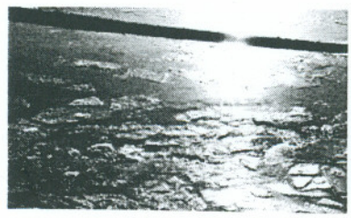
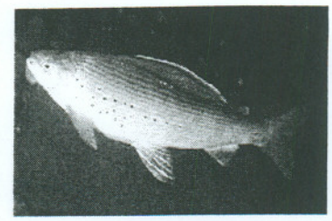
DRAFT

SEWAGE LAGOON DISCHARGE ASSESMENT
TUKTOYAKTUK, NT





Prepared for:

Government of the Northwest Territories
Department of Municipal and Community Affairs

Prepared by:

IEG Environmental

February 2005
IEG Project 5727-04

DRAFT

SEWAGE LAGOON DISCHARGE ASSESSMENT
TUKTOYAKTUK, NT

Submitted to:

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DISTRIBUTION:

1 Electronic Copy, Ilian Zinoviev, Department of Municipal and Community Affairs, GNWT

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1.0 INTRODUCTION

IEG Environmental (IEG) was contracted by the Government of the Northwest Territories (GNWT) Department of Municipal and Community Affairs (MACA) to undertake a sewage lagoon discharge assessment in Tuktoyaktuk, NT. The Hamlet of Tuktoyaktuk's water licence requires they investigate the potential impacts of the seasonal sewage discharge from the municipal sewage lagoon on the receiving environment, Kugmallit Bay. The assessment includes:

- Water and sediment study before discharge;
- Water study during discharge;
- Water and sediment study after discharge;
- Study fish and benthic organisms both in side and outside the impacted area; and
- Analysis and interpretation of the results.

1.1 Scope of Work

The scope of work includes:

- Obtain and review all related documentation, including the Water License, annual reports, construction drawings, operating and maintenance manuals, guidelines etc.
- Travel to Tuktoyaktuk to complete the sampling program:
    - Sample and analyze the water of Kugmallit Bay at the point of discharge, before, during and after decanting the sewage lagoon;
    - Sample and analyze the sediments before and after decanting the sewage lagoon; and
    - Sample and analyze the fish and benthic organisms (including shellfish).
- Assess the impacts of sewage discharge on fish and shellfish harvesting activities; and
- Generate a report summarizing and interpreting the results.

2.0 SEWAGE LAGOON OPERATIONS

All municipal wastewater generated in the Hamlet of Tuktoyaktuk is collected by vacuum truck and transported to the municipal sewage lagoon located approximately 5.0 km from the community. The lagoon is a natural lake, approximately 5.9 ha in area. It has been modified with a perimeter berm at the south edge for retention purposes. The lagoon is discharged to an adjacent ocean inlet once a year in the fall. A temporary pump is set up on top of the berm to accomplish the discharge.

3.0 DISCHARGE ASSESSMENT METHODOLOGY

3.1 Field Summary

The project was awarded at the end of September 2004. It was important to travel to Tuktoyaktuk as soon as possible after the award date so the Hamlet could discharge the lagoon before it became too cold to do

so. Therefore, there was insufficient time to apply for and receive the permits required to complete the fisheries study. The fisheries study is scheduled to be performed during the 2005 lagoon discharge. See **5.0 Work to be completed during the 2005 discharge** below.

Field work that was completed during the 2004 discharge was:

- Water sampling before, during and after discharge;
- Sediment sampling before and after discharge;
- The effluent plume was defined; and
- Water and sediment sampling at a background location.

3.1.1 Site visit October 4-7, 2004

The first site visit took place October 4 – 7, 2004. During this site visit:

- Water and sediment samples were collected before discharge;
- Water samples were collected during discharge;
- Background samples were collected; and
- The plume mixing zone was measured.

To complete the field work, Sarah Dando, EIT traveled from Yellowknife and David Wells, Environmental Specialist traveled from Inuvik.

Due to weather delays, the Hamlet could not discharge the lagoon continuously and it was evident the lagoon would not finish pumping while IEG staff were on site. It was decided with the project officer that IEG would return to Tuktoyaktuk after the lagoon had discharged and after the ice was frozen thick enough for IEG to safely travel onto the ice to collect the after discharge samples.

IEG staff did not meet with the HTC during the site visits because the permitting work for the fisheries portion of the project was not completed. IEG did meet with the Hamlet to inform the Hamlet about the project.

3.1.2 Site visit October 27, 2004

David Wells and Greg Morrissey traveled from Inuvik to Tuktoyaktuk October 27, 2004 to complete the after discharge water and sediment sampling. During this site visit a hole had to be augured through the ice to collect the water and sediment samples.

3.2 Methodology

The following methodology was used to collect samples for the project.

3.2.1 Water and Sediment Samples

Water and sediment samples were collected at three different locations:

- Site 1, downstream of Site 2
- Site 2, downstream of the effluent discharge; and

- Background, in Tuktoyaktuk Harbour

All three site locations are indicated on Figure 1 in Appendix A.

During the October 4 – 7 site visit, site conditions dictated that two sample points be used for the water quality and sediment sampling, site 1 and site 2. The bay was frozen except for an opening of approximately 10,702m^2.

Water samples collected before and during discharge at sites 1 and 2 were collected from the side of a boat using a bailer. Water samples collected after discharge were collected using a bailer through a hole that had been augured through the ice. The bailer was rinsed a minimum of three times before sample collection. Sample collection followed *Standard Methods for the Examination of Water and Wastewater* (20th edition, 1998). Once the samples were collected they were preserved overnight at 4°C and then transported to Taiga Environmental Laboratories in Yellowknife, NT.

The before discharge sediment samples were collected using a sediment corer from the side of a boat. The after discharge sediment samples were collected with the sediment corer through a hole augured in the ice. The sediment cores were packaged and sent to Enviro-Test Laboratories in Edmonton, AB.

Sample results and analysis can be found in the proceeding sections.

3.2.2 Plume delineation

As outlined in the Terms of Reference for the project, salinity was to be used to delineate the plume migration through Kugmallit Bay. To complete the delineation of the effluent plume IEG decided to temporarily install portable salinity meters, with data loggers, in Kugmallit Bay.

The eight salinity meters were installed by:

1. Setting the salinity meter to automatically log a reading every 0.5 hour.
2. Wrap the meter in a plastic bag.
3. Secure the meter to a piece of blue insulation.
4. Pierce a hole through the insulation with the rebar so the insulation is now floating on the water.
5. Secure the insulation to the rebar by tying a rope to the rebar and to the insulation.
6. Put the probe in the water.
7. Securing a piece of rebar into the sediment.

Please see a photo of the setup in Appendix C.

The location of the eight probes was limited by the area of open water, the locations of the meter stations are identified in Figure 1, Appendix A. The average depth of the water at all eight stations was 0.75 m and the average depth of the probes was 0.6 m

The meters logged data from the late afternoon of October 5 to the morning of October 7th, 2004. Pumping began at 18:30 October 5th and continued discontinuously until after the IEG team left the site on October 7th, 2004.

