2006 Cambridge Bay Annual Water Licence Report

Prepared for:
Nunavut Water Board
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1.0 INTRODUCTION

In 2006, the community infrastructure systems providing water, sewage and solid waste management to the residents of the Hamlet of Cambridge Bay were successfully operated and maintained by the community. **Figure 1** and **Figure 2** provide an overview of the location of the source water and wastewater lagoon with respect to the community.

1.0 WATER USE

The raw water source is Water Supply Lake, approximately 3 kilometers north of the community. The catchments area for the Lake is 231 hectares (571 acres). The summer storage of Water Supply Lake is approximately 1,738,000 m^3 and winter storage volume is about 544,000 m^3 with 2.5 meters of ice. The water source is not near any human activities and, as such, is relatively free from potential contamination.

The intake facilities extend 20 meters into Water Supply Lake to a depth of approximately 4 meters below the surface. The intake pump discharge line consists of a 100 mm diameter HDPE pipe. This pipeline is coupled to submersible pump at the intake pumphouse and rests with a HDPE intake shaft or casing pipe. The water is chlorinated at the intake pumphouse prior to pumping to the distribution pumphouse.

A 2,900 meters water supply pipeline runs from the intake facilities to the distribution pumphouse at the centre of community. The 150 mm waterline is freeze protected with insulation and a 50 mm recirculation waterline.

Water is then distributed by water trucks from the truckfill station in the community center to the water tanks within each residence in the community. Water delivery is provided to the residents by the Hamlet using 12,000 litre water trucks. There is a 260 m^3 storage tank located beside the distribution pumphouse. **Figure 3** shows the location of the intake area, pipeline, and distribution pumphouse. **Figure 4** shows the water distribution pumphouse.

2.0 WASTEWATER DISCHARGE

Sewage is collected from the community by sewage trucks to the sewage lagoon system, located approximately 1.5 km northeast of the community and adjacent to the existing Waste Metal Disposal Site. The system consists of several natural ponds connected in series (Pond 1, Pond 2, Pond 3, Pond 4, Pond 5 and Pond 6) as shown in **Figure 5**. Based on the normal water level in the lagoon ponds, the lagoon volume was estimated to be 72,000 m^3 by IEG Environmental Consultants.

The sewage is discharged into Pond 1 of the lagoon by tanker trucks at truck discharge site. The treated sewage by the lagoon is channeled into Cambridge Bay. Currently, there is no discharge control structure in the lagoon. The existing lagoon is, therefore, seasonally flooded due to spring runoff flowing into the lagoon from the surrounding watershed. The sewage effluent from the lagoon is discharged to Cambridge Bay continually.

3.0 WATER AND WASTEWATER QUANTITIES

Water consumption values are not available for this report. As such, water consumption was estimated as 140 litres per capita per day. The population for Cambridge Bay was estimated as 1,407 based on the Statistics Canada reported population of 1,309 in 2001 and an assumed 2.44% annual growth rate.

As such, water consumptions are estimated per month below.

Month	Total Water Use (Litres)
January	6,410,180
February	5,789,840
March	6,410,180
April	6,203,400
May	6,410,180
June	6,203,400
July	6,410,180
August	6,410,180
September	6,203,400
October	6,410,180
November	6,203,400
December	6,410,180
Total	75,474,700

The monthly and annual quantities of wastewater discharged are not metered, but are estimated to equal the quantity of potable water. The estimated annual wastewater production of 75,474m^3 allows a retention time in the sewage lagoon of 348 days.

4.0 SYSTEM MODIFICATIONS, MAINTENANCE AND LICENCE AMENDMENTS

The water use and waste disposal in the Hamlet of Cambridge Bay is regulated by a Type B Water Licence. The water use and waste disposal in the Hamlet of Cambridge Bay is regulated by a Type B Water Licence. The water licence for the Hamlet of Cambridge Bay, number NWB3CAM0207, was issued on September 1, 2002 and expires on August 31, 2007.

In February 2005, the Nunavut Water Board issued Amendment 1 to Licence No. NWB3CAM0207 in order to allow the Hamlet to remediate petroleum-impacted soils at a Hydrocarbon-Impacted Soil Landfarm Treatment Facility.

