



- **Government of Nunavut**

Dam Safety Review

Type of Document

Final

Project Name

Dam Safety Review
Sewage Lagoons and Water Reservoir
Gjoa Haven, Nunavut

Project Number

OTT-00209248-A0

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October 16, 2013

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Executive Summary

A dam safety review of the sewage lagoon and the water supply system located in the Hamlet of Gjoa Haven, Nunavut was undertaken. This work was authorized by Community and Government Services of the Government of Nunavut.

The sewage lagoon is located east of the Hamlet. The sewage lagoon is circular and was constructed in the 1970s. It is understood that the height of the berm was increased sometime back by placing additional fill on the existing berm. It appears that this fill was placed on the crest of the berm by end dumping. It was not levelled or compacted. As a result of placement of this fill, the crest of the berm is very narrow and its side slopes are very steep.

The discharge chute is located on the north side of the lagoon whereas the overflow pipe is located on the south side. The overflow pipe discharges into a secondary lagoon located south of the main lagoon.

It is reported that the lagoon has been leaking for years. As a result of the leakage, water has ponded along the east and south east side of the lagoon as well as along the west side of the lagoon.

Wetlands are located on the south side of the main lagoon. Based on the site visit and visual examination of the facility, the following observations/recommendations are made:

- 1.) The slopes of the lagoon berm are very steep and are being subjected to seepage forces in some areas;
- 2.) The fill that has been dumped on top of the original berm is very loose since it was not graded or compacted; and
- 3.) The material used in construction of the berm is very permeable and as such the lagoon is expected to continue leaking.

The slopes of the berm are considered inherently unstable and could fail at any time. It is therefore recommended that the use of this lagoon should be discontinued and the lagoon decommissioned when the new lagoon is operational.

Review of the water supply system revealed that the Hamlet draws its water from Swan Lake. The water is heated at the pump station and is transported to the treatment plant located approximately 2.3 km away via a pipeline. At the treatment plant, the water is chlorinated, filtered through anthracite sand and fine sand filters and re-chlorinated. It is then stored in the storage tank for discharge to the trucks.

All the equipment reviewed is in good working condition and well maintained. No safety concerns were identified with the water treatment and supply system.

The above and other related considerations have been discussed in greater detail in the report.

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1 Introduction

The Hamlet of Gjoa Haven in Nunavut was visited on September 17 and 18, 2013. The purpose of the visit was to review water retaining structures from a dam safety perspective. The visit was in response to one of the requirements of the Water Licence issued by the Nunavut Water Board to the Hamlet of Gjoa Haven, Nunavut.

During the site visit, we were accompanied by Mr. Shah Alam of the Government of Nunavut.

The following structures were reviewed during the visit:

- 1.) Active Sewage Lagoon; and
- 2.) Water Reservoir and Truck Fill Station.

The locations of the various facilities are shown on Figure 1.

2 Review of Wastewater Disposal Facilities

2.1 Active Lagoon

No design or as-built drawings of the active sewage lagoon were available for review.

The existing lagoon is located east of the Hamlet of Gjoa Haven and south of the airport runway (see Figure 2).

The site was visited on September 17 and 18, 2013 and the following observations were made.

It is understood that the existing lagoon was built in the 1970s. The lagoon is circular (Photos 1 and 2) with an estimated diameter of approximately 150 m. Based on the site observations, it appears that the initial lagoon was constructed in a conventional manner with a berm of unknown crest width and unknown side slopes. The height of the original berm was estimated to be 2.5 m to 3.0 m with side slopes of 2H:1V approximately. It is reported that a few years back, additional material was placed on top of the berm to increase its height by 1 m approximately. It appears that this material was simply dumped on top of the berm with trucks or other mechanical equipment and was not levelled or compacted. As a result, the crest of the berm is undulating and soil mounds are visible (Photos 3 and 4). It is also very narrow (approximately 1 metre) (Photo 5). The side slopes of the berm have been steepened by the dumping of the soil on top of the berm thereby resulting in steeper slopes than the original design (Photo 6) due to soil sloughing. Current berm slopes are estimated to be at an inclination of 1H:1V approximately.

