

# Hamlet of Tuktoyaktuk

Water



## Operation and Maintenance Documentation

Sewage



## Sewage Treatment Facility

Solid Waste



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## **1.0 INTRODUCTION**

The proper operation and maintenance of Hamlet of Tuktoyaktuk's sewage treatment facility are important components of its overall municipal waste management system. It is universally recognized that inappropriate operation and maintenance (O & M) of a sewage treatment facility may cause the lagoon site to become a source of potential public health hazards and adverse environmental impacts.

### **1.1 OBJECTIVE OF TUKTOYAKTUK'S SEWAGE TREATMENT FACILITY**

The primary objective of the Hamlet of Tuktoyaktuk's sewage treatment facility is to assist the lagoon site staff in the proper operation and maintenance of the site, to apply appropriate technology and procedures to treat and dispose off its municipal sanitary sewage in a manner to minimize the potential public health and environmental hazards from the site, and acceptable to Northwest Territories Water Board (NWTWB). However, the application of appropriate technology depends upon the geology, terrain and climate of the area, as well as the technical and financial capabilities of this Hamlet. In the case of Hamlet of Tuktoyaktuk the appropriate technology is a "natural retention lagoon with a seasonal discharge".

The following general requirements to minimize the potential public health and environmental (water pollution) hazards are addressed in this O & M manual:

1. To minimize environmental nuisances that can interfere with community life and development;
2. To minimize the possibility of polluting surface waters through retention and controlled discharge; and
3. To minimize public health impact through retention and controlled discharge.

### **1.2 SEWAGE TREATMENT FACILITY SITE DESCRIPTION**

The Hamlet of Tuktoyaktuk's sanitary sewage treatment facility retention site provides 365-day retention to treat the Hamlet's sanitary sewage. The site is a natural lake, 5.9 ha in area that has been modified with perimeter structures to provide a retention structure.

The site is located approximately 5.8 km south of the Hamlet Office and approximately 3.9 km south of the Airport Terminal Building. The site is also 1.5 km southwest of the Reindeer Point Subdivision (Figure 1. Facility Locations).

The area surrounding the lagoon site is influenced by winds primarily from a northwesterly direction, and tides of 30 to 60 centimetres. The lagoon is discharged in the early fall of each year to a saltwater inlet. The lagoon is 3.0 km southeast from the open ocean, and approximately 6.5 km from the ocean by way of the inlet, which varies in depth from 1 to 4 m.

The lagoon operates under the following parameters:

Effluent BOD5	120 mg/L
Effluent Suspended Solids	180 mg/L
Effluent pH	6 to 9
Freeboard in Lagoon	0.5 m

The sewage collection services are contracted out by a private contractor who operates vacuum trucks seven days a week.

The sewage treatment facility is estimated to have a capacity to serve a population of 1,900 depending upon the level of commercial and industrial activity that occurs in the future.

### 1.3 SEWAGE TREATMENT FACILITY TREATMENT PROCESSES

The treatment process that best describes the Tukoyaktuk sewage treatment facility is an “aerobic retention lagoon” (See Figure 2. Sewage Treatment Schematic). The term “aerobic” refers to the biological processes in the lagoon that are happening in the presence of oxygen. These processes include organisms such as algae functioning with heat from the sun and oxygen from the wind. The process also includes plants at the perimeter of the lagoon growing and absorbing the constituents of the sewage. The aerobic processes occur only in the shallower water (less than 2.5 metres) of the lagoon.

The term retention refers to the impoundment structure that contains the sewage for a 365 day period in advance of the discharge into the Arctic Ocean. The retention provides the opportunity for the biological processes to occur, particularly during the long, warm, sunny days of the short Arctic summer. The biological processes may function to some degree at low temperatures and without sunlight, however, the processes that treat the sewage become very, very slow. During the summer the biological processes thrive with the sun, wind and long days.

Another process that takes place in the lagoon is a physical process that uses the ultra-violet radiation from the sun to “disinfect” the sewage.