4.0 SAMPLE RESULTS

Please see Appendix A for a site diagram showing the various sample locations and Appendix B for complete table of results.

4.1 Water and Sediment Samples

The results of the water sampling analysis showed there was little change between the two test sites and the control site before, during and after discharge.

Table 1 summarizes the water sample results below, highlights of the results are:

- Fecal Coliforms of 1 CFU/100 ml and Biological Oxygen Demand of 2 mg/L were unchanged for all sites during all phases of discharge.
- The maximum ph deviation of 0.17 occurred at site 1 during the discharge phase and the greatest difference from the control site was 0.10 which occurred at site 1 after the discharge. This variation is pH is to expected within the natural range of pH fluctuations.
- Total suspended solids (TSS) were measured at 4 mg/L to 102 mg/L at site 1 before and after the discharge. TSS at site 2 ranged between 34 mg/L to 24 mg/L before and after the discharge respectively. The TSS of 34 mg/L before discharge at site 2 may be attributed to the propeller of the boat stirring up the sediment. TSS levels of 34 to 24 mg/L are low and expected as natural variation. TSS of 104 mg/L would be considered high, however it is unclear if the value is a result of the sewage lagoon discharge because site 1 appeared to be outside of the influence of the discharge which will be further discussed in the following section.
- Total Phosphorus levels increased from 0.05 mg/L to 0.09 mg/L to 0.11 mg/L at site 1 throughout the 3 phases respectively. Site 2 showed smaller deviations of 0.06 mg/L, 0.09 mg/L and 0.09 mg/L respectively. The level of Total Phosphorus at the control site was 0.06 mg/L. All Phosphorus levels are considered high for natural system.
- All parameters were compared to the Canadian Council of Ministers of the Environment (CCME) *Canada Environmental Quality Guidelines for Marine Aquatic Life*. Of the parameters sampled for the study, only pH is represented in the guideline and all values fell within the pH range outlined in the guideline.

Table 1: Summary of Water Sample Results

ANALYTE	SITE 1			SITE 2			CONTROL	GUIDELINE[1]
	Before	During	After	Before	During	After		
Coliforms, Fecal (CFU/100ml)	1	1	1	1	1	1	1	N.G.
BOD (mg/L)	2	2	2	2	2	2	2	N.G.
pH	7.85	7.89	7.72	7.85	7.88	7.74	7.82	7.0-8.7
Solids, Total Suspended (mg/L)	4	16	102	34	12	24	12	N.G.
Phosphorus, Total (mg/L)	0.05	0.09	0.11	0.06	0.09	0.09	0.06	N.G.

[1] Canadian Environmental Quality Guideline, Marine Aquatic Life

N.G: No Guideline

The results of the sediments analysis showed similarities between both sampling sites before and after discharge.

Table 2 summarizes the sediment sample results below, highlights of the results are:

- Only levels of Titanium and % Sand increased at both sites.
- Sodium, % moisture, Total Nitrogen by LECO, and % clay decreased at both sites.
- Levels of Mercury, Silver, Beryllium, Cadmium, and Thallium were unchanged or below the detection limit at both sampling sites.
- The texture of the sediment remained unchanged.
- For a number of metals, levels increased at site 1 after discharge while they decreased at site 2 after discharge. These include: Aluminum, Barium, Calcium, Cobalt, Chromium, Copper, Iron, Potassium, Magnesium, Nickel, Phosphorus, Strontium, Vanadium, and Zinc. % Silt showed the same trend.
- Levels of Available Phosphate and Molybdenum at site 1 remained unchanged after discharge at 5 ppm and 1 ppm respectively.
- At site 2 Manganese and Lead remained unchanged after discharge at 150 ppm and 9 ppm respectively.
- All sediment sample results were compared to the CCME *Canada Environmental Quality Guidelines for Marine Sediment*. There are two guideline values for sediment the interim soil quality guideline (ISQG) and the probably effect limit (PEL). As indicated in the table below the ISQG was used as it is the more conservative guideline. The two parameters that exceeded the ISQG were Copper before and after discharge at site 2 and Chromium after discharge at site 1. The PEL for Copper is 108 mg/kg and 160 mg/kg for Chromium, sample results for both parameters are lower than the PEL.

When comparing the results to the control site sediment analysis there were no measurements that differed by an order of magnitude and no clear trends of increasing or decreasing metal content either before or after the discharge occurred.

Table 2: Summary of Sediment Sample Results

ANALYTE	Unit	SITE 1			SITE 2			GUIDELINE[1]	CONTROL
		Before	After	Change	Before	After	Change		
Inorganic Carbon	%	0.11	0.61	*0.5*	0.26	0.15	*-0.11*	N.G.	0.27
Total Organic Carbon	%	2.3	1.4	*-0.9*	4.7	2.6	*-2.1*	N.G.	3.5
Total Carbon by Combustion	%	2.4	2	*-0.4*	5	2.7	*-2.3*	N.G.	3.8
Available Phosphate-P	mg/kg	5	5	*0*	1	2	*1*	N.G.	<1
Mercury (Hg)	mg/kg	0.06	<0.05	*>0.01*	0.06	<0.05	*>0.01*	0.130[2]	0.06
Silver (Ag)	mg/kg	<1	<1	*D.L*	<1	<1	*D.L*	N.G.	<1
Aluminum (Al)	mg/kg	4700	6100	*1400*	7300	6600	*-700*	N.G.	5300
Barium (Ba)	mg/kg	150	210	*60*	350	170	*-180*	N.G.	190
Beryllium (Be)	mg/kg	<2	<2	*D.L*	<2	<2	*D.L*	N.G.	<2
Calcium (Ca)	mg/kg	4400	14200	*9800*	9100	6600	*-2500*	N.G.	11300
Cadmium (Cd)	mg/kg	<1	<1	*D.L*	<1	<1	*D.L*	0.7[2]	<1
Cobalt (Co)	mg/kg	5	7	*2*	9	8	*-1*	N.G.	5
Chromium (Cr)	mg/kg	18	105	*87*	35	22	*-13*	52.3[2]	11
Copper (Cu)	mg/kg	11	15	*4*	23	19	*-4*	18.7	13
Iron (Fe)	mg/kg	12200	27200	*15000*	17800	15800	*-2000*	N.G.	16700
Potassium (K)	mg/kg	1000	1200	*200*	2000	1500	*-500*	N.G	1300
Magnesium (Mg)	mg/kg	3700	6800	*3100*	6500	4400	*-2100*	N.G	6200
Manganese (Mn)	mg/kg	130	430	*300*	150	150	*0*	N.G	210
Molybdenum (Mo)	mg/kg	1	1	*0*	2	1	*-1*	N.G	2
Sodium (Na)	mg/kg	3400	1700	*-1700*	11800	2000	*-9800*	N.G	6200
Nickel (Ni)	mg/kg	17	59	*42*	36	25	*-11*	N.G	17
Phosphorus (P)	mg/kg	380	2450	*2070*	500	470	*-30*	N.G	450
Lead (Pb)	mg/kg	<5	7	*<2*	9	9	*0*	30.2[2]	6
Tin (Sn)	mg/kg	<5	<5	*D.L*	6	<5	*-1*	N.G	<5
Strontium (Sr)	mg/kg	25	42	*17*	50	30	*-20*	N.G	40
Titanium (Ti)	mg/kg	46	52	*6*	26	34	*8*	N.G	35
Thallium (Tl)	mg/kg	<1	<1	*D.L*	<1	<1	*D.L*	N.G	<1
Vanadium (V)	mg/kg	18	25	*7*	25	23	*-2*	N.G	21
Zinc (Zn)	mg/kg	50	60	*10*	90	70	*-20*	124[2]	50
% Moisture	%	39.8	16.4	*-23.4*	92.8	23.5	*-69.3*	N.G	51.1
% Sand	%	75	77	*2*	53	61	*8*	N.G	68
% Silt	%	12	15	*3*	24	22	*-2*	N.G	18
% Clay	%	13	8	*-5*	22	16	*-6*	N.G	14
Texture		Sandy loam	Sandy loam	*no change*	Sandy clay	Sandy loam	-	N.G	Sandy loam
Total Nitrogen by LECO	%	0.15	0.09	*-0.06*	0.32	0.21	*-0.11*	N.G	0.25