The berm is made of sand and gravel with frequent cobbles. Generally, the material appears coarser and more permeable than normally used for construction of a facility of this type (Photos 3 and 7). The lagoon is not lined. It is not known whether the coarser material was used to increase the height of the berm or the original berm was also constructed with similar material.

The discharge chute is located along the north part of the lagoon. The discharge chute is in a state of disrepair. There was some evidence of erosion close to the toe of the berm at this location (Photo 7).

The overflow pipe is located on the south side of the lagoon (Photo 8). The overflow pipe discharges into a secondary lagoon located on the south side of the main lagoon (Photos 9 and 10). The berms of the secondary lagoon are 1.0 m to 1.5 m in height.

The wetlands are located on the south side and part of the west side of the lagoon (Photo 11).

It is reported that the lagoon has been leaking for a number of years. The predominant areas of leakage are along the east to south sides of the lagoon (Photo 12) and along the west side of the lagoon (Photo 13). As a result of water leakage over the years, water has ponded adjacent to the east and west sides of the lagoon. The worst leakage takes place at the location of the previous overflow unit, which was decommissioned and the area filled with sand and gravel material without any compaction or without provision of a liner.

Based on the site visit, we provide the following commentary:

- 1.) The lagoon slopes are much steeper than the conventional design requirements, which generally vary from 2H:1V to 3H:1V.
- 2.) The upper approximately 1 m to 1.5 m of the berm comprises of dumped sand and gravel material, which was neither levelled nor compacted. As a result, this material is loose and is also expected to be more susceptible to erosion and slope failure.
- 3.) The material used in construction of the berm is very coarse and as a result is expected to be very permeable.
- 4.) The lagoon has been leaking at the two locations for a number of years. Hence, the berm is being subjected to seepage forces. The slopes of the berm are considered to be too steep for this condition.

2.2 Lagoon Access Road

The access road to the existing lagoon is a two-lane unpaved road. It is well maintained and we understand that there are no issues with the road.

2.3 Lagoon Walk-Way

There is no walk-way on top of the berm since the crest of the berm is very narrow and undulating due to placement of soil mounds to increase the height of the berm.

2.4 Monitoring Wells

The facility does not contain any monitoring wells.

2.5 Consequences of Lagoon Failure

Failure of the lagoon may result in a release of a large quantity of effluent to the wetlands, depending on the time of the year when failure occurs. Release of a large quantity of effluent to the wetlands is unlikely to endanger human life since there is no development in the area. However, release of a large quantity of effluent to the wetlands may result in eutrophication of the wetlands, which may impact aquatic life, e.g. fish habitats, etc.

3 Water Supply System

3.1 Water Source

The Hamlet of Gjoa Haven draws its water supply from Swan Lake located approximately 2.3 kms northwest of the Community (Photos 14 and 15). It is reported that a sufficient quantity of water is available from Swan Lake to satisfy the Community needs and that the water quality is also good. Water is drawn from the lake via a 150 mm diameter pipe by pumps located in the pumping station (Photo 16). The water is heated to 15 degrees Celsius and pumped into the pipeline to the water treatment plant and truck fill station (Photo 17) located approximately 2.3 km southeast of Swan Lake. The pumping station is also equipped with an emergency truck fill station. During transmission of the water from the pumping station to the water treatment plant, it is heated twice at heating stations located along the pipeline approximately 1 km apart.

3.2 Water Treatment Plant & Truck Fill Station

The water at the water treatment plant is chlorinated. It is then filtered through anthracite sand and fine sand filters (Photo 18). Subsequently to filtration, it is re-chlorinated (Photo 19) and stored in the storage tank (Photo 20). The storage tank has a capacity of 385,000 litres, which is reported to be sufficient to meet the community's demands for approximately one to two days in case of any plant malfunction. During the normal operation of the plant, the intake pump runs daily to keep the water flowing through the buried pipeline.

The water from the storage tank is used to fill the water trucks at the truck fill station (Photo 21) for transportation to the community.

It is understood that the fuel tank located adjacent to the water treatment plant is double-walled. However, it is noted that it has not been provided with a containment unit.