### 1.4 INFORMATION SOURCES

The preparation of this O & M manual is based upon the following information sources:

1. Water Licence N7L3-0714 (Renewal) for the Incorporated Hamlet of Tuktoyaktuk Northwest Territories (Effective Jun 28, 2005 and expiring June 27, 2009).
2. Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Sewage Lagoons in the Northwest Territories - Volume I: Planning and Design / Volume II: Operation and Maintenance, Department of Municipal and Community Affairs, and Government of the Northwest Territories, 1988.

## **2.0 LAGOON OPERATIONAL REQUIREMENTS**

The Hamlet of Tuktoyaktuk's sewage treatment facility operational requirements will be those activities that must be done on a regular basis (daily, weekly, or yearly).

The operation of the Hamlet's sewage treatment facility has been divided into seven types of activities:

1. Normal Operation (daily)
2. Safety (daily)
3. Checking (weekly)
4. Sampling (yearly)
5. Reporting (yearly)
6. Record Keeping (daily/weekly)
7. Review (yearly)

### **2.1 NORMAL OPERATION OF LAGOON**

The Hamlet of Tuktoyaktuk's sewage treatment facility system has four main components (See Figure 3. Facility Organization and Figure 4. Facility Components):

1. the inlet structure
2. retention pond
3. berm structure
4. discharge stream

The normal operation of the sewage treatment facility involves observing the inlet structure on a daily basis for any unusual situations. Observations should also be made of the lagoon surface; note, if there is material floating and what the material may be.

An entry should be recorded every day on the Daily Operation Observations Record to either indicate that the operation is normal, or that something abnormal was observed and corrective steps had to be taken.

### **2.2 ANNUAL DISCHARGE OF SEWAGE TREATMENT FACILITY**

The sewage treatment facility should be discharged annually using the pumping system over the berm (See Figure 5. Discharge Activity). The discharge should be done in the early fall in order to provide the maximum treatment of the sewage. During the discharge, measures should be taken to control the erosion at the discharge area. Before the annual discharge, an appropriate notice will be given to the public to advise them of the release of wastewater effluent from the sewage treatment facility.

## 2.3 SAFETY OF LAGOON

The operator must ensure that all aspects of wastewater management are conducted safely.

General public and unimportant access to the lagoon site should be prevented. This includes all forms of recreation activities. This is to ensure no possible contamination or infection of the public, with no protective awareness, from pathogenic microorganisms.

The equipment and any other structures should be kept clean. This reduces problems with footing and also makes it less likely that equipment will be damaged or broken by debris.

After work, before eating, and at other convenient times, wash your hands thoroughly.

Caution should be used when working with wastewater. If you get splashed accidentally with sanitary sewage, wash promptly with plenty of water. Treat all cuts and skin abrasions immediately to prevent any infection.

All those working on the wastewater system should keep normal preventative health care vaccinations up to date. Check with a physician as to the recommended inoculations (usually includes typhoid and paratyphoid).

## 2.4 SEWAGE TREATMENT FACILITY CHECKING

On a once-a-week basis, all main components of the sewage treatment facility system should be checked and adjusted, if necessary. The purpose of the detailed checking is to spot things that may lead to problems later and to record the conditions of the date checked.

It is anticipated that the storm surges, which influence the shoreline erosion at the landfill, may not be a serious concern for the lagoon because the lagoon is located over 6 km inland from the ocean by a shallow channel.

**Inlet Structure:** The inlet structures and surrounding area should be examined for blockages or other operational problems.

**Retention Pond Wastewater Level:** During open water periods, the water level should be observed and recorded.

**Berm Condition:** All visible parts of the lagoon berm should be observed and the condition noted.

**Wastewater Colour:** The variations in colour can be an important indicator of lagoon performance. This may only be possible during open water periods.

## Sewage Treatment Facility Colours and Indications

Dark Green – Good, high pH; high dissolved oxygen (DO).

Dull Green to Yellow – Not very good; pH dropping; DO dropping; blue-green algae are becoming established.

Grey to Black – Very bad; lagoon anaerobic.

Tan to Brown – Okay, if caused by a type of algae bloom; not good if due to silt or bank erosion.