There are no records of system modifications or maintenance in 2006 for the water and sewer systems serving the Hamlet of Cambridge Bay.

5.0 SURVEILLANCE NETWORK PROGRAM MONITORING

A sampling of Cambridge Bay's wastewater system was undertaken on June 21, 2006 at the sewage lagoon pond "lagoon", the outlet of the pond adjacent to the metal disposal site "pond", and the ocean discharge point "outlet". The locations are presented in **Figure 6**. Sample results are detailed below. Previous sampling data, where available, is included. The laboratory report is included in **Appendix A.**

Table 1 "Lagoon" Sampling Results

Effluent Discharge Paramater	Unit	"Lagoon" Sample Point		MWWE Guideline[1]
		1998 Sample (Average)	2006 Sample	
pH		8.88	7.55	6.5 - 8.5[2]
Total Suspended Solids	mg/L	63	48	180
BOD_5	mg/L	88	25	120
Ammonium	mg/L	N/A	7.25	--
Kjeldahl Nitrogen	mg/L	N/A	15.8	--
Organic Carbon	mg/L	N/A	20.2	--
Faecal Coliforms	CFU/100 mL	N/A	<1	--
Total Dissolved Solids	mg/L	N/A	287	--

Notes:

1. [1] Guidelines for the Discharge of Treated Municipal Wastewater in the NWT, 1992 (Season: Summer, 150-600 Lcd) (Receiving Env: Marine/Bay).
2. [2] As stated in the Water License of the hamlet of Cambridge Bay.
3. [2] NA - not analyzed/not available.
4. It should be noted that the MWWE Guideline values are for the effluent discharge into the environment, not the effluent from "lagoon" only.

Table 2 "Pond" Sampling Results

Parameter	Units	"Pond" Sampling Point			MWWE Guidelines [1]
		1998 Sample (Average)	October 2003 Sample	June 2006 Sample	
pH		8.73	N/A	8.15	6.5-8.5
Total Suspended Solids	mg/L	8.73	40	41	180
BOD5	mg/L	70.3	11	26	120
Fecal Coliforms	CFU/dL	65.6	N/A	<1	--
Silver, Ag	mg/L	0.00019	<0.0050	<0.0001	0.1
Aluminum, Al	mg/L	N/A	0.280	0.105	2.0
Arsenic, As	mg/L	N/A	N/A	0.0007	0.05
Boron, B	mg/L	N/A	0.500	0.137	5.0*
Barium, Ba	mg/L	N/A	0.068	0.027	1.0*
Beryllium, Be	mg/L	N/A	<0.0020	<0.0001	--
Bismuth, Bi	mg/L	N/A	<0.001	<0.0005	--
Calcium, Ca	mg/L	N/A	66.1	21.7	--
Cadmium, Cd	mg/L	0.00011	<0.00100	<0.00001	0.005*
Cobalt, Co	mg/L	0.0004	<0.002	0.0002	0.1*
Chromium, Cr	mg/L	0.0033	<0.0050	<0.0005	0.1
Copper, Cu	mg/L	0.0067	0.010	0.013	0.2*
Iron (total), Fe	mg/L	2.5214	2.81	1.40	--
Potassium, K	mg/L	N/A	28.4	7.5	--
Magnesium, Mg	mg/L	N/A	74.1	14.6	--
Manganese, Mn	mg/L	0.0188	0.162	0.038	0.05*
Molybdenum, Mo	mg/L	NA	<0.005	<0.001	0.2
Sodium, Na	mg/L	NA	193.0	37.4	--
Nickel, Ni	mg/L	0.0019	0.0050	0.0022	0.3*
Lead, Pb	mg/L	0.0027	<0.0050	0.0009	0.05*
Tin, Sn	mg/L	N/A	<0.050	<0.001	5.0
Strontium, Sr	mg/L	N/A	0.1170	0.0380	--
Titanium, Ti	mg/L	N/A	0.0100	0.0047	--
Thallium, Tl	mg/L	N/A	<0.05000	<0.00005	--
Vanadium, V	mg/L	N/A	0.003	0.0003	--
Zinc, Zn	mg/L	0.0225	0.028	0.021	0.50

Notes:

1. 1998 sample results are obtained from a report titled "Environmental Audit & Site Contamination Assessment of Cambridge Bay Waste Disposal Sites, 2000".
2. NA - Not analyzed/data not available.
3. -- - No applicable guideline.
4. October 2003 Sample Report is obtained from IEG Report "Cambridge Bay Municipal Sewage Lagoon and Waste Facilities Assessment, October 2005".
5. October 2006 Sample Report is based upon samples collected by Earth Tech and Analyzed by Norwest Labs, Edmonton.
6. [1] Guidelines for the Discharge of Treated Municipal Wastewater in the NWT, 1992 (Season: Summer, 150-600 Lcd) (Receiving Env: Marine/Bay).
7. * Dissolved.
8. **Field measurements (2006 Sample):** pH 8.5; Temperature in water 7°C.

Table 3 "Outlet" Sampling Results

Parameters	Units	"Outlet" Sampling Results			MWWE Guidelines[1]
		1998 Sample (Average)	October 2003 Sample	June 2006 Sample	
pH		7.74	N/A	9.18	6.50 - 8.50[2]
TSS	mg/L	11.50	189	28	180.0
BOD_5	mg/L	6.33	156	17	120.0
Fecal Coliforms, FC	CFU/dL	154	N/A	<1[#]	--
Ammonium		N/A	N/A	0.58	--
Kjeldahl Nitrogen		N/A	N/A	6.32	--
Silver, Ag	mg/L	0.0001	<0.005	N/A	0.10
Aluminum, Al	mg/L	N/A	2.75	N/A	2.0
Arsenic, As	mg/L	N/A	0.0012	N/A	0.05
Boron, B	mg/L	N/A	0.39	N/A	5.0[*]
Barium, Ba	mg/L	N/A	0.037	N/A	1.0[*]
Beryllium, Be	mg/L	N/A	<0.002	N/A	--
Calcium, Ca	mg/L	N/A	32.70	N/A	--
Cadmium, Cd	mg/L	0.0001	<0.001	N/A	0.005[*]
Cobalt, Co	mg/L	0.0007	<0.002	N/A	0.1[*]
Chromium, Cr	mg/L	0.0030	<0.005	N/A	0.1
Copper, Cu	mg/L	0.0030	0.149	N/A	0.2[*]
Iron, Fe	mg/L	N/A	1.69	N/A	0.3[*]
Potassium, K	mg/L	N/A	18.10	N/A	--
Magnesium, Mg	mg/L	N/A	25.60	N/A	--
Manganese, Mn	mg/L	N/A	0.054	N/A	0.05[*]
Mercury, Hg	mg/L	0.00001	<0.0002	N/A	0.0006
Molybdenum, Mo	mg/L	N/A	<0.005	N/A	0.2
Selenium, Se	mg/L	N/A	0.002	N/A	0.05
Sodium, Na	mg/L	N/A	89	N/A	--
Nickel, Ni	mg/L	0.0018	0.004	N/A	0.3[*]
Lead, Pb	mg/L	0.0013	<0.005	N/A	0.05[*]
Tin, Sn	mg/L	N/A	<0.05	N/A	5.0
Strontium, Sr	mg/L	N/A	0.053	N/A	--
Titanium, Ti	mg/L	N/A	0.044	N/A	--
Thallium, Tl	mg/L	N/A	<0.05	N/A	--
Vanadium, V	mg/L	N/A	0.003	N/A	--
Zinc, Zn	mg/L	0.0096	0.081	N/A	0.5

Notes:

1. 1998 sample results are obtained from a report titled "Environmental Audit & Site Contamination Assessment of Cambridge Bay Waste Disposal Sites, 2000".
2. October 2003 Sample Report is obtained from IEG Report "Cambridge Bay Municipal Sewage Lagoon and Waste Facilities Assessment, October 2005."
3. October 2006 Sample Report is based upon samples collected by Earth Tech and measured by Norwest Labs, Edmonton.

