Environment Canada Environnement Canada

SUMMARY OF OPERATIONS AND MAINTENANCE PROCEDURES FOR DRINKING WATER, SEWAGE, SOLID WASTE DISPOSAL AND WASTE TREATMENT FACILITIES

— Eureka High Arctic Weather Station —

In support of the
Nunavut Water Board License
No. 3BC-EUR0611

Prepared by Environment Canada
Assets, Contracting and Environmental Management Directorate (ACEMD)

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Canada

Control Page

On receipt of revisions and/or amendments, the Assets, Contracting and Environmental Management Directorate (ACEMD) shall complete this control page to ensure that the Summary of Operations and Maintenance Procedures for Sewage, Solid Waste Disposal and Treatment Facilities at Eureka High Arctic Weather Station (HAWS) is always current and consistently reflects the operations and activities taking place on site.

Version	Date in Force	Expiry Date	Description / Purpose
1	November. 23rd, 2007	November 22nd , 2008	Original Summary
2	March 3, 2009	March 3, 2010	Eureka Water License, II. General Considerations, ss. D(ii) Water License Inspection, Nov. 27, 2007 Station Program Manager Review
3	February 16, 2010	February 16, 2011	Update Hazardous Waste Disposal Update Appendices to reflect current practice
4	January, 2011	None	Updates required for licence renewal as per NWB
5	March 2012	None	Updates required as per License renewal and AANDC inspection and comments

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Acronyms and Symbols

ACEMD	Assets, Contracting and Environmental Management Directorate
BOD	Biochemical oxygen demand
CFC	Chlorofluorocarbon
DIAND	Department of Indian Affairs and Northern Development
HAWS	High Arctic Weather Station
L	Liter
m	Metre
m^3	Cubic metre
N	North
PCBs	Polychlorinated biphenyls
PEARL	Polar Environment Atmospheric Research Lab
pH	Measure of acidity or alkalinity
PWGSC	Public Works and Government Services Canada
UV	Ultraviolet
W	West

1. Introduction

The Eureka High Arctic Weather Station (HAWS) is located on the north side of Slidre Fjord, at the north-western tip of Fosheum Peninsula of Ellesmere Island, at 80^{o} 0' N and 85^{o}56' W.

The Eureka HAWS is a weather monitoring facility. It is operated by Environment Canada, and has been in operation since 1947. The Eureka HAWS is a centre of activity for Environment Canada, the Department of National Defence, the Polar Continental Shelf Project, and the Polar Environment Atmospheric Research Lab (PEARL). Most of the work is carried out in the short Arctic summer – June, July and August. The number of people located on-site varies between 8 and 40 (this includes the members of the Department of National Defence).

2. Operational Practices for Drinking Water

At Eureka HAWS, drinking water is obtained from a fresh water lagoon located near Station Creek, which is a stream, located immediately to the west of the main Station that carries melt water from ice and snow in the Arctic spring (May and June). No inhabitants reside in the Station Creek watershed.

Some concern has been raised in the past with regards to the runoff from the abandoned dump site that is located at the west end of the runway. The runoff from this part of the airport runway does flow into the Station Creek drainage basin during the spring season. But the potential for any contaminants affecting the water quality of the Creek is very low.

The Creek flows for about three to four months in an average year. The water lagoon is filled by pumping water from Station Creek, after the spring runoff has slowed down and the water is running clear of suspended solids. The volume of the water in the impoundment must be sufficient to supply the Eureka HAWS needs throughout the year. It is estimated that the impoundment holds approximately 12,000 m^3 of water. Daily consumption of water for a location such as Eureka HAWS has been estimated to be 290 L per person per day (Smith and Nahir, 2000). The volumes of water used in 2009 to 2012 by the Eureka HAWS are shown in Table 1.

Table 1. Volume of water used by Eureka HAWS from 2009 to 2012.

Month	Volume (m^3)			
	2009	2010	2011	2012
January	140.9	162.7	212.5	268.6
February	194.9	260.0	288.2	318.2
March	237.7	302.9	251.4	330.1
April	221.5	237.5	436.6	186.3
May	328.8	384.5	481.3	43.1
June	438.7	413.7	440.6	323.9
July	357.6	340.4	311.4	339.4
August	130.0	206.9	211.6	281.2
September	197.2	202.0	274.9	222.4
October	275.1	216.5	274.4	339.1
November	187.0	229.6	272.4	188.8
December	141.0	195.3	307.0	111.9
Annual Total	**2850.4**	**3152.0**	**3762.3**	**2953.0**

Periodic (yearly and monthly) analysis of water samples collected from the impoundment, holding tanks and from inside the Eureka HAWS indicate that the chlorination, filtration, ultraviolet (UV) and reverse-osmosis treatments of the raw water provides good quality water to the station.