Red or Pink – Presence of purple sulphur bacteria (anaerobic conditions) or presence of red algae (aerobic conditions).

## 2.4 SAMPLING

The purpose of taking samples and carrying out tests on them is to obtain information on how well the lagoon performs.

There are six important parts to the process of sampling. These are:

1. taking the sample at the time called for;
2. using a properly cleaned container for the sample to be taken;
3. careful collection of the sample from the correct location and doing any necessary field tests called for at that time;
4. careful and correct labeling of the sample container and filling out a record sheet;
5. use of proper testing procedures, where tests can be performed on site; and
6. shipping of the sample in proper containers and expeditiously so that it arrives on time for the testing.

**Sample Frequency:** Samples will be taken on an annual basis during the annual discharge or “decant” in the summer and early fall. Four samples should be taken during each decant.

**Sample Parameters:** Samples will be taken and analyzed for pH, fecal coliforms, suspended solids, BOD<sub>5</sub>, and Ammonia Nitrogen.

**Sample Locations:** Samples are normally required to be taken at the effluent discharge area (SNP 0714-2 – See Figure 3. Facility Organization). Occasionally, other samples may be collected as required by the conditions of the Water License.

**Sample Collection:** Normally, you will be required to collect all of the samples at the specified location above in supplied bottles; normally two bottles - one sterile bottle for fecal coliforms and the other bottle for the remaining parameters. This type of sampling is referred to as a grab sample as it is collected at one time from a specific location. The grab samples are collected by dipping a sample collector or the bottle into the flow stream. The samples should preferably be collected by rinsing sample bottles with the sample wastewater for a couple of times prior to final sample collection.

Sample Containers: The sample containers can affect the sample test results. The type of material it is made of and the way it was cleaned are the most important factors. Most lagoon samples are collected in plastic bottles that have been well washed and rinsed about six times. If the samples are to be used for bacteria determination, then special sterilized bottles must be used. These must be handled carefully so that the sample is not contaminated.

Field Tests: Normally, the only test you may be required to carry out on the lagoon site is pH. The equipment for this is a pH litmus paper kit (with instructions included).

## 2.5 SAMPLE REPORTING

An annual report on the sample parameters will be submitted to Northwest Territories Water Board (NWTWB).

## 2.6 RECORD KEEPING AND REPORTING

Record keeping and reporting is necessary to have information on what has happened. The use of accurate records reports is very important for the Hamlet, NWT Water Board and its supporting agencies, and to engineers that may need to work on the sewage treatment facility.

The records and reports must be detailed enough to allow evaluation of performance and to track the development of problems. The records and reports also give a good check on completed tasks, and those left to complete. The records and reports for the Tuktoyaktuk sewage treatment facility include:

1. Daily Inspections and Weekly Systems Checks Record prepared by Hamlet staff (See Appendix A)
2. Annual Sampling Report prepared by water sample testing laboratory.
3. Annual Water Licence Report prepared by the Hamlet staff.

## 2.7 REVIEW

A compilation of the sewage treatment facility operations and sampling of the lagoon will be prepared once a year as a summary of the operation and performance for the purpose of submitting an annual report to NWT Water Board and for the purpose of an operation management review by the Hamlet Administration.



### **3.0 LAGOON MAINTENANCE REQUIREMENTS**

#### **3.1 LAGOON INLET STRUCTURES**

The inlet structures enable the sewage treatment facility to function properly (See Figure 4. Facility Components). In addition, these structures require considerable attention to ensure that they operate properly and do not experience or cause any erosion.

The most important aspect of maintenance of inlet structures is that they must not freeze in a way that inhibits their operation. Another important problem is caused by sludge deposition near the inlet structure, which has to be cleared manually or by machinery at regular intervals, on need-basis.

The lagoon has a free fall wastewater discharge. The sewage treatment facility operator must be aware of the following locations of potential problems:

1. the support structure holding the pipe;
2. the foundation and wall of the support structure;
3. potential of ice build-up; and
4. potential of ice damage.