N.G: No Guideline

D.L: Below Detection Limit

[1] Canadian Environmental Quality Guideline

[2] Interim Soil Quality Guideline

4.2 Plume delineation

To delineate the effluent plume salinity readings were used. As freshwater in the lagoon was pumped into the bay it mixed with salt water from the ocean and the salinity dropped. This was observed and recorded to produce Figures 2-4 which displays the size and extent of the effluent plume. Figure 2 shows the receiving water before the discharge, figure 3 shows the extent of the plume during discharge and figure 4 shows the plume a few hours after the pump shut off before it was started again, representing the salinity in the receiving water after discharge.

The discharge process began at 18:30 local time on Oct 5, 2004 and was discontinuous due to the pump shutting down because of the cold weather. The following is a summary of pumping during the first site visit through the observations by IEG staff and discussions with the Hamlet staff. These observations were compared to the raw data from the data loggers.

- At 9:00 am October 6, 2004, 14 hours after discharge began the pump was observed to be off. The salinity in the bay was uniform at 16% with station 6 reporting 13.5% at a separate, natural mixing zone closer to open waters.
- The effluent plume reached its' maximum extent 60m with a 6.5% salinity at station 2. Station 6 and 7 were reporting 14% salinity indicating the natural mixing zone further downstream from the discharge outlet had expanded more into the inlet. This had previously not been observed.
- Observations taken October 7, 2004 at 12:00 am to1:00 am local showed no signs of an effluent plume because the pump froze and ceased to function.
- The pump was again functioning at 4:00 am to 5:00 am on October 7, 2004. The plume resembled the shape and extent from the previous day.
- The last observation taken at 8:00 am to 9:00 am indicated a similar effluent plume with 9.5% being the lowest salinity recorded at station 2.
- Figure 2 indicates that station 2 was the closest station to the extent of the plume.
- The data correlates to when the pump was on/off. During the operation of the pump salinity dropped to a low of 6.5% and returned to background levels within 2 hours of the pump turning off.

The following is a comparison graph of the salinity versus time for all eight stations throughout the entire discharge process. It can be clearly seen the only station influenced by the discharge is station 2. The salinity at station at station 2 decreased shortly after the pump started pumping and returned to background levels approximately 2 hours after the pump stopped pumping. The following are observations of when the pump was either on or off during the study.

- Pump started at approximately 18:30 October 5th
- October 6th
    - Pump is off at 9:00
    - Pump is on at 11:00
    - Pump is off at 14:45
    - Pump is on at 16:00
    - Pump is on at 19:00

- Pump is off at 21:30

- October 7th, pumping started again at approximately 10:00

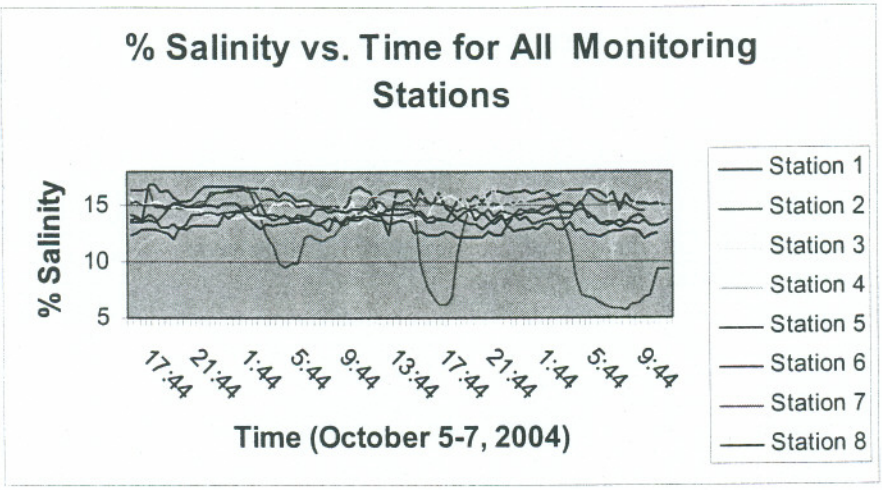


Figure 1 Plume Delineation, Station Summary

4.2.1 Mixing Zone

The station equipment used to determine the plume and mixing zone was only able to determine the outer most extent of the mixing zone because of the ice in the bay. The thin ice prevented IEG from installing the stations closer to the discharge point.

At this time, IEG cannot determine the shape or extents of the plum between station 2 and the discharge point and therefore cannot determine if the plume meets the mixing zone criteria in *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* section 4.5 Initial Mixing zone.

The guidelines state 4.5.1 (b) "The initial mixing zone around a point discharge in a lake, estuary or marine water may extend up to 100 metres horizontally in all directions, but shall not encompass more than 1/3 of the least cross-sectional area of the water along any horizontal direction through the discharge point." Section 4.5.2 Initial Mixing Zone Limitations outlines further criteria for the mixing zone.

During the 2005 discharge it is recommended the plume delineation study be performed again, this time placing the stations between station 2 and the discharge location. Performing the discharge earlier in the year before the risk of freezing the pump would also make it clearer to define the extent of the plume and to determine how long the plume persists in the environment after the whole lagoon is discharged.

5.0 FISHERIES WORK TO BE COMPLETED IN 2005

As previously stated, it was too late in the year to complete the fisheries permitting before discharge therefore IEG has recommended to MACA the following schedule to complete both the permitting and fisheries study:

- Submit all regulatory applications for the fish and benthic organisms study by the spring of 2005 to allow ample time to satisfy the regulatory process requirements.