It is also reported that the water used to wash the chlorine tank is discharged outside and most likely flows to the lake. The plant is equipped with de-chlorination facilities and the wastewater is de-chlorinated prior to its discharge.

4 Recommendations

- 1.) It is recommended that the use of the present lagoon should be discontinued as soon as the new lagoon has been commissioned. The reason for this is that the existing lagoon is leaking and that its continued use may result in progressive washing out of the fines from the lagoon. The washing out of the fines will result in increased permeability of the lagoon and greater seepage of water through the lagoon. This process is expected to continue until such time that the lagoon fails.
- 2.) The present lagoon should be decommissioned once its use has been discontinued. The decommissioning may consist of removal of the sludge from the bottom of the lagoon. The sludge should be spread to dry in the sun. The lagoon may be backfilled with the berm material. Any shortfall in the material may be made up by importing material from a borrow pit.

*Client: Government of Nunavut
Project Name: Dam Safety Review, Sewage Lagoons and Reservoir
Location: Gjoa Haven, Nunavut
Project Number: OTT-00209248-A0
Date: October 16, 2013*

Figures



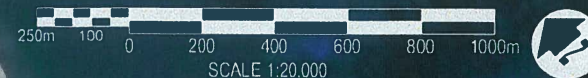
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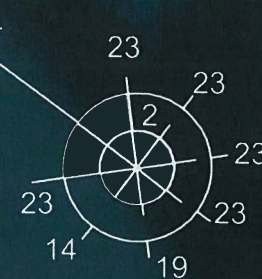
scale NTS	CLIENT: GJOA HAVEN, NUNAVUT	project no. OTT-00209248-A0
date 9/10/2013	TITLE: MONITORING STATION LOCATIONS	FIG 01
drawn by E.A.		



Mean Speed of Wind (km/h)
Frequency Scale 1mm = 1%

Hydrological Atlas of Canada – Annual Winds. (1978).
Natural Resources Canada. Retrieved June 28, 2011,
from <http://atlas.nrcan.gc.ca>.

Wind Frequency measurements were not from Gjoa Haven and are from closest anemometer to the area.



EDIT DATE: 26.07.2011 PLOT DATE: 26.07.2011 ACAD FILE: 4:\new\p1000\115029\setbacks\dwg\figs 12.dwg

IMAGE FROM GOOGLE EARTH PRO REGISTERED TO DILLON CONSULTING LTD.



PROJECT	Hamlet of Gjoa Haven, Nunavut Waste Treatment Facility
TITLE	Site Locations and Setbacks

PROJECT NUMBER	11-5029
DATE	June 2011
FIGURE NUMBER	Figure 2

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Appendix A: Photos

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Photograph No. 1

View of lagoon from north looking south. Note circular shape of lagoon.



Photograph No. 2

Partial view of lagoon looking west from north.

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Photograph No. 3

View of berm looking south from north. Note coarse fill mounds.



Photograph No. 4

View of berm looking north. Note fill mounds.

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Photograph No. 5

View of top of berm looking east from north. Note narrow crest of berm.



Photograph No. 6

View of top of berm looking west from north. Note steep slopes of berm.

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Photograph No. 7
Discharge chute. Note erosion at toe of berm.



Photograph No. 8
Overflow pipe.

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Photograph No. 9
Partial view of secondary lagoon.



Photograph No. 10
Another view of secondary lagoon.

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Photograph No. 11
View of wetlands located south of lagoon.



Photograph No. 12
View of water ponding east and south east of lagoon.

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Photograph No. 13
Ponded water at west side of lagoon.



Photograph No. 14
View of Swan Lake (source of water supply).

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Photograph No. 15
Another view of Swan Lake.



Photograph No. 16
View of water pumping station, emergency truck fill station, and fuel tank.

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Photograph No. 17
Front view of water treatment plant and fuel tank.



Photograph No. 18
Filtration Plant.

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Photograph No. 19
Chlorination station.



Photograph No. 20
Partial view of water storage tank.

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Photograph No. 21
Truck fill station.

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