The metal support structure should also be inspected for corrosion and related problems that may weaken the support structure.

#### **3.2 LAGOON DISCHARGE STREAM**

The discharge stream is a pump and pipe over the berm (See Figure 4. Facility Components; Figure 5. Discharge Activity). The pump and piping are used on an annual basis; therefore maintenance is required in advance of the annual discharge and as required during the discharge.

#### **3.3 LAGOON BERMS**

There are four main functions of lagoon berms:

1. to form part of a storage container for retention of the wastewater for treatment;
2. to form access to parts of the lagoon;
3. to allow variation in wastewater levels due to wastewater volume changes; and
4. to provide “freeboard”.

The objective of berm inspection is to make sure excessive leakage does not occur. Erosion of dikes is mainly caused by wave action and surface runoff. Regular monitoring and maintenance are required to control berm erosion.

Surface runoff must be prevented from entering the lagoon through diversion ditches around the berms. The ditches must be properly maintained to prevent blockage of drainage.

### 3.4 ODOR PROBLEMS, WEED AND INSECT CONTROL

Odor Problem: Under normal operating conditions, the lagoon will not cause serious odor problems. However, at certain times, severe odors may occur. The lagoon is located at a significant distance from the nearest house; therefore, odor problems would not normally be a concern.

The most troublesome conditions are:

1. lagoon and storage lagoons in the period following ice break-up;
2. at the end of an extensive period of cloud cover (in spring to fall when there is no ice cover), resulting in reduced sunlight and therefore reduced algae activity and low oxygen production; and
3. extensive floating sludge mats.

The operator of the lagoon has limited opportunities to do anything about these conditions.

For Item 1. This problem will normally be of short duration; it is also likely to occur annually.

For Item 2. "Hope" for sunshine soon.

For Item 3. Floating scum and algae mats need to be broken up and dispersed.

Weed Control: A number of surface weeds can develop in sewage treatment facility. The problem with these weeds is that they block out the sunlight that is needed by algae to produce dissolved oxygen. A second problem is that when the floating plants die, they begin to decompose using up oxygen which is needed by the wastewater bacteria.

The ways to control surface weeds are as follows:

1. skimming (often difficult and requires repeating); and
2. use of herbicides (approval is required for their use).

The removed weeds should be landfilled and buried, where possible, to prevent odor and insect problems.

Insect Control: Flies and mosquitoes create the most common insect problems in sewage treatment facility. Most mosquitoes breed in sheltered, calm water containing vegetation and floating materials to which the female can attach the eggs. The egg clusters are fragile and easily damaged by turbulent action caused by wind currents. Poor weed control and the accumulation of a scum layer will make insect problems worse.

Puddles of water outside the lagoon will also harbour insects. Berm maintenance and the filling of potholes and puddles will reduce the opportunity for insect reproduction. In some cases, the use of insecticides may be necessary. Approval of the insecticide and the application procedure should be obtained through the supervisor.