- Complete the fish and benthic organism study at the end of August, early September 2005 during the usual fall discharge.

The analysis to be conducted for the fish and benthic organism study is to describe fish and benthic species present within the potentially impacted area, evaluate metal body burden of select species and evaluate and compare body burden of select species between experimental and control sites to determine if there is a statistically significant difference. To achieve this goal IEG will:

- Sample fish and benthic organisms inside the impacted area and at a control point in one sample session;
- Fish and bethnic communities, if available, are to be sampled at the cursory level for determining species present in the impacted and control area;
    - Fish are to be identified down to the species level and benthic organisms to the generic level.
- Morphometric measurements will be taken for each fish collected:
    - Total length;
    - Fork length; and
    - Weight
- Body burden will be collected from selected shallow water, inshore species for evaluation of metals and PCBs

The suggested fish species to be sampled for body burden, if available, at Kugmallit Bay are:

- Starry Flounder – Platichthys stellatus
- Saffron Flounder – Eliginus gracilis
- Arctic Flounder – Pleuronectes glacialis
- Fourhorn Sculpin – Myoxocephalus quadricornis
- Clams – Macoma spp; and
- Other common benthic species as determined from sampling.

IEG estimates that 10 fish will be collected and analyzed for body burden analysis.

6.0 CONCLUSIONS & RECOMMENDATIONS

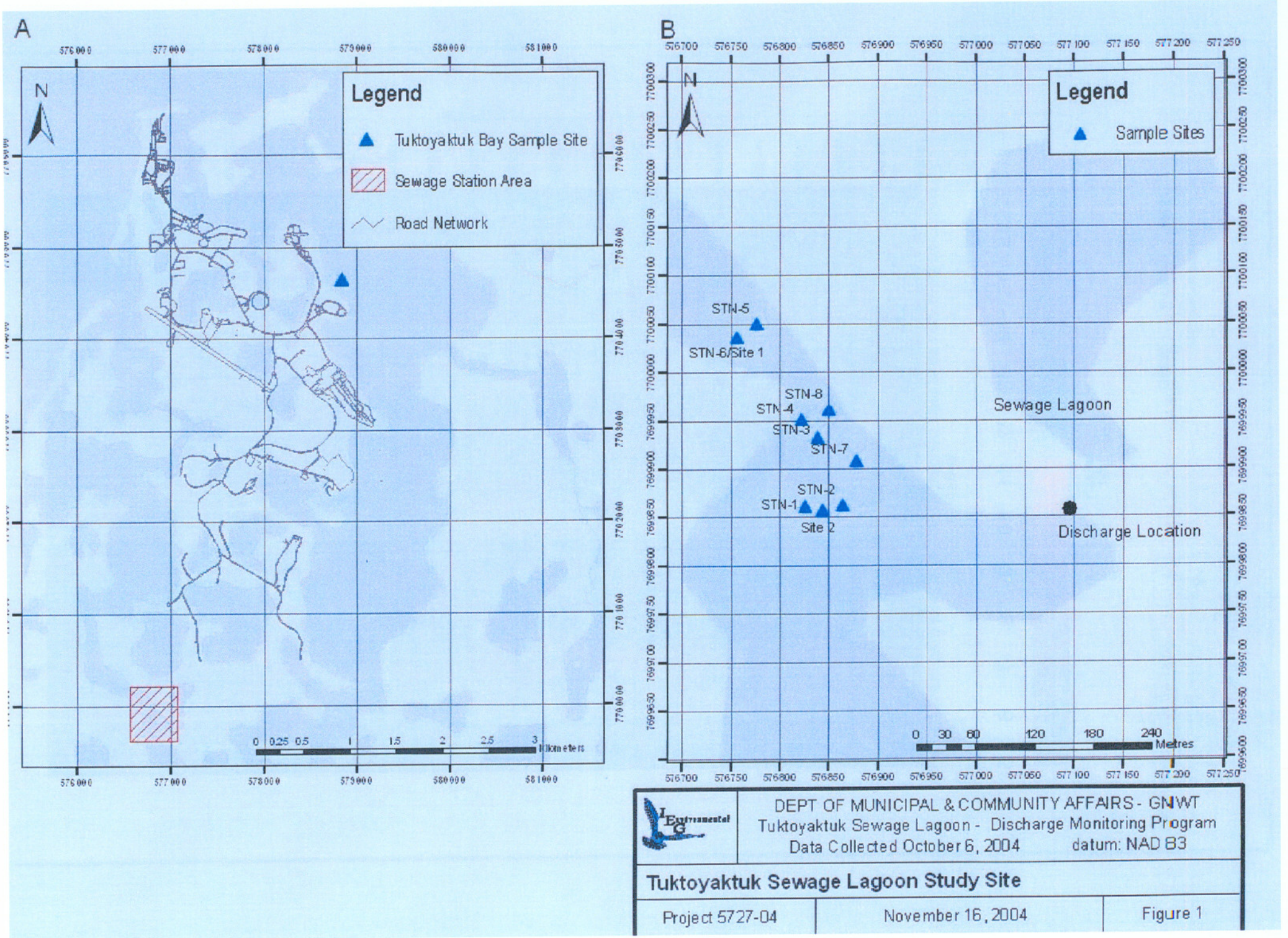
The results from the water and sediment analysis during the 2004 discharge indicate:

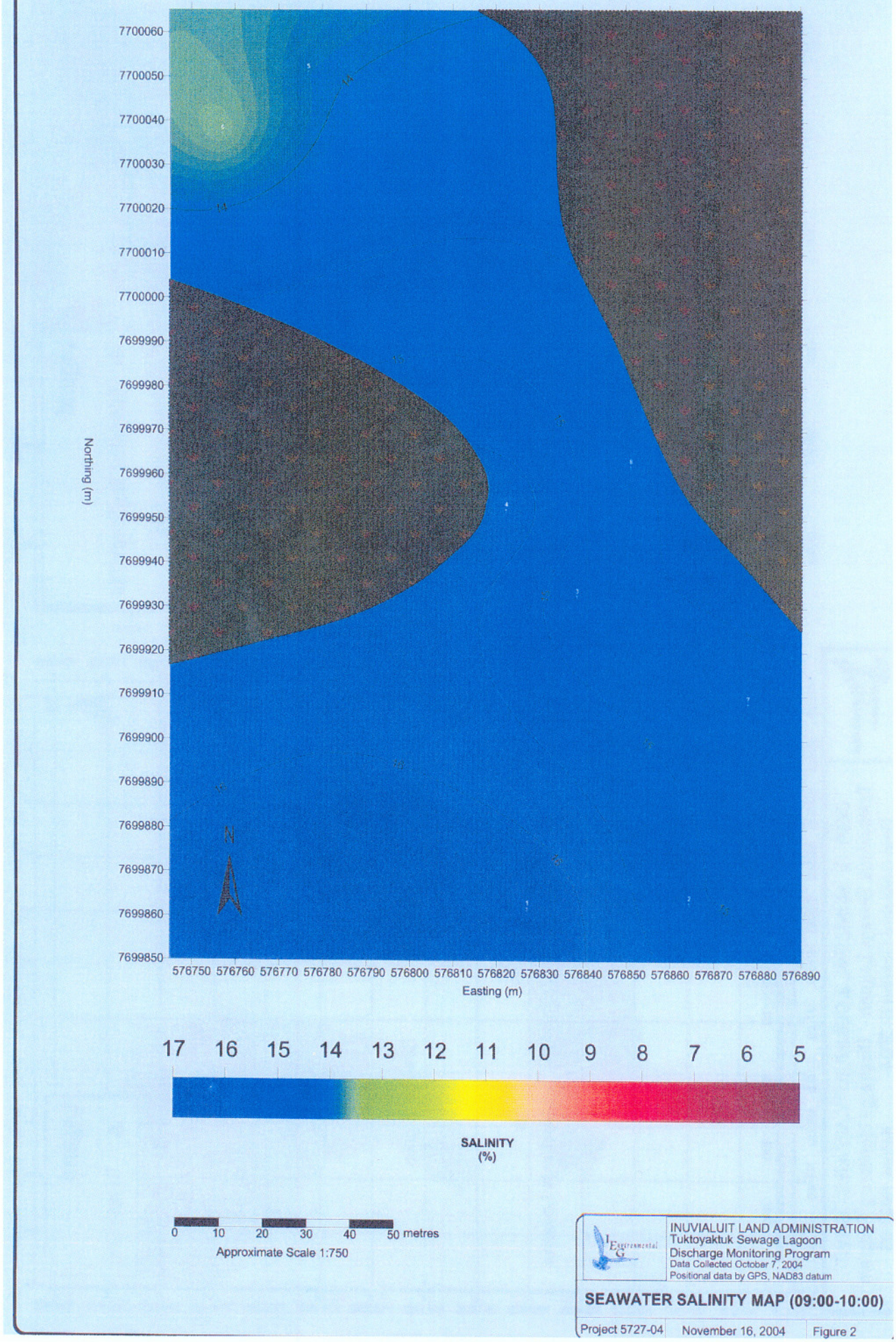
- The method used with the stations appears to have captured the outermost extent of the mixing zone. This method should be used again next year during the fisheries study and encompass the area between station 2 and the discharge location. Completing the study next year would determine if the mixing zone meets the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* section 4.5 Initial Mixing zone.
- The effluent plume appears to be of limited size and mixes with the receiving waters readily. Due to prevailing currents and the shallow depths the effluent plume dissipated rapidly as was seen

when the pump stopped functioning and the % salinity returned to natural levels within approximately 2 hours.

- The results of the sediment analysis revealed no clear trends. Certain metals increased after the discharge while others decreased. The constitution of the sediment, both before and after discharge varied less than 10% from the control sample. Thus indicating the cumulative or long term effects from the annual discharge may limited. Further monitoring should be conducted before concluding there are no long term effects from the annual discharge.
- Of the five parameters sampled during the study, F.Coli, BOD, TSS, pH and Phosphorous only Phosphorous levels remained higher than the before discharge and control limits. The increase in Phosphorous has limited effect in a nutrient limited system, such as Kugmallit Bay. However, this study did not determine why both the control and Kugmallit Bay had high natural levels of Phosphorous.
- Although the fisheries study is remaining to be completed, from the data collected during the 2004 discharge, there is minimal impact to the receiving water as a result of the annual sewage lagoon discharge.