Monthly drinking water sampling and analysis is carried out on-site to assess the acceptance of the treated water and to ensure no threat to the staff's health. The testing procedure and results analysis is further described in Appendix A of the Quality Assurance (QA) and Quality Control (QC) Program document supplied separately to the Nunavut Water Board. Water usage is monitored and recorded during any water pumping processes and the monthly/yearly water usage is calculated and recorded.

A daily visual inspection is performed of the drinking water system which includes verification of water levels in the holding tanks, chlorinator fluid levels, water filter conditions, as well as the proper operation of all related pumping, piping and water delivery systems. Visual inspections are also performed on the Water Lagoon containment structure and fencing.

The chlorination system consists of an LMI Milton Roy Series P7 chlorinator including an electronic metering pump and dispenser which introduces Javex 12 chlorine from the chlorine holding tank into the domestic water intake line, destined for large the holding tanks, when water is pumped from the water lagoon to large holding tanks in the Power House. The chlorine supply for the chlorine tank is derived from 5litre jugs of Javex 12, which is appropriately labelled and stored on elevated shelving within the power house room away from any possible sources of water or other chemicals. The jugs of chlorine are emptied into the chlorination tank when required. The use of smaller 5 litre containers enables the ease of storage and handling and prevents the possibility of a major spill or contamination. Proper personal protective equipment is supplied for use when the transfer of chlorine is required. If a spill should occur, the solid cement floor along with the supplied spill kit that is available within the room will contain and absorb any spills. The MSDS sheets for this product is stored within this room along with a mobile eyewash station should these ever be required.

A schematic of the water distribution system is shown in Figure 1.