### 3.5 SIGNS

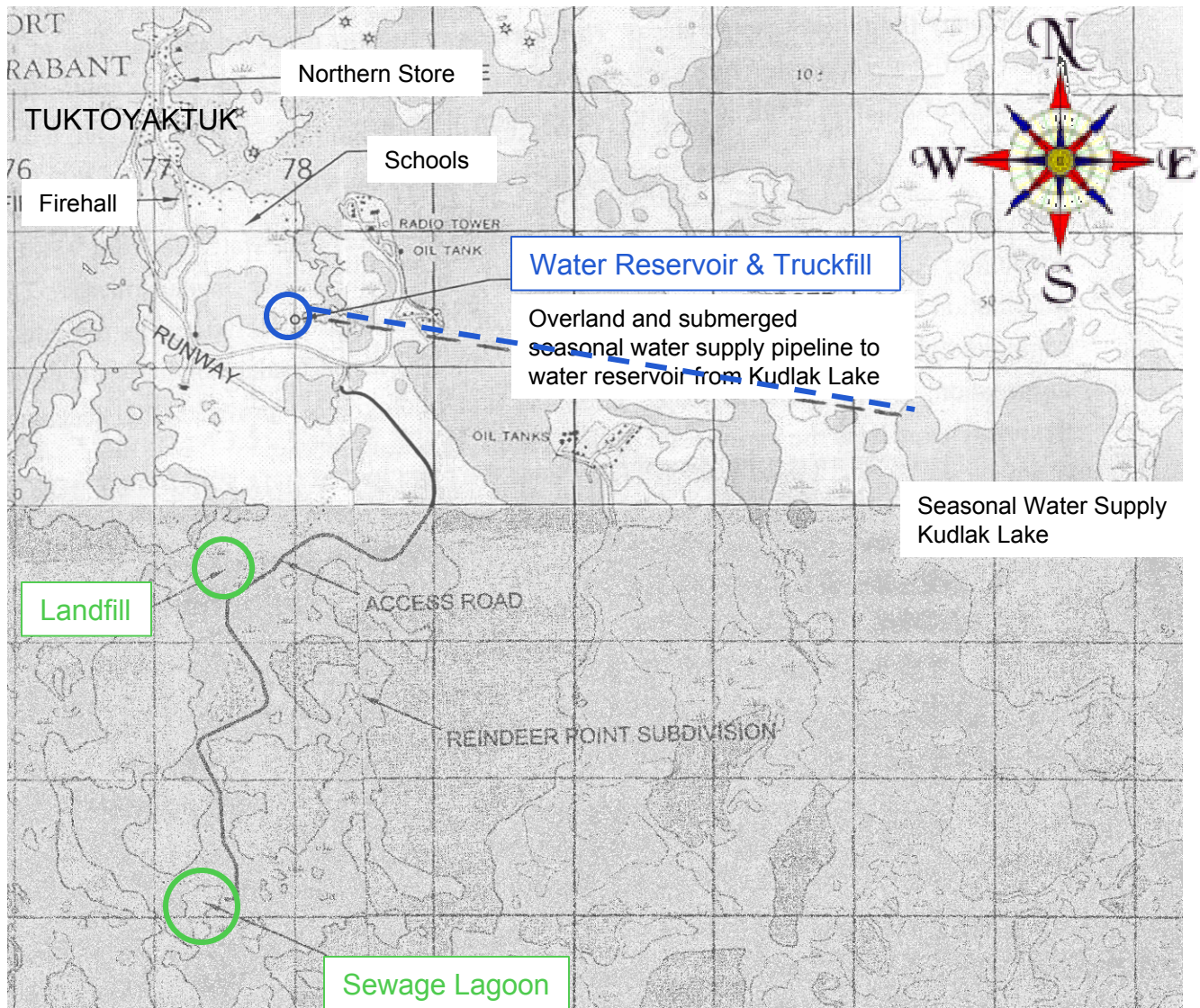
Bilingual warning signs are normally installed at regular intervals around the lagoon. Lost or damaged signs should be replaced.

### 3.6 MAINTENANCE OF ACCESS ROAD

The access road was designed to be an all weather road. Maintenance takes three basic forms: road shaping and smoothing, roadway filling, and snow removal. These activities follow normal community procedures.