Appendix A
Figures

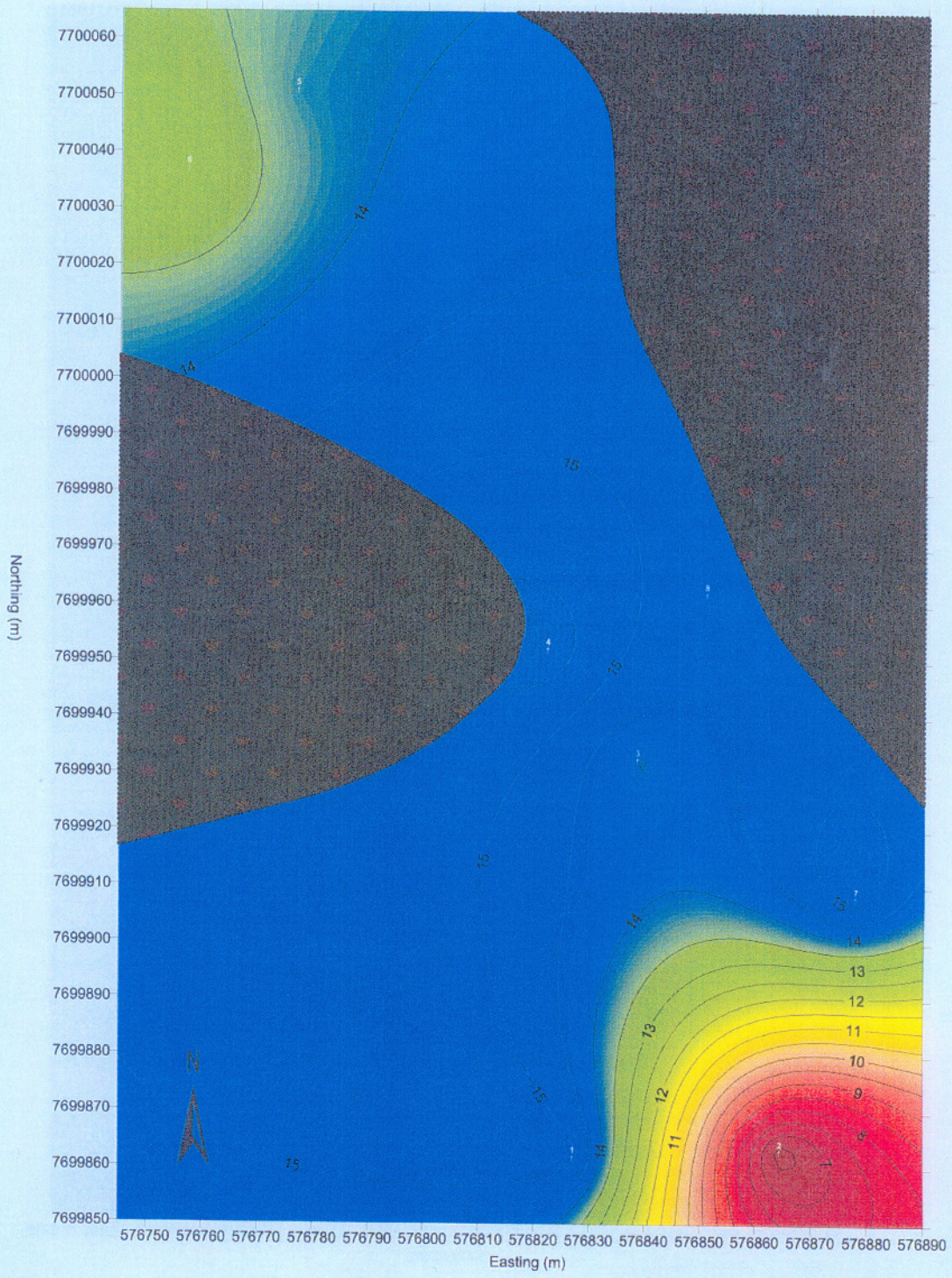

A
N
Legend
Tuktoyaktuk Bay Sample Site
Sewage Station Area
Road Network
0 0.25 0.5 1 1.5 2 2.5 3
Kilometers
B
N
Legend
Sample Sites
STN-5
STN-6/Site 1
STN-8
STN-4
STN-3
STN-7
STN-2
STN-1
Site 2
Sewage Lagoon
Discharge Location
0 30 60 120 180 240
Metres
DEPT OF MUNICIPAL & COMMUNITY AFFAIRS - GNWT
Tuktoyaktuk Sewage Lagoon - Discharge Monitoring Program
Data Collected October 6, 2004
datum: NAD 83
Tuktoyaktuk Sewage Lagoon Study Site
Project 5727-04
November 16, 2004
Figure 1



INUVIALUIT LAND ADMINISTRATION
Tuktoyaktuk Sewage Lagoon
Discharge Monitoring Program
Data Collected October 7, 2004
Positional data by GPS, NAD83 datum

SEAWATER SALINITY MAP (09:00-10:00)

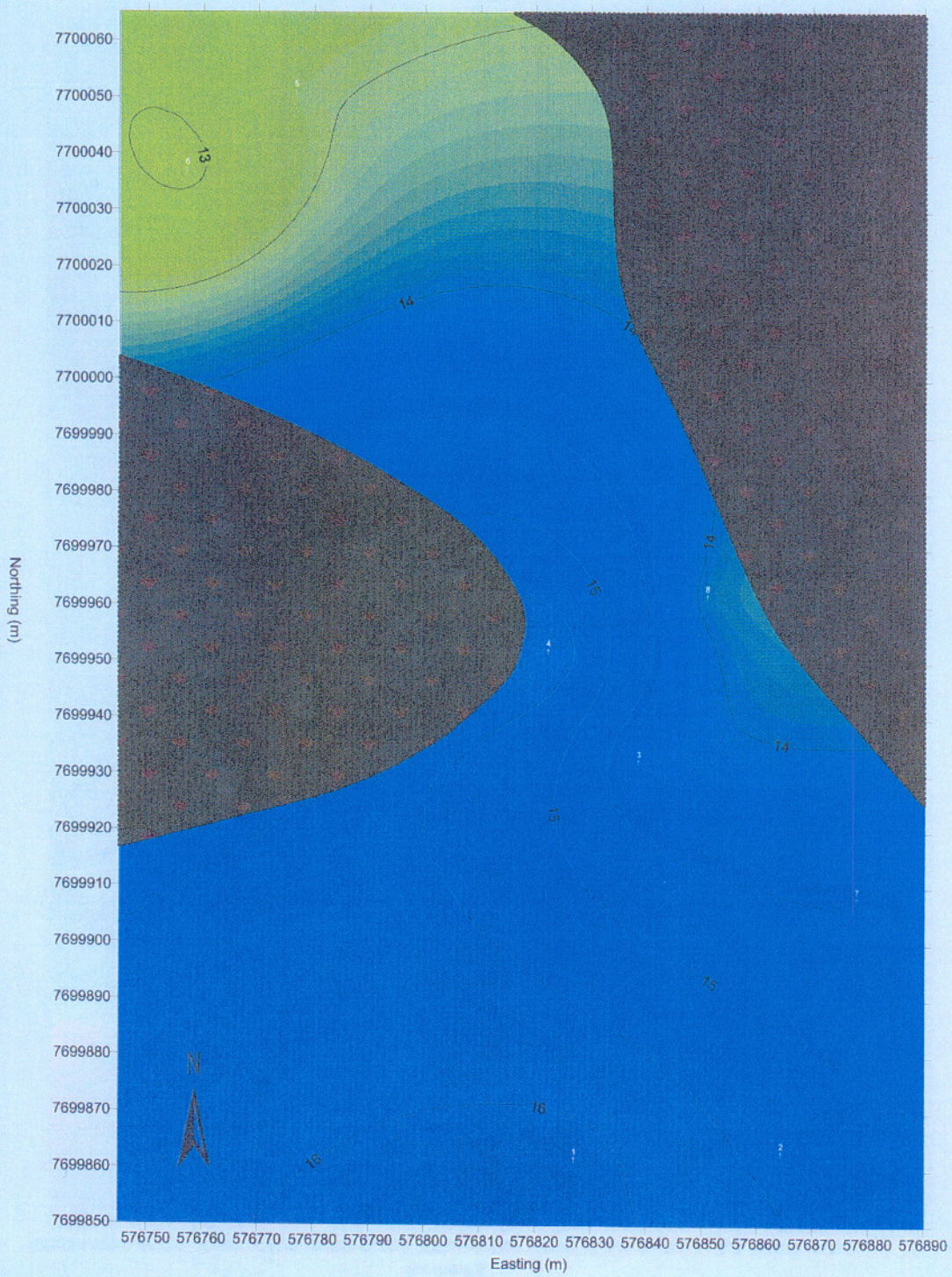
Project 5727-04 | November 16, 2004 | Figure 2



INUVIALUIT LAND ADMINISTRATION
Tuktoyaktuk Sewage Lagoon
Discharge Monitoring Program
Data Collected October 7, 2004
Positional data by GPS, NAD83 datum

SEAWATER SALINITY MAP (15:00-16:00)

Project 5727-04 | November 16, 2004 | Figure 3



17 16 15 14 13 12 11 10 9 8 7 6 5

SALINITY (%)

0 10 20 30 40 50 metres

Approximate Scale 1:750

INUVIALUIT LAND ADMINISTRATION
Tuktoyaktuk Sewage Lagoon
Discharge Monitoring Program
Data Collected October 7, 2004
Positional data by GPS, NAD83 datum

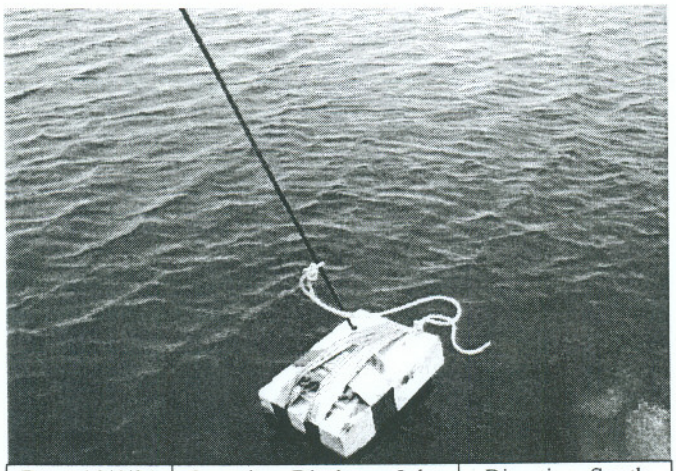
SEAWATER SALINITY MAP (0:00-1:00)