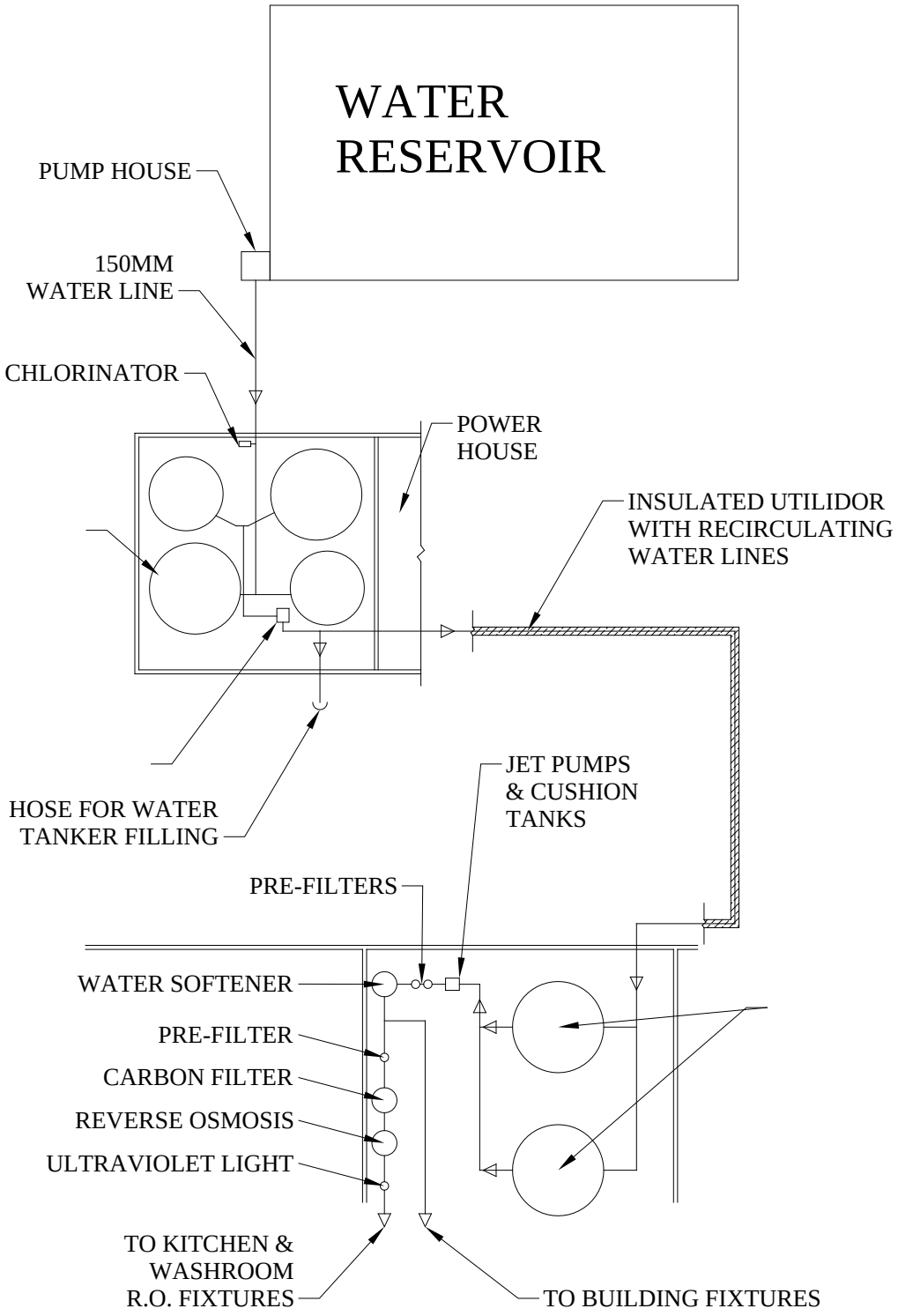

Figure 1. Water distribution system at Eureka HAWS.

3. Management of Wastewater

The following section describes the management of wastewater at Eureka HAWS.

3.1 General Description of the System

The wastewater and sewage lagoon at the Eureka HAWS is a single cell, engineered retention lagoon and is located to the south of the complex in the immediate vicinity of the Fjord (Figure 2). The volume of the lagoon was estimated as follows, by using the known dimensions and by integrating these in a formula by Smith and Nahir, 2000 (Table 2):

Table 2. Lagoon Dimensions at Eureka HAWS.

Length	
Length – South Side	100.6 m
Length – North Side	89.8 m
Average Length	**95.2 m**

Width	
Width – East Side	19.7 m
Width – West Side	24.9 m
Average Width	**22.3 m**

Depth	
Average Depth	**2.0 m**

Estimation of volume of the lagoon

Volume = Length x Width x Depth
= 95.2 m x 22.3 m x 1.05 m
= 2229 m^3
= 2.23 x 10^6 L

Maximum Daily Flow Rate (to fill the lagoon) = $\frac{\text{Volume}}{365 \text{ days}}$
= $\frac{2.23 \times 10^6 \text{L}}{365 \text{ days}}$
= 6109.6 L/day

It is estimated that a person will use 290 liters per day of water and therefore:

= $\frac{6109.6 \text{ L/day}}{290 \text{ L/day}}$
= waste from 21 people will fill the lagoon

Figure 2. Wastewater treatment cell at Eureka HAWS.

3.2 Collection into the System

Due to the semi-closed nature of the system, it is expected that the volume of wastewater produced will be similar to the volume of the water used. Some of the water supply is utilized in order to humidify and condition the air of Operations Complex during the dry winter months which is then vented to atmosphere.

The collection of the wastewater throughout the Station occurs by gravity. All piping is located within warm portions of the facility. The wastewater is then collected in a storage tank in a separate building at the northeast corner of the complex. The collected wastewater is intermittently pumped to the lagoon when the volume of the liquid in the holding tank reaches a preset level.

3.3 Treatment and Discharge of the System

Wastewater is pumped to the lagoon where solids are allowed to settle and limited decomposition takes place. The sewage lagoon is usually emptied twice a year – at the beginning of July and the end of August. In early July, the sewage lagoon needs to be emptied as it is filled to capacity. Lagoon is decanted a second time at the end of August prior to freezing to ensure that the lagoon is completely empty prior to entering the winter season.

Figure 3. Lagoon Prior to emptying.

Figure 4. Sampling of effluent.

The decanting process normally takes about 48 hours. Wastewater samples are collected at the discharge pipe. Samples of wastewater are taken when lagoon is 2/3 (16 hours) & 1/3 (32 hours) decanted and sent to lab for analysis within 24 hours. The quantity of wastewater decanted is estimated using a formula which multiplies the run time of the pumps with the rated output pumping volume of the pumps as per the Water Licence Monitoring Program requirements.