### 3.7 SURFACE RUNOFF MANAGEMENT

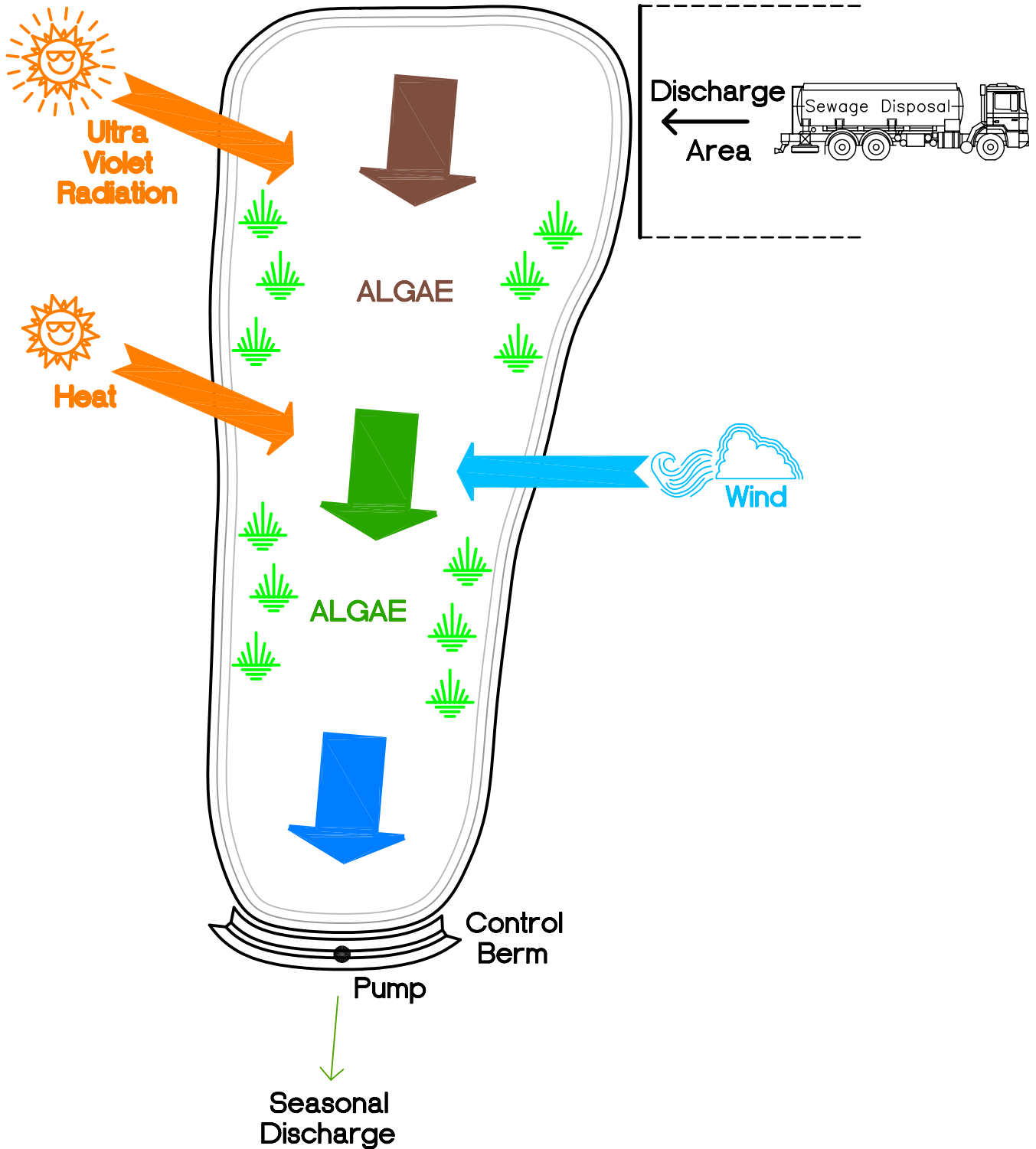
Drainage ditches and culverts near the sewage treatment facility should be checked, particularly in the early spring, to ensure that they are not blocked by ice. Any blockages should be cleared immediately to avoid surface runoff from entering the lagoon.