Parameters	Units	"Outlet" Sampling Results			MWWE Guidelines[1]
		1998 Sample (Average)	October 2003 Sample	June 2006 Sample	

4. [1] Guidelines for the Discharge of Treated Municipal Wastewater in the NWT, 1992 (Season: Summer, 150-600 Lcd) (Receiving Env: Marine/Bay).
5. [2] Water License requirement.
6. # Result is not reliable because of equipment error as reported by the Norwest Labs.
7. * Dissolved content.
8. Field measurements (2006 Sample): pH 8.5; Temperature in water 7°C.
9. N/A - Parameter not analyzed/data not available
10. -- No specific guidelines are available.

In 2006, to the best of the community's knowledge, based upon feedback from the community's operating staff and the limited water sample data, the community infrastructure systems were operating within the criteria of the water licence with the exceptions that: the laboratory reported pH at the outlet sample point of 9.18, higher than the allowable regulation of 8.5, though field measurements indicated a pH of 8.5; and the estimated annual removal of approximately 75,475 m^3 of water from the Water Lake exceeded the water licence allowance. The current water licence allows for the removal of 70,000 m^3 of water from Water Lake annually.

6.0 SYSTEM ABANDONMENT AND RESTORATION WORK

The water and sewer systems serving the Hamlet of Cambridge Bay did not have any record of system abandonment or restoration work completed in 2006.

7.0 SYSTEM STUDIES AND INSPECTIONS

Earth Tech Canada was retained by the Government of Nunavut on behalf of the Hamlet of Cambridge Bay to complete a planning report to identify potential new sites for the community's solid and liquid waste disposal to meet the future needs of the community. The report, entitled "Planning Report for New Waste Management Sites" was issued on July 12, 2006 and identified eight potential sites. The planning report included a proximity analysis to human activities, the airport, and other site features, an analysis of road access, cost estimates and general site development configurations. Three of the sites were discounted due to proximity to the community and to the airport. The remainder of the sites was recommended for further consideration.

In August, 2006, Earth Tech prepared a report entitled 'Cambridge Bay Waste Facility Improvements Sewage Analysis – Summary Report". A water sampling program of the existing lagoon and landfill was undertaken and the results of previous water sampling in 1998 and 2003 were analyzed. The report concluded that the discharge of the existing lagoon system was at an acceptable level and met MWWE Guidelines, with the exception of pH, Al_{total}, and Fe_{total}. Additionally, it was found that the solid waste landfill runoff was a significant source of contaminants to the existing lagoon system.

Based on the above effluent sampling results, community and stakeholder input and discussions with the Nunavut Water Board, future engineering developments of the Hamlet of Cambridge Bay will focus on redeveloping the current liquid and solid waste facilities.

In support of redeveloping the existing waste management sites, a topographical survey and a geotechnical investigation was undertaken in the fall of 2006. The survey investigations provided contour information for the landfill and lagoon pond areas and the discharge stream; the geotechnical investigation provided information about the soil conditions around the sites and around the community for potential use in the construction redevelopment work. This report, entitled "Geotechnical Evaluation for Municipal Waste Facilities, Cambridge Bay, NU" was issued in December, 2006.

There were no Indian and Northern Affairs Canada (INAC) inspections reported for the Hamlet of Cambridge Bay in 2006.

8.0 TRAINING AND COMMUNICATION EXERCISES

Some staff attended a sewage treatment and solid waste management technologies workshop held by Earth Tech in the Hamlet of Cambridge Bay on February 27, 2006.

9.0 SYSTEM DISCHARGES

Sewage enters into Pond 1 at the truck discharge site. Sewage travels through the six lagoon ponds identified in Figure 4**.** The wastewater will enter a series of natural lakes and wetlands before ultimately discharging into Cambridge Bay approximately 450 metres east of the community. Effluent from the sewage lagoon discharges during spring, summer and fall. Effluent does not discharge during winter due to freezing.

10.0 SYSTEM EXCAVATIONS

In 2006, there were no record of trench or sump excavations associated with the Hamlet's water, sewer and solid waste management systems.

11.0 LAGOON SLUDGE

In 2006, there was no removal of solid waste or sludge from the sewage lagoon.