The samples are analyzed for biochemical oxygen demand (BOD_5), total suspended solids, ammonia, fecal coliforms, pH, conductivity, metals, major cations, sulphates, oil and grease and total phenols.
In 2006 concentrations of certain parameters exceeded the "*Canadian Sediment Quality Guidelines for the Protection of Aquatic Life".* Since then, Environment Canada, via Franz Environmental and SENES Consultants Ltd, has proceeded to perform background sampling of soils and surface water in order to determine the source of such exceedences. As outlined in the draft report "*2012 Supplemental Investigation Eureka High Arctic Weather Station, Nunavut"* the findings and discussion of results state;
"The results of the background surface water samples indicate that the average concentration (from 2009 to 2012) were above EQGs for aluminum, cadmium, copper, iron, lead, manganese, selenium, silver, and zinc. This indicates that elevated concentrations of those metals may be naturally occurring and not the result of human activity……
"All nine background sediment samples collected (five from Blacktop Creek and four from Station Creek) had arsenic concentrations above the EQG. One sample collected from Blacktop Creek contained copper above the guideline. The average concentration of arsenic was also above the EQG indicating that elevated arsenic concentration in the sediment is likely due to naturally occurring conditions and not a result of human activity."

3.4 Sludge Disposal Plan

There is no management of sludge from the wastewater lagoon as all settled solids are left in place within the lagoon.

Decisions by EC subsequent to the previously mentioned sewage treatment and disposal options analysis may have implications for the current sewage lagoon and its sludge. If it is decided to:

- close the existing lagoon; or
- remove the existing sludge,

the services of a qualified engineer will be obtained to determine whether the lagoon is/is not highly contaminated and to recommend a remediation option(s) which may include the following:

- o the lagoon may be de-watered (eg. evaporation allowed to take place), backfilled and shaped to blend in with existing contours provided that measures are applied for leachate control;
- o the sludge may be de-watered and the dried residue removed and disposed of on-site in an engineered land fill; or
- o the de-watered sludge may be containerized and land filled to preclude contact with the Arctic ecosystem.

The Golder Associates report indicated that the recommended treatment for sludge disposal, based on initial sampling and analysis of the sludge and the review of the precipitation and evaporation data for Eureka, could be performed with the use a simple 2-cell drying bed. The 2 cells used on an alternating basis would allow sufficient time for dewatering and sludge stabilization. The dried sludge could be left in place or removed to the site's landfill.
Upon completion of the Worley Parsons Geotechnical study and consultations with the Nunavut Water Board, a strategy for further proceedings will be developed.

3.5 Inspection and Monitoring of the System

A daily visual inspection is performed of the wastewater treatment system which includes verification of wastewater levels in the holding tank and lagoon as well as the proper operation of all related pumping, piping and wastewater delivery systems from the Operations Complex to the Sewage Lagoon. Visual inspections are also performed on the Sewage Lagoon containment berm when visible.

See appendix 3 for the map illustrating site components of the systems.

A quality assurance/Quality control plan (QA/QC Plan) will be developed in parallel with the current development of Environment Canada's RAP for this site and will be provided to NWB and AANDC upon its completion. The QA/QC Plan will include the most current sampling methods to all applicable standards acceptable to an accredited laboratory and it shall include a covering letter from the accredited laboratory confirming acceptance of the Plan for analyses to be performed.

4. Landfill Strategy

4.1 Introduction

4.1.1 Purpose

This manual has been produced to assist Eureka personnel in the proper operation and maintenance of the Weather Station's land fill disposal facilities.

4.1.2 Site Setting

The Eureka HAWS is located on the north side of Slidre Fiord, at the south-western tip of Fosheim Peninsula, Ellesmere Island, Nunavut at site coordinates 79^{o} 59' 41"N and 85^{o} 48' 48"W (see Appendix1[1]). It is located in the Eureka Hills Eco-region, within the Northern Arctic Eco-zone and the topography of the area is rolling and ridged, reaching altitudes of no more than 1000 m above sea level. Soils in the Site area are primarily a sand/gravel fill underlain by silty, sandy clays. Permfafrost is present with an active layer ranging between 0.6 and 1.2 m in thickness. The climate is cold and dry; mean annual temperatures range from -30.5^{o}C in winter to 0.5^{o}C in summer. Annual precipitation ranges between 50 to 75 mm. The prevailing winds are from the west.

The main portion of the Site occupies an area immediately east of Station Creek and contains approximately 17 buildings with associated infrastructure. An airstrip is located approximately 1.5 km northeast of the main site. The Site is located on a hillside sloping down from the airstrip, levelling out where most facilities are located before sloping down further to the ocean. A 20 km road to the north connects the Site with an experimental facility, the former ASTRO Lab, now known as the PEARL Facility (Polar Environment Atmospheric Research Laboratory).

The total area of the occupied Site is approximately 2.23 hectares and is held under INAC Land Use Permit #1021. The permit was initially established in 1955.

4.1.3 Population Projection

While the population varies, particularly in the summer, the average population is about 10 and is not expected to change in the foreseeable future.