## Hamlet of Tuktoyaktuk Sewage Treatment Operation and Maintenance

**Figure 1. Facility Locations**

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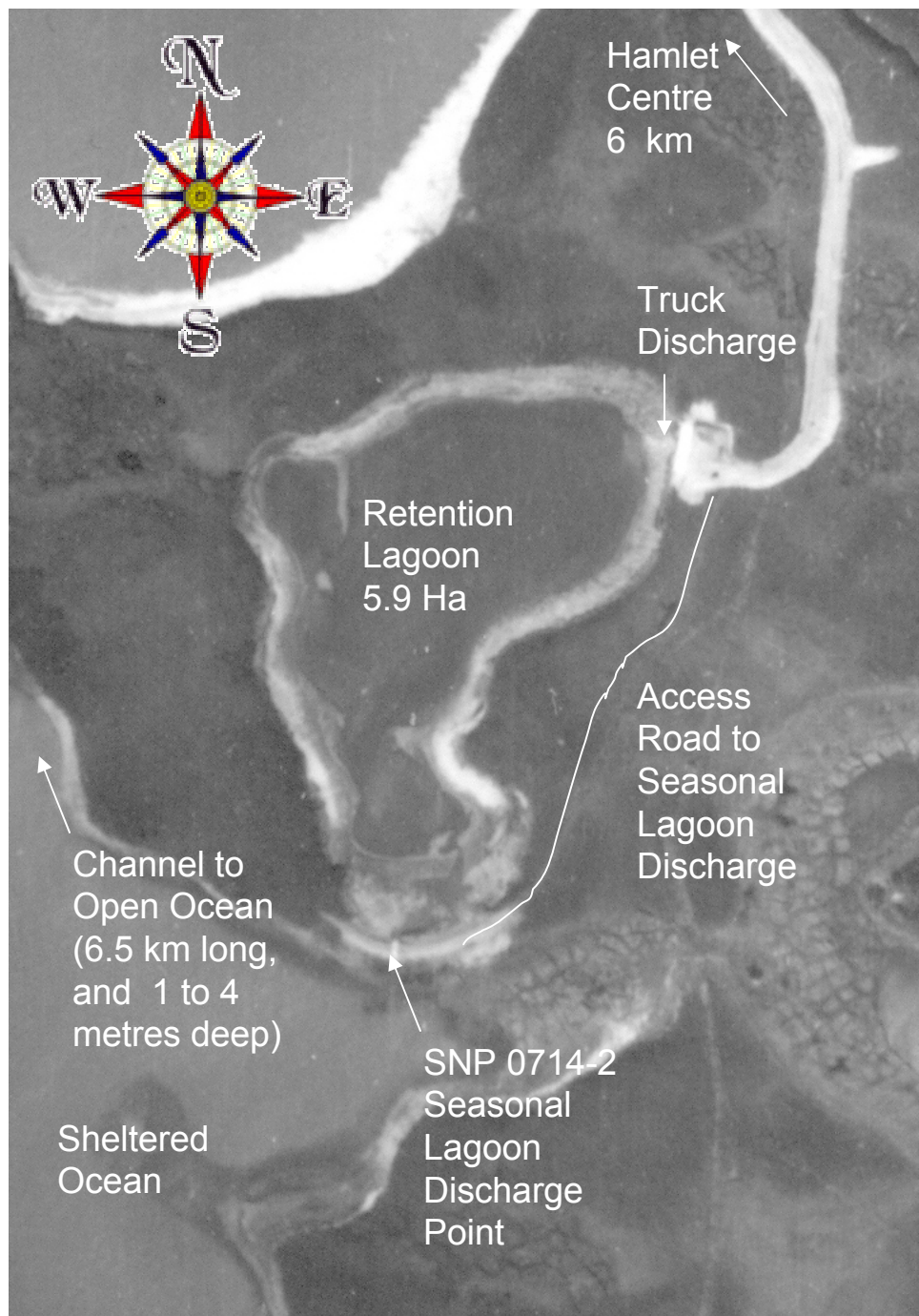


Date: SEPTEMBER 30, 2005

Hamlet of Tuktoyaktuk, N.W.T.  
Sewage Lagoon Operation and Maintenance Manual  
SEWAGE TREATMENT SCHEMATIC

