_E, which is less than the existing interim soil quality criterion (CCME 1991). Therefore the provisional soil quality guideline supersedes the interim soil quality criterion for this land use.

[i]Data are sufficient and adequate to calculate only an SQG_E. An interim soil quality criterion (CCME 1991) was not established for this land use, therefore the SQG_E becomes the soil quality guideline.

[j]In site-specific situations where the size and/or the location of commercial and industrial land uses may impact primary, secondary, or tertiary consumers, the soil and food ingestion guideline is recommended as the SQG_E.

[K]Data are sufficient and adequate to calculate only a provisional SQG_E.

[l]Data are sufficient and adequate to calculate only an SQG_E, which is less than the interim soil quality criterion (CCME 1991) for this land use. Therefore the SQG_E becomes the soil quality guideline, which supersedes the interim soil quality criterion for this land use.

[m]Data are sufficient and adequate to calculate only an SQG_E, which is greater than the interim soil quality criterion (CCME 1991) for this land use. Therefore the interim soil quality criterion (CCME 1991) is retained as the soil quality guideline for this land use.

[n]Data are sufficient and adequate to calculate a provisional SQG_{HH} and an SQG_E. The provisional SQG_{HH} is equal to the SQG_E and to the existing interim soil quality criterion (CCME 1991) and thus becomes the soil quality guideline, which supersedes the interim soil quality criterion for this land use.

[o]Data are sufficient and adequate to calculate a provisional SQG_{HH} and an SQG_E. The provisional SQG_{HH} is less than the SQG_E and thus becomes the soil quality guideline for this land use.

[p]Data are sufficient and adequate to calculate only an SQG_E. An interim soil quality criterion (CCME 1991) was not established for these substances, therefore, the SQG_E becomes the soil quality guideline.

[q]Data are sufficient and adequate to calculate only a provisional SQG_{HH}, which is less than the existing interim soil quality criterion (CCME 1991). Thus the provisional SQG_{HH} becomes the soil quality guideline, which supersedes the interim soil quality criterion for this land use.

[r]Data are sufficient and adequate to calculate only a provisional SQG_{HH}. An interim soil quality criterion (CCME 1991) was not established for this land use, therefore the provisional SQG_{HH} becomes the soil quality guideline.

[s]Data are sufficient and adequate to calculate only an SQG_{HH}. An interim soil quality criterion (CCME 1991) was not established for this land use, therefore the SQG_{HH} becomes the soil quality guideline.

[t]Data are sufficient and adequate to calculate an SQG_{HH} and an SQG_E. Therefore the soil quality guideline is the lower of the two and represents a fully integrated *de novo* guideline for this land use.

[u]This guideline value may be less than the common limit of detection in some jurisdictions. Contact jurisdictions for guidance.

[v]Data are sufficient and adequate to calculate only a preliminary SQG_{FWAL} (Soil Quality Guideline for freshwater aquatic life). This value is 6,210 $mg \cdot kg^{-1}$. See accompanying factsheet for further information.

[w]10^{-5} Incremental Risk

[x]10^{-6} Incremental Risk

[y]Unless otherwise indicated, supporting documents are available from the National Guidelines and Standards Office, Environment Canada.

[z]Supporting documents are available from the Canadian Council of Ministers of the Environment at http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=125

References

CCME (Canadian Council of Ministers of the Environment). 1991. Interim Canadian environmental quality criteria for contaminated sites. CCME, Winnipeg.

———. 1996. A protocol for the derivation of environmental and human health soil quality guidelines. CCME, Winnipeg. [A summary of the protocol appears in Canadian environmental quality guidelines, Chapter 7, Canadian Council of Ministers of the Environment, 1999, Winnipeg.]

———. 1997. Recommended Canadian soil quality guidelines. CCME, Winnipeg.

———. 2006. A protocol for the derivation of environmental and human health soil quality guidelines. CCME, Winnipeg. [The protocol is available online through the CCME website at http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=125]

Table 2. Interim remediation criteria for soil ($mg \cdot kg^{-1}$) that have not yet been replaced by Canadian Soil Quality Guidelines[1].

