GJOA HAVEN, NT

DRAFT

SEWAGE & SOLID WASTE DISPOSAL

OPERATION & MAINTENANCE MANUAL

DILLON CONSULTING LIMITED

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TABLE OF CONTENTS

Table of Contents (Continued)

APPENDICES

1.0 INTRODUCTION

1.1 Purpose

This man0ual has been produced to assist Hamlet of Gjoa Haven personnel in the proper operation and maintenance of the Hamlet's waste disposal facilities. The manual has been developed according to the requirements of the Nunavut Water Board, and is based on the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities", MACA, 1996.

1.2 Site Setting

The Hamlet of Gjoa Haven is on the southeast coast of King William Island on the Northwest Passage at 68°N and 96°W. It is approximately 1100 km northeast of Yellowknife. There is no direct road access to Gjoa Haven. Within the community there is approximately 12.8 km of road. The local economy is