Project 5727-04 | November 16, 2004 | Figure 4

Appendix B
Sample Results

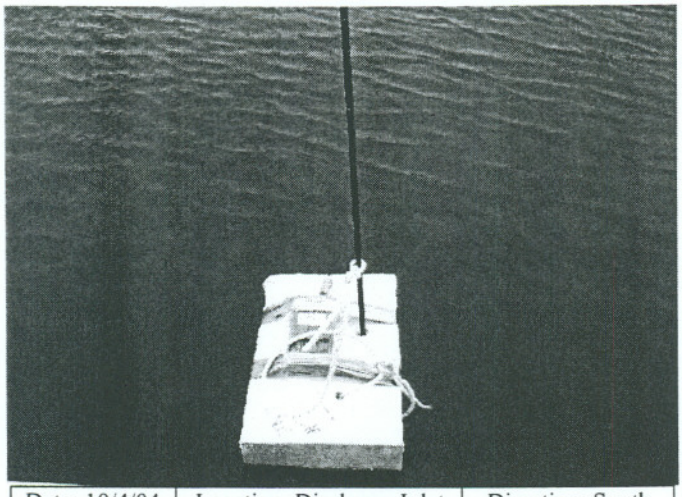
Appendix C
Photo Log

PHOTO LOG

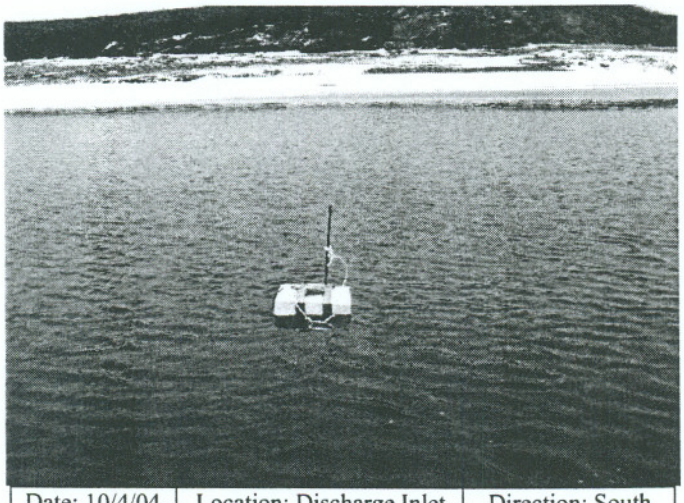


Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Portable Salinity Metre		

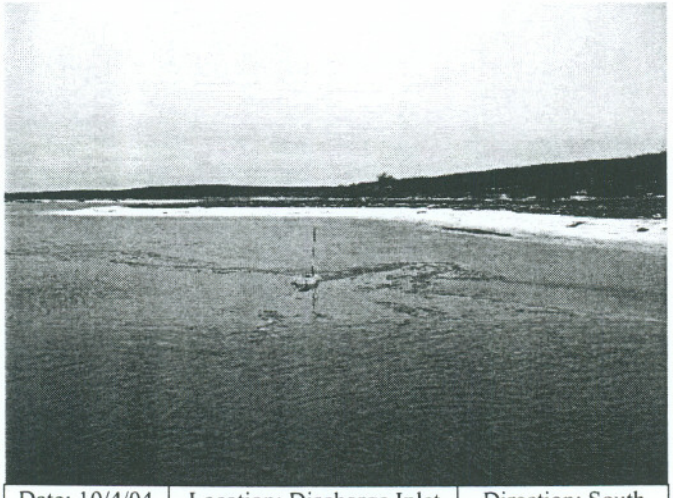
Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Sarah Dando, IEG recording observations		



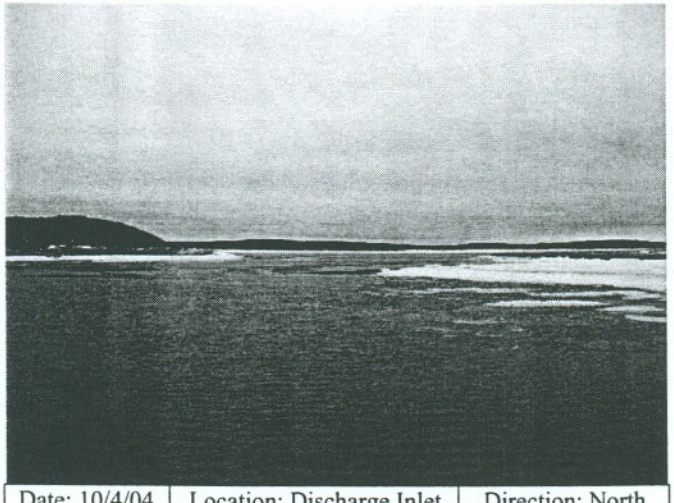
Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Portable Salinity Metre		



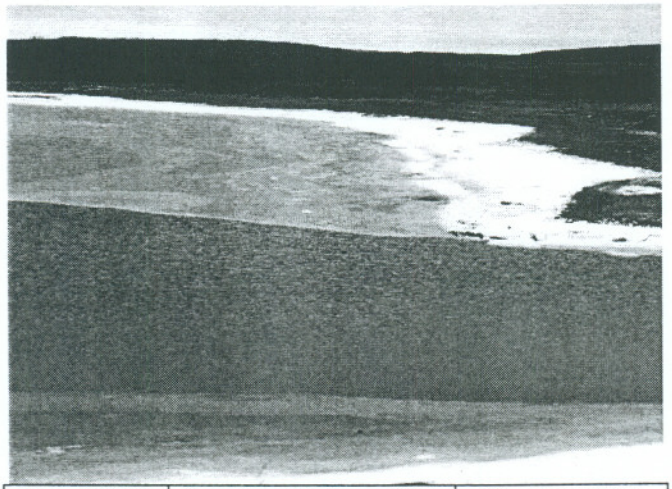
Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Portable Salinity Metre		



Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Portable Salinity Metre		



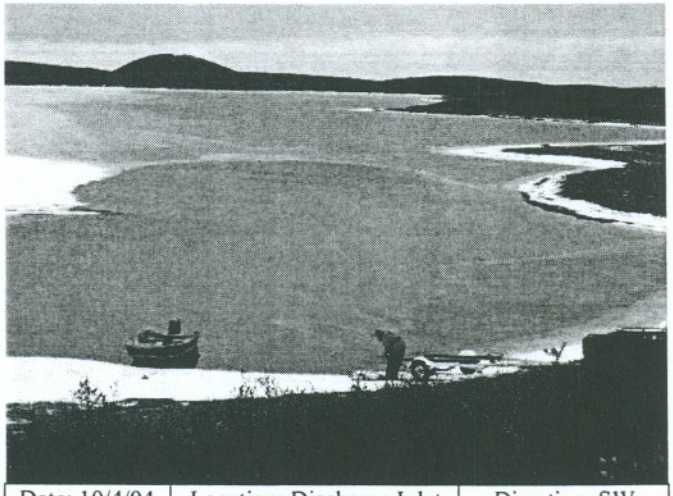
Date: 10/4/04	Location: Discharge Inlet	Direction: North
Description: Discharge Inlet leading to Kugmallit Bay		