4.1.4 Contact List

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Station Program Manager
Eureka Weather Station
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4.2 Background

4.2.1 Context

Solid waste management at Eureka is a challenge for the following reasons:

- Extreme cold;
- Isolation;
- High cost of transportation; and
- Tiny population

Eureka is a weather station located at 80^{o} N with, as indicated above, a population of approximately 10 people. The site is only accessible by air and sea. Personnel, mail, freight and food are flown in to Eureka on a monthly basis. Once a year, a Canadian Coast Guard ice breaker brings supplies in late August. Any materials sent out from Eureka for disposal or recycling on the return trip of the Coast Guard must remain in the Arctic port of Nanisivik for one year before it can be sent south.
Notwithstanding the constraints that the above place on normal waste management practices, Eureka is committed to practices of procurement of green products, diversion from land fill sites, reuse and recycling.

4.2.2 Solid Waste Generation

- 10-12 bags of kitchen wastes are generated weekly. Based on an evaluation of the garbage log of 2006, each person in Eureka generates approximately 8 kg of waste per day.
- Significant volumes of cardboard boxes and wooden pallets are generated from the packaging material that accompanies the food.
- Currently approximately 1000 L of waste oil is produced each year on site, and together with other miscellaneous petroleum products, are currently stored in empty 205 L drums on wooden pallets in a storage compound entitled EC Drum Cache between the airstrip and main complex.
- Miscellaneous chemicals such as solvents and glycols and used Jet fuel are placed in empty barrels until filled and are also stored on wooden pallets in the EC Drum Cache storage compound between the airstrip and main complex.
- Old batteries are stored in wooden crates packed with vermiculite which are located in the “dead line” area behind the main complex right beside the EC Drum Cache which also contains old machinery.
- Ozone depleting substances such as un-serviceable refrigerant containing machinery is sent out to recovery facilities located in the South and is not dealt with on-site
- A map locating the storage locations for this waste is included in Appendix 3.

4.3 Landfill Locations

(See Appendix 2 & 3)

4.3.1 East Landfill

This landfill is used to contain non-organic/non-hazardous waste that cannot be incinerated and is located at the east end of the landing strip (79^{o} 59.484'N and 85^{o} 46.335'W). Ash from the incinerator is also landfilled at this location.

4.3.2. Ash Landfill

The ash landfill used to receive ash from the incineration of kitchen wastes although since 2000 there has been no ash deposited at this site. It is located south of the airstrip and slightly west of the South Landfill (79^{o} 59.534'N and 85^{o} 47.865'W). The ash from the Westlands CY-50-CA incinerator (with a capacity of 35kg/hr) is of organic origin and is transferred to barrels which are capped and sealed before being buried in the landfill. Since the ash is of organic kitchen waste and buried in this fashion, no non-hazardous confirmatory analyses is performed. A description of the incinerator and its basic operation is included in Appendix 4.

4.3.3 Asbestos Landfill

The asbestos landfill is adjacent to the ash land fill (79^{o} 59.531'N and 85^{o} 46.838'W). This landfill receives any asbestos removed from buildings on site.

4.3.4 West Landfill

This site is closed (79^{o}59.844'N and 85^{o}51.125'W). It contains kitchen waste and buried fuel drums.

4.3.5 Crushed Barrel Landfill

This site is located south of the runway (79^{o} 59.374'N and 85^{o} 55.586'W) but west of the South Landfill. Barrels will no longer be buried but sent South via retrograde as per AANDC recommendations.

4.3.6 History of Existing Landfills

An extensive, but unsuccessful, effort was undertaken to locate historical plans and drawings of the landfills at Eureka.

4.4 Operation and Maintenance of Solid Waste

4.4.1 Site Description

As previously noted, the major active landfills are just south of the east end of the landing strip. They are approximately 1.3 km from the Fjord. As the drainage from the above disposal grounds flows in the direction of the Fjord, there is concern that the surface runoff and leachate could reach the Fjord. As required by the Surveillance Monitoring Program, pursuant to Eureka's water licence, Eureka monitors the runoff

during periods of flow and samples are analyzed as per the parameters listed in the licence program monitoring requirements.

4.4.2 Waste Separation

Eureka's waste is separated into organic (kitchen waste), non-organic (cans, bottles, old vehicles, etc.), construction and demolition (wood, asbestos, etc.) and hazardous (waste oil, hydraulic fluids, batteries, oxygen depleting substances, old window and door frames with lead paint, etc). It should be noted that Eureka uses green products (nonhazardous and biodegradable) when possible (See Appendix 3[3]).