12.0 OPERATION AND MAINTENANCE PLANS

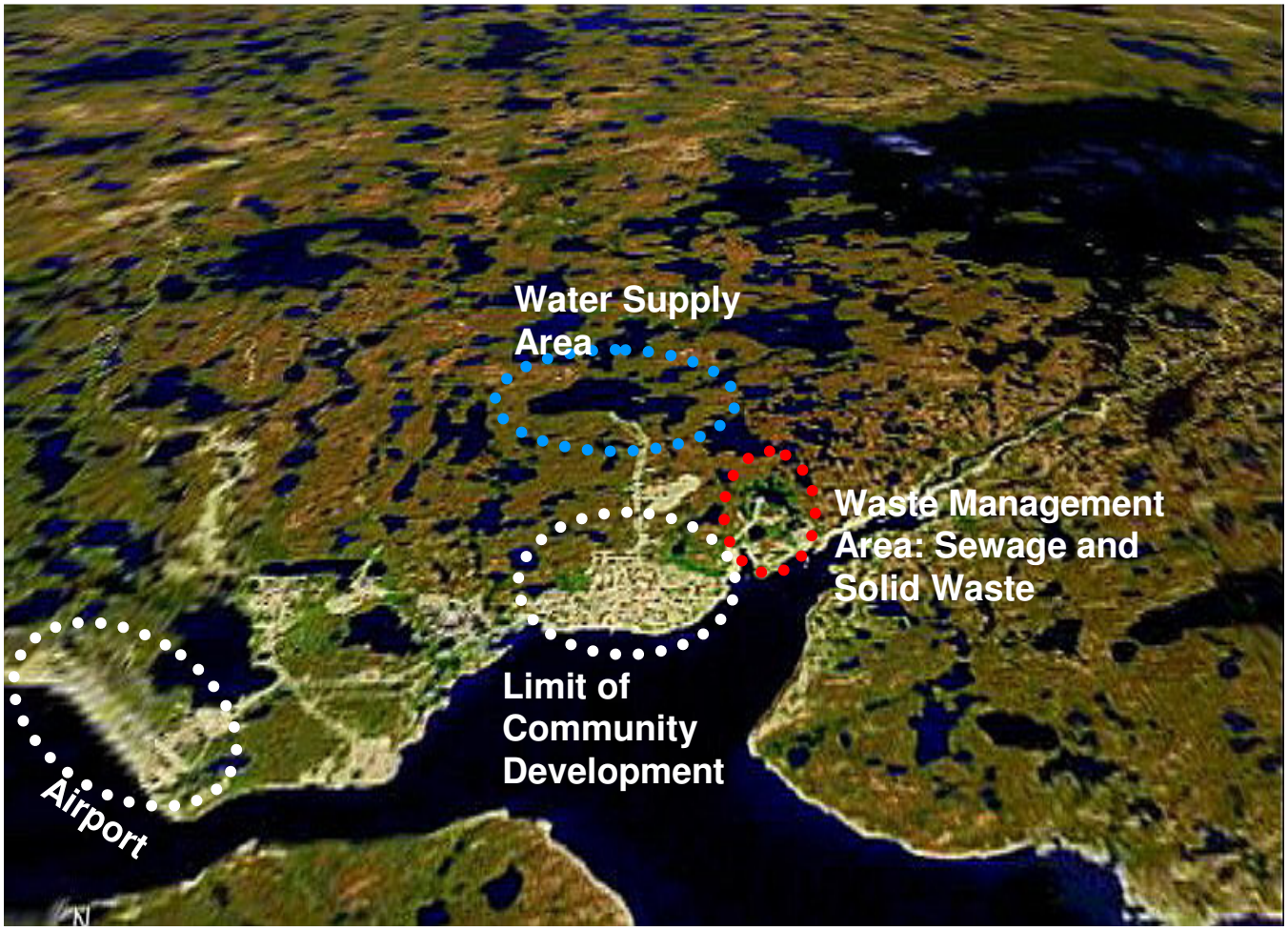
Operation and Maintenance (O&M) Manuals for the Hamlet of Cambridge Bay's solid and sewage waste treatment systems have been identified as a requirement for the renewal of the Hamlet's water licence by the Nunavut Water Board (NWB). As such O&M Manuals will be updated and submitted to the NWB for review.

13.0 REFERENCES

"Cambridge Bay Municipal Sewage Lagoon and Waste Facilities Assessment", IEG, October 2005.

"Cambridge Bay Waste Facility Improvements, Sewage Analysis Summary Report", Earth Tech Canada, August 2, 2006.