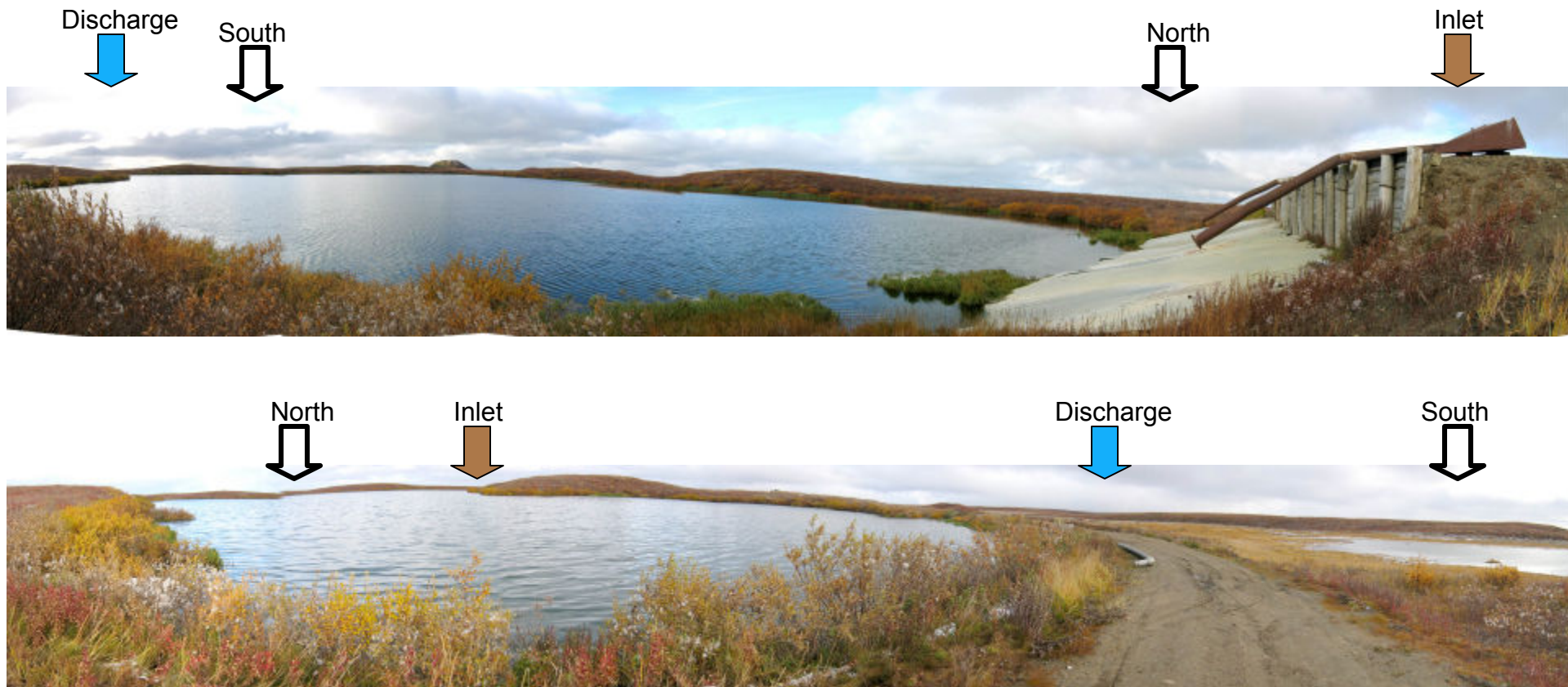
Figure 2





Hamlet of Tuktoyaktuk  
Sewage Treatment Waste Operation and  
Maintenance

**Figure 3. Facility Organization**



Hamlet of Tuktoyaktuk  
Sewage Treatment Waste Operation and  
Maintenance

**Figure 4. Facility Components**



A **tyco** International Ltd. Company

2005-09-28

Outlet of pumped  
lagoon seasonal  
discharge into ocean.



Photo Courtesy of IEG



Pumping system for  
seasonal discharge into  
ocean.

Inlet of pumped  
lagoon seasonal  
discharge into ocean.





# Appendix A

## Record Keeping Documentation

# Tuktoyaktuk Sewage Lagoon Record Keeping

Daily Operation Observations for Month of \_\_\_\_\_, 20\_\_.

Day	Lagoon Normal	Lagoon Not Normal	Observations
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

Weekly Inspections for Month of \_\_\_\_\_, 20\_\_.

Week	Truck Discharge	Water Level	Berm	Water Colour	Observations
1					
2					
3					
4					
5					

Mark with a checkmark to confirm inspection.