4.5 Disposal Procedures

4.5.1 Organic Waste

Organic and burnable waste is disposed of in a state of the art incinerator which was installed in 2008 and which meets the latest Environment Canada requirements. As mentioned previously, two to three times a week, the heavy equipment operator takes between 10-12 bags to the incinerator for burning which includes food cans. The ash generated by the burning is packaged in clean 205 L barrels (approximately 24/year) and moved with heavy equipment to the storage compound where it is free from disturbance. In the summer months, the ash (without the barrels) is deposited in a cell of the East Landfill and capped with 0.3 m of gravel capping material at a 3:1 slope.

4.5.2 Non-Organic, Non-Hazardous Waste

Non-organic and non-hazardous waste that cannot be incinerated is deposited in the East Landfill. The waste deposited in this land fill includes tires, construction materials (drywall, siding, wood, steel, tin, ash from incinerator), old vehicles and equipment (drained of fluids and batteries removed), wire, cable, tin, steel, copper, aluminum, empty compressed gas cylinders, plastics. Capping consists of 0.3 m of compacted native soils scraped from the surrounding gully.

4.5.3 Asbestos Waste

The limited amount of asbestos generated is double-bagged, placed in the Asbestos Landfill and covered with 1.5 m of gravel capping material and its location recorded so that subsurface soils will not be disturbed in the future.

4.5.4 Empty Drums

Any remaining liquid in empty drums is collected as hazardous material; the empty drums are then crushed, and now, placed in a secondary containment berm for temporary storage until they can be sent retrograde to a southern facility for disposal.

4.5.5 Hazardous Waste

- Secondary containment of hazardous materials awaiting disposal is provided in the form of salvage drums, crates, constructed with plastic lining or secondary containment pallets or metal pans and stored in the EC Drum Cache area (see Appendix 3).
- Used oil is stored in empty drums in the EC Drum Cache area (see Appendix 3 map) and is shipped as retrograde cargo on the annual sea lift to a certified recycling depot in the south.
- Used jet fuel is stored in empty drums in the EC Drum Cache area (see Appendix 3 map) and is shipped as retrograde cargo on the annual sea lift to a certified recycling depot in the south. EC is currently seeking a waste fuel burner which is capable of burning fuel that contains water.
- When sufficient batteries are collected (~ 2-3 pallets), they are stored in wooden crates packed with vermiculite which are located in the “dead line” area behind the main complex right beside the EC Drum Cache (see Appendix 3 map) and shipped as retrograde cargo on the annual sea lift to a certified recycling depot in the south.
- Waste glycol is stored in empty drums in the EC Drum Cache area (see Appendix 3 map) and is shipped out on sealifts or flights of “opportunity” to Safety-Kleen (Quebec) Ltd. 85 rue de Hambourg, Saint-Augustin-de Desmaures, QC, G3A 1S6.
- Ozone depleting substances such as un-serviceable refrigerant containing machinery is sent out to recovery facilities located in the South and is not dealt with on-site
- Any contaminated soils occurring from minor spills are recovered using heavy equipment, transported, and deposited in the ex-situ biotreatment cell located south of the runway (see Appendix 3 map). Both the Ex-situ biotreatment cell and the in-situ land farm are monitored on a weekly basis and the soil is tilled a few times during the summer months when the soil is not frozen.

4.6 Maintenance and Inspection

4.6.1 Landfills

Inspections of the landfill sites are performed on a daily or weekly basis depending on existing weather conditions. During runoff periods, samples of runoff are taken and analysed according to the parameters listed on the license requirements for the monitoring program.

There is not a problem with windblown debris because most material subject to being carried by the wind is either in the form of incinerated ash which is buried in capped and sealed barrels or it is fully covered in the summer.
Appropriate signage is posted.

Odour control is also not a problem because all organic waste is incinerated.

Outdoor burning is not carried out in Eureka in conformity with the Nunavut Water Board's direction unless the incinerator breaks down or a "bulk" burning {eg. sealift crates & pallets (non pressure treated wood), cardboard} is carried out. In both of the preceding situations, DIAND's Inspector is informed and permission is granted from the appropriate authority. Prior to proceeding with the open burning process, certain conditions must be evaluated, both environmental and physical, in order to ensure safe and responsible operation, which mirrors the Nunavut Government policy entitled "Municipal Solid Waste Suitable for Open Burning" at the following web address: http://env.gov.nu.ca/programareas/environmentprotection/legislation