Parameter	Year released	Land use			
		Agricultural	Residential/ parkland	Commercial	Industrial
General Parameters					
Conductivity [dS/m]	1991	2	2	4	4
pH	1991	6 to 8	6 to 8	6 to 8	6 to 8
Sodium adsorption ratio	1991	5	5	12	12
Inorganic Parameters					
Antimony	1991	20	20	40	40
Beryllium	1991	4	4	8	8
Boron (hot water soluble)	1991	2	—	—	—
Cobalt	1991	40	50	300	300
Fluoride (total)	1991	200	400	2000	2000
Molybdenum	1991	5	10	40	40
Silver	1991	20	20	40	40
Sulphur (elemental)	1991	500	—	—	—
Tin	1991	5	50	300	300
Monocyclic Aromatic Hydrocarbons					
Chlorobenzene	1991	0.1	1	10	10
1,2-Dichlorobenzene	1991	0.1	1	10	10
1,3-Dichlorobenzene	1991	0.1	1	10	10
1,4-Dichlorobenzene	1991	0.1	1	10	10
Styrene	1991	0.1	5	50	50
Phenolic Compounds					
Chlorophenols[a] (each)	1991	0.05	0.5	5	5
Nonchlorinated[b] (each)	1991	0.1	1	10	10
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo*(a)*anthracene	1991	0.1	1	10	10
Benzo*(b)*fluoranthene	1991	0.1	1	10	10
Benzo*(k)*fluoranthene	1991	0.1	1	10	10
Dibenz*(a,h)*anthracene	1991	0.1	1	10	10
Indeno(1,2,3-c,d)pyrene	1991	0.1	1	10	10
Phenanthrene	1991	0.1	5	50	50
Pyrene	1991	0.1	10	100	100
Chlorinated Hydrocarbons					
Chlorinated aliphatics[c] (each)	1991	0.1	5	50	50
Chlorobenzenes[d] (each)	1991	0.05	2	10	10
Hexachlorobenzene	1991	0.05	2	10	10
Hexachlorocyclohexane	1991	0.01	—	—	—
Miscellaneous Organic Parameters					
Nonchlorinated aliphatics (each)	1991	0.3	—	—	—
Phthalic acid esters (each)	1991	30	—	—	—
Quinoline	1991	0.1	—	—	—
Thiophene	1991	0.1	—	—	—

[1]**Notes:**

All values are in $mg \cdot kg^{-1}$ unless otherwise stated.

Guidelines released in 1991 were published in "Interim Canadian Environmental Quality Criteria for Contaminated Sites" (CCME, 1991).

These interim remediation criteria are considered generally protective of human and environmental health and were based on experience and professional judgement.

These interim criteria (CCME, 1991) should only be used when soil quality guidelines based on the CCME soil protocol (CCME, 1996; 2006) have not yet been developed for a given chemical. Also, because the interim remediation criteria were not developed using the soil protocol and its integral checks, they cannot be modified through the site specific remediation objective procedure.

[a]Chlorophenols include
chlorophenol isomers (ortho, meta, para)
dichlorophenols (2,6- 2,5- 2,4- 3,5- 2,3- 3,4-)
trichlorophenols (2,4,6- 2,3,6- 2,4,5- 2,3,4- 3,4,5-)
tetrachlorophenols (2,3,5,6- 2,3,4,5- 2,3,4,6-)

[b]Nonchlorinated phenolic compounds include
2,4-dimethylphenol
2,4-dinitrophenol
2-methyl 4,6-dinitrophenol
nitrophenol (2-,4-)
phenol
cresol

[c]Aliphatic chlorinated hydrocarbons include
chloroform
dichloroethane (1,1- 1,2-), dichloroethene (1,1- 1,2-)
dichloromethane
1,2-dichloropropane, 1,2-dichloropropene (cis and trans)
1,1,2,2-tetrachloroethane, tetrachloroethene
carbon tetrachloride
trichloroethane (1,1,1- 1,1,2-), trichloroethene

[d]Chlorobenzenes include
all trichlorobenzene isomers
all tetrachlorobenzene isomers
pentachlorobenzene

References

CCME (Canadian Council of Ministers of the Environment). 1991. Interim Canadian environmental quality criteria for contaminated sites. CCME, Winnipeg.

———. 1996. A protocol for the derivation of environmental and human health soil quality guidelines. CCME, Winnipeg. [A summary of the protocol appears in Canadian environmental quality guidelines, Chapter 7, Canadian Council of Ministers of the Environment, 1999, Winnipeg.]

———. 2006. A protocol for the derivation of environmental and human health soil quality guidelines. CCME, Winnipeg. [The protocol is available online through the CCME website at http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=125]

Reference listing:

Canadian Council of Ministers of the Environment. 2007. Canadian soil quality guidelines for the protection of environmental and human health: Summary tables. Updated September, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

For further scientific information, contact:

Environment Canada
National Guidelines and Standards Office
351 boul. St. Joseph
Gatineau, Quebec, K1A 0H3
Phone: (819) 953-1550
Facsimile: (819) 956-5602
E-mail: ceqg-rcqe@ec.gc.ca
Internet: http://www.ec.gc.ca/ceqg-rcqe

For additional copies, contact:

CCME Documents
Toll Free: (800) 805-3025
Internet: http://www.ccme.ca

Aussi disponible en français.

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BURNSIDE

Appendix G

Site Forms

Form 1
Waste Placement Form
Hamlet of Rankin Inlet

Time Period			Waste Delivered by Hamlet Staff		Waste Delivered by Others	Total (m^3)	Waste Activities (i.e. burning, compacting, covering, etc.)	Staff Initials
From	To	Number of Days	Number of Loads	Estimated Quantity (m^3)	Estimated Quantity (m^3)	Volume		
Totals								

Form 2
Weekly Landfill Inspection Form
Hamlet of Rankin Inlet

Inspected By: _____ Date: _____

Wind Direction: _____ Temperature: _____

Precipitation: _____ Ground Cover: _____

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Health and Safety (dangers and concerns)		
Wildlife		
Entrance Road and Site Roads (condition, ditches, snow, surface, etc.)		
Signs		
Litter (fences, on site, off site, etc.)		
Berms and Fences		
Waste Diversion Area		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Bulky Metals		
Hazardous Waste Storage		
Landfill Area		
Waste Drop Off		
Burning		
Waste Placement and Compaction		
Waste Materials (hazardous wastes, damaged materials, etc.)		
Cover Material (stockpile, exposed waste, etc.)		
Waste Compaction and Placement		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Surface Drainage (water flow, erosion, waste in ditches, etc.)		
Leachate Seepage from Waste		
Environmental Impacts (litter on tundra, impacted water escaping site, etc.)		
Equipment (garbage trunk, loader, bulldozer, dump truck, etc.)		
Cell/Layer Construction (slopes, cover, etc.)		
Site Planning		
Other Issues and Concerns		

Form 3
Solid Waste Planning
Hamlet of Rankin Inlet

Prepared By: _____

Date: _____

Solid Waste Planning Issue	Current Operations	To Do Items and Schedule
Health and Safety		
Site Inspection Results/Concerns		
Waste Placement and Filling Summary		
Hazardous Waste Storage Summary		
Bulky Metals Summary		
Environmental Monitoring		

Solid Waste Planning Issue	Current Operations	To Do Items and Schedule
Annual Reporting		
Nunavut Water Board License Requirements		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		

Form 4
Soil Disposal Record Log
Hamlet of Rankin Inlet

Year: _____

Date	Volume of Soil Disposed (m^3)	Origin	Location of Soil Deposited at Facility	Soil Sampling Done? (Y/N)	Soil Sample Background Concen.	Nutrient Info (cm)	Tillage Activity (cm)	Comments
Total								

Form 5
Monthly Landfarm Inspection Form
Hamlet of Rankin Inlet

Inspected By:_____ Date:_____

Wind Direction:_____ Temperature:_____

Precipitation:_____ Ground Cover:_____

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Health and Safety (dangers and concerns)		
Entrance Road and Site Roads (condition, ditches, snow, surface, etc.)		
Signs		
Soil Stockpiles		
Berm		
Surface Drainage (water flow, erosion, etc.)		
Leachate Seepage from Waste		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Tilling		
Vegetation		
Other Issues and Concerns		

Form 6
Landfarm Facility Planning
Hamlet of Rankin Inlet

Prepared By: _____

Date: _____

Landfarm Planning Issue	Current Operations	To Do Items and Schedule
Health and Safety		
Site Inspection Results/Concerns		
Soil Placement and Filling Summary		
Nutrient Treatments		
Tilling Operations		
Environmental Monitoring		

Landfarm Planning Issue	Current Operations	To Do Items and Schedule
Drainage of Site		
Annual Reporting		
Nunavut Water Board License Requirements		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		

BURNSIDE

Appendix H
NWB Annual Monitoring Report Format

NWB Annual Report **Year being reported:** Select

License No: **Issued Date:**
Expiry Date:

Project Name:

Licensee:

Mailing Address:

Name of Company filing Annual Report (**if different from Name of Licensee please clarify relationship between the two entities, if applicable**):

General Background Information on the Project (***optional**):

Licence Requirements: the licensee must provide the following information in accodance with

Select Select

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s):
Water Quantity:
- Quantity Allowable Domestic (cu.m)
- Actual Quantity Used Domestic (cu.m)
- Quantity Allowable Drilling (cu.m)
- Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal
- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)
Date of Spill:
Date of Notification to an Inspector:
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Revisions to the Spill Contingency Plan

Select

Additional Details:

Revisions to the Abandonment and Restoration Plan

Select

Additional Details:

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Select

Additional Details:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Select

Additional Details:

Results of any additional sampling and/or analysis that was requested by an Inspector

Select

Additional Details: (date of request, analysis of results, data attached, etc)

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Select

Additional Details: (Attached or provided below)

Any responses or follow-up actions on inspection/compliance reports

Select

Additional Details: (Dates of Report, Follow-up by the Licensee)

Any additional comments or information for the Board to consider

Date Submitted:		
Submitted/Prepared by:		
Contact Information:	**Tel:**	
	Fax:	
	email:	