"Hamlet of Cambridge Bay, Sewage and Solid Waste Facilities, Planning Report for New Waste Management Sites", Earth Tech Canada, July 12, 2006.



Hamlet of Cambridge Bay
Annual Report
Water Supply and Waste Sites

Figure 1

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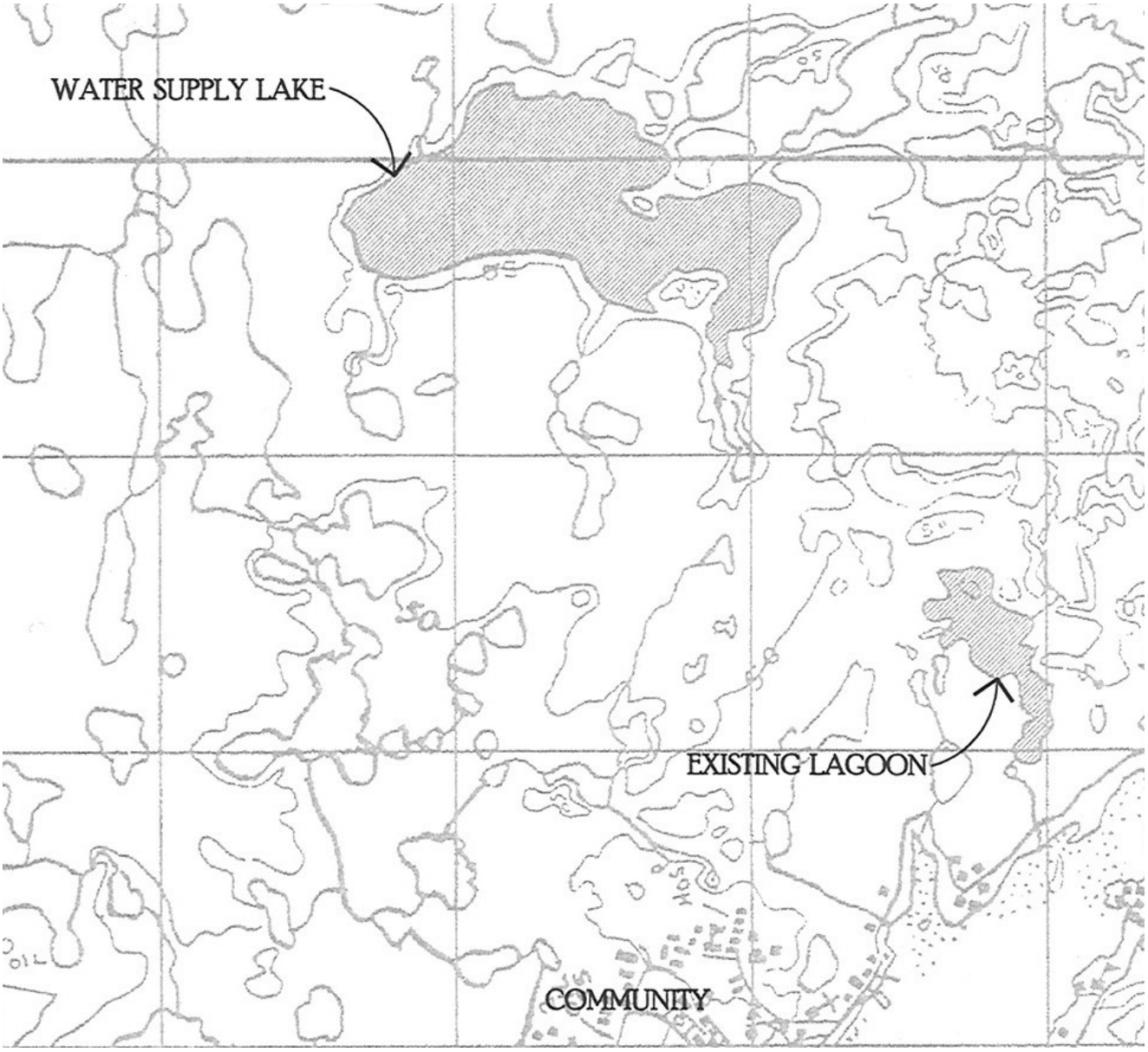
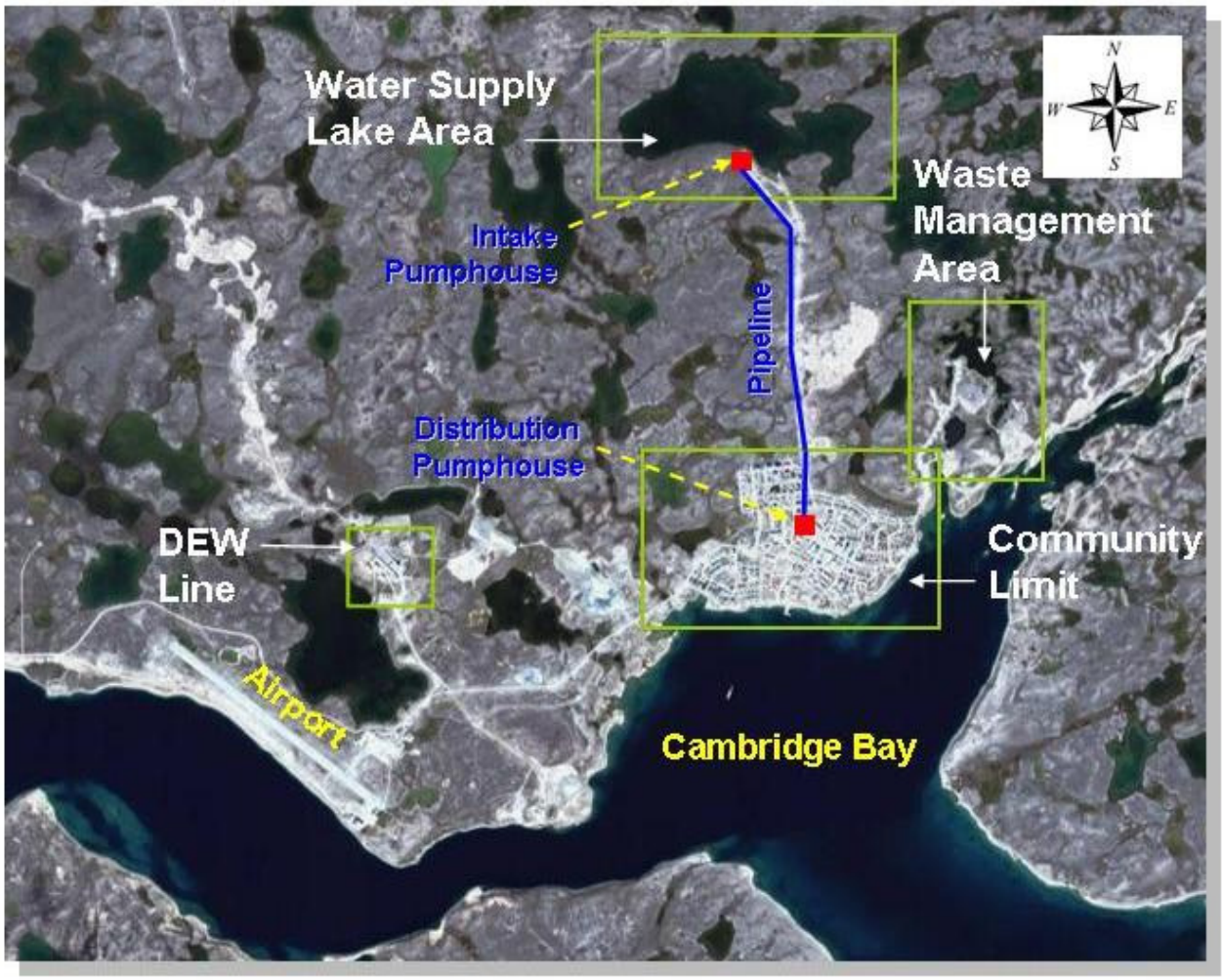