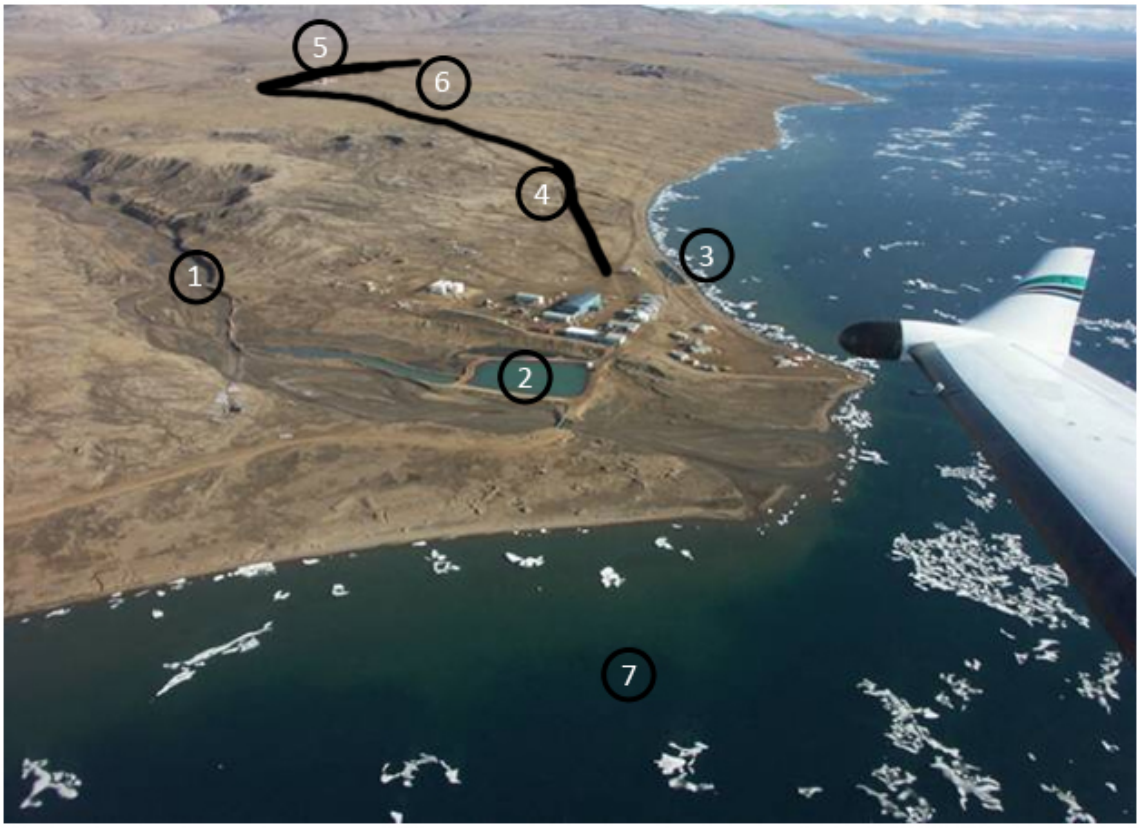
4.6.2 Landfarm

Until final development of the Remedial Action Plan (RAP) by Environment Canada, the Landfarm located north of the Powerhouse will continue to be tilled once per year in order to provide adequate aeration to the soil as was performed during the course of the research project by Whyte et al., 2001 which involved the implementation of a bioremediation program, in order to stimulate indigenous hydrocarbon degrading microorganisms in an effort to reduce the fuel contamination. The annual application of liquid fertilizer performed during the research project, which terminated in 2007, is no longer being continued.
As recommended by the Franz Environmental Phase III Environmental Site Assessment (ESA), the remedial options for this AEC should be re-evaluated to develop a more effective approach as it does not appear that the PHC impacted soils are being remediated to any significant degree. As the Phase III ESA is complete, Environment Canada is now entering the Remediation Phase of the project and currently developing the RAP. The development of a holistic approach to all PHC contaminated soil and the development of an overall management strategy of contamination began in 2012 as detailed in Addendum 1 of the Interim Abandonment and Restoration Plan (2011).