Date: 10/4/04	Location: Discharge Inlet	Direction: West
Description: Discharge inlet taken from atop the hill		

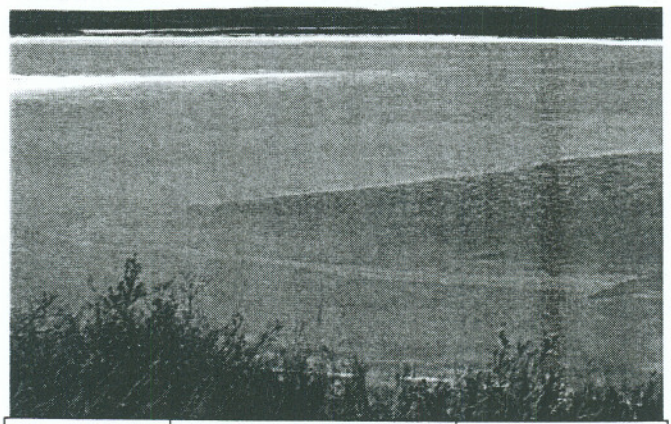
Date: 10/4/04	Location: Discharge Inlet	Direction: SW
Description: Discharge inlet taken from atop the hill		

Date: 10/4/04	Location: Discharge Inlet	Direction: SW
Description: Portable Salinity Metre from atop the hill between the discharge inlet and the lagoon		



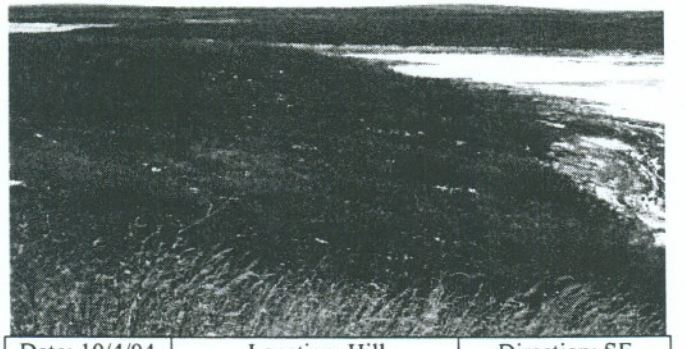
Date: 10/4/04	Location: Discharge Inlet	Direction: SW
Description: Boat launch to place salinity metres		

Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Discharge inlet taken from atop the hill		

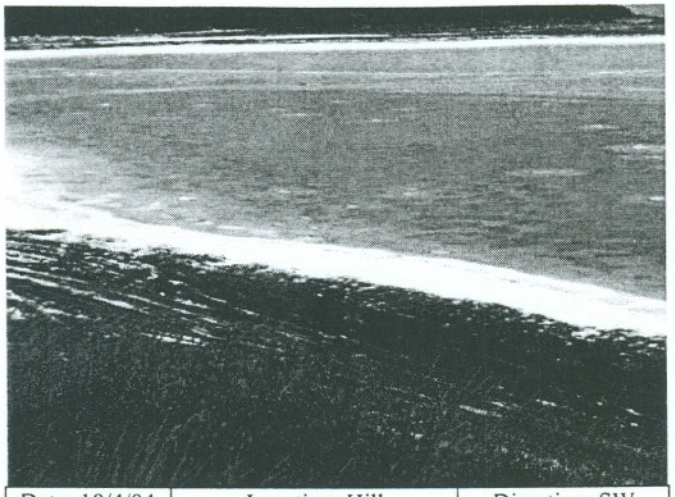


Date: 10/4/04	Location: Discharge Inlet	Direction: South
Description: Discharge inlet taken from atop the berm		

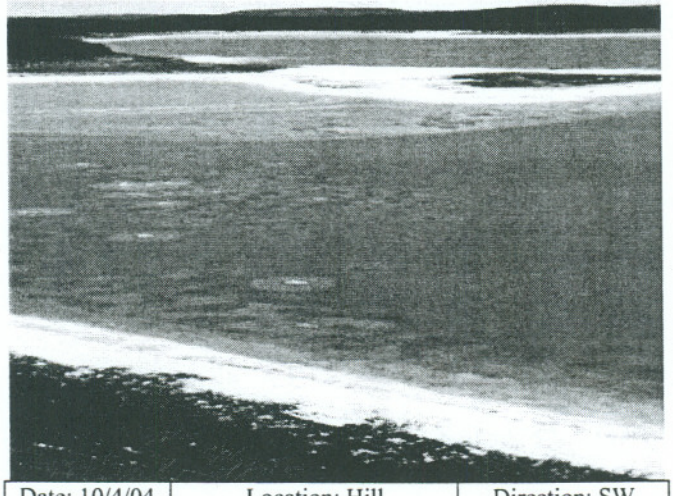
Date: 10/4/04	Location: Discharge Inlet	Direction: SE
Description: Access along beach and discharge inlet		



Date: 10/4/04	Location: Hill	Direction: SE
Description: Discharge, Inlet		



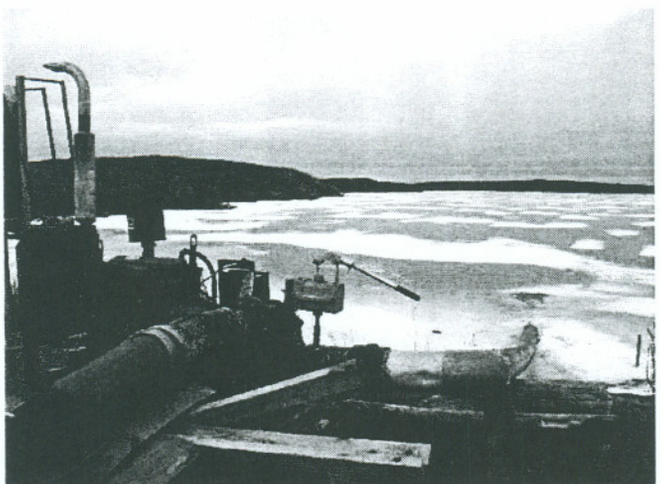
Date: 10/4/04	Location: Hill	Direction: SW
Description: Access along beach and Discharge inlet		



Date: 10/4/04	Location: Hill	Direction: SW
Description: Discharge Inlet		

Date: 10/4/04	Location: Discharge Pipe	Direction: SW
Description: Discharge Pipe leading into discharge inlet		

Date: 10/4/04	Location: Pump Station	Direction: NW
Description: Pump station setup and standing fuel tank		



Date: 10/4/04	Location: Pump Station	Direction: SW
Description: Pump station facing sewage lagoon		