Hamlet of Cambridge Bay
Annual Report
Lagoon and Water Supply Locations

Figure 2

EarthTech



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Water Pumphouse and Pipeline Locations

Figure 3

EarthTech

Hamlet of Cambridge Bay
Annual Report
Sewage Lagoon Pond Locations

Figure 4

EarthTech

Figure 3 Water Distribution Pumphouse

Hamlet of Cambridge Bay
Annual Report
Water Distribution Pumphouse

Figure 5

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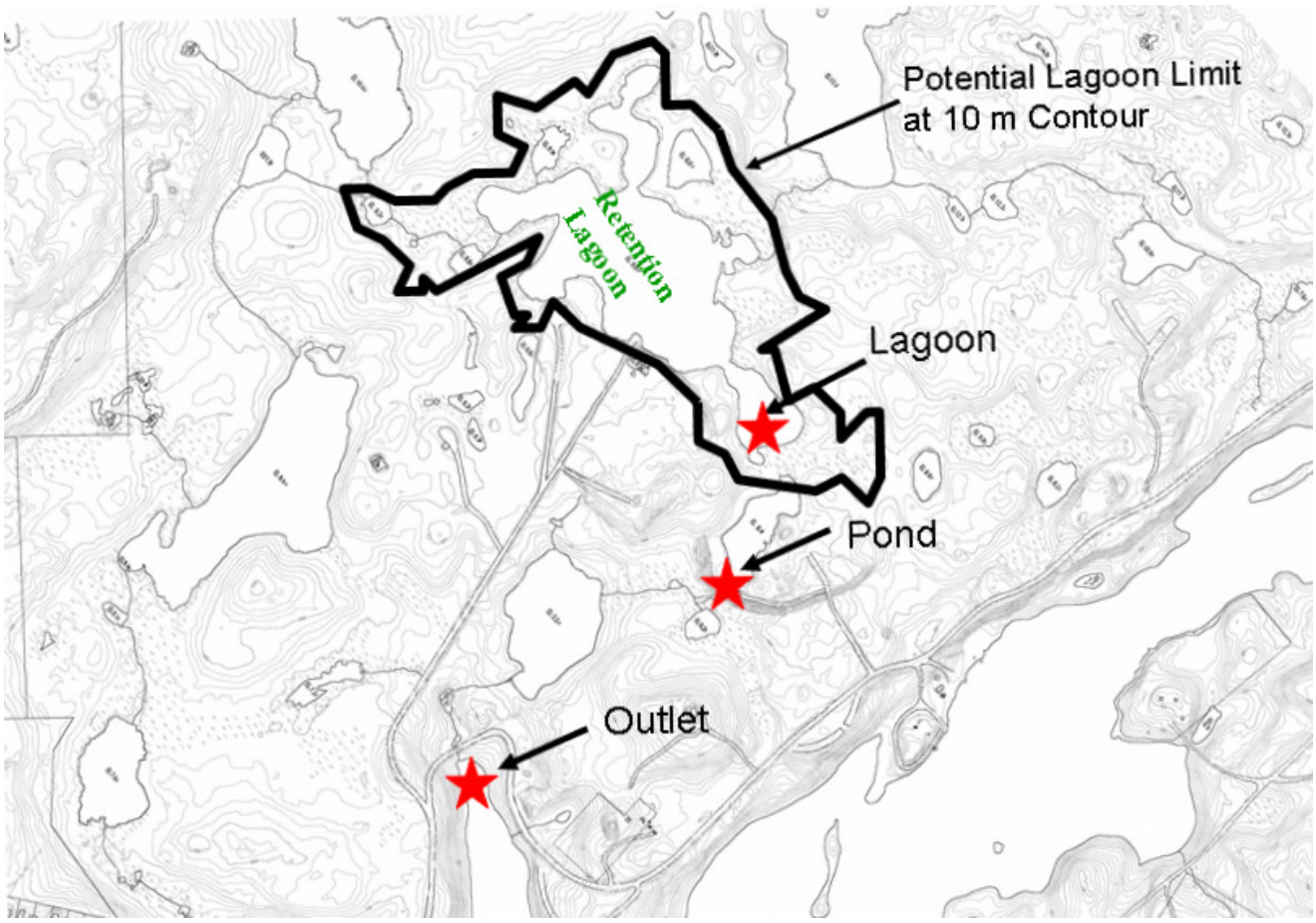

Hamlet of Cambridge Bay
Annual Report
Sewage Lagoon Sampling Locations

Figure 6

EarthTech