4.7 Records

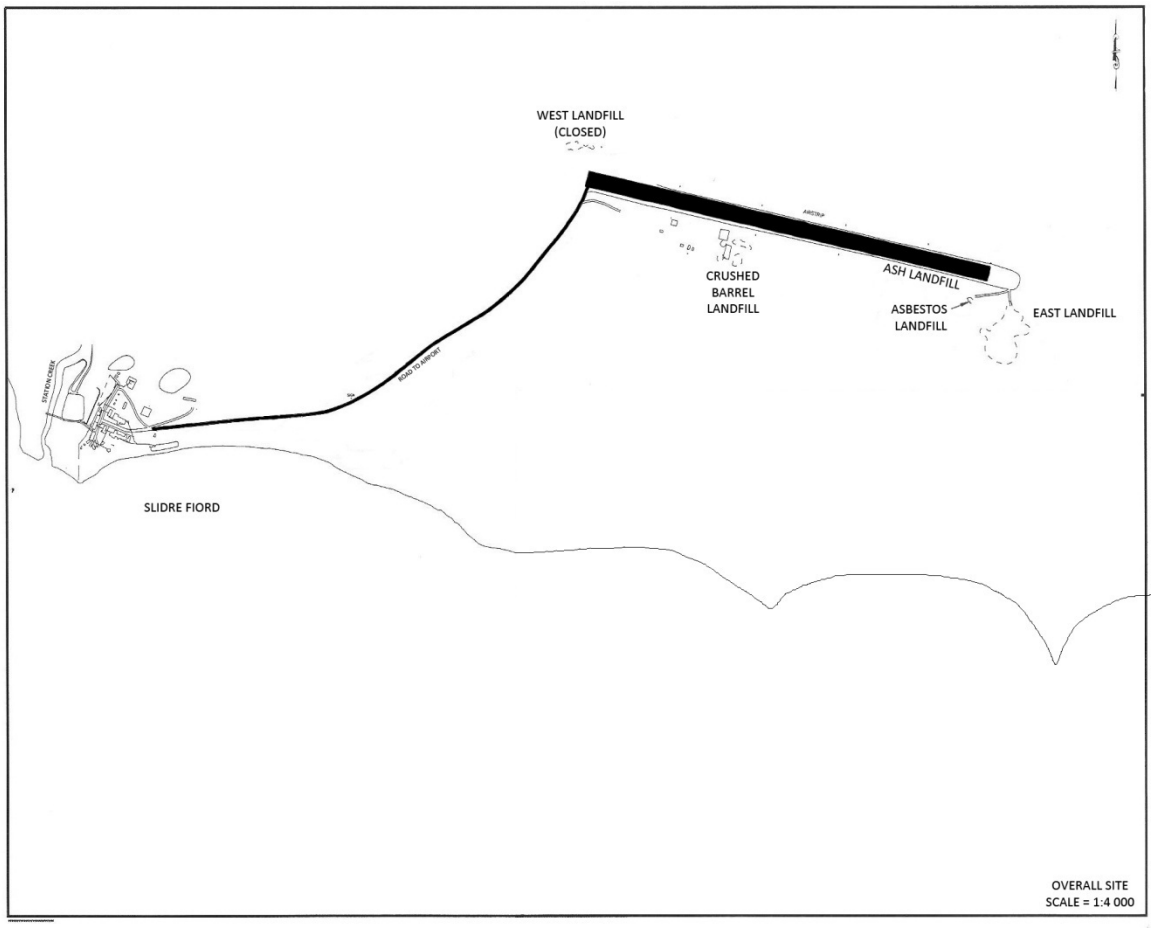
- Quantities of garbage generated are recorded monthly.
- MSDS sheets are available for viewing by personnel.
- Maintenance of landfills are recorded and described under Progressive Reclamation Work Undertaken in Eureka's Annual Report to the Water Board.
- Manifests are obtained and filed for shipments of hazardous material.
- Annual inspections by DIAND are recorded and a response is forwarded to DIAND and the Water Board.

Appendix 1: Eureka Weather Station, Nunavut



1. STATION CREEK
2. WATER SUPPLY LAGOON
3. SEWAGE LAGOON
4. ROAD TO RUNWAY
5. RUNWAY
6. EAST, ASBESTOS, ASH LANDFILLS
7. SLIDRE FIORD

Appendix 2: Locations of Eureka's Landfills



Appendix 3: Topographical map illustrating components of Fresh Water and Wastewater systems, Hazardous Materials storage areas, and landfill locations

Eureka Systems and Storage Locations Map Appendix 3.pdf (CNTRL+click hyperlink)

Appendix 4: Incinerator Operations Procedures

Incinerator Operating Procedures Appendix 4.pdf (CNTRL+click hyperlink)

5. References

Duong, D. and R. Kent (1996). *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories*. Government of the Northwest Territories, Municipal and Community Affairs Community Development.

Environmental Services, Public Works and Government Services Canada (Western and Northern Region) (1998). *Waste Management Plan for Eureka High Arctic Weather Station*. A report prepared for Atmospheric Environment Services, Environment Canada, Prairie and Northern Region.

Smith, D.W. and M. Nahir (2000). *Study of the Wastewater and Water Supply systems at the Eureka Weather Station*. A report prepared for Atmospheric Services, Environment Canada by Public Works and Government Services Canada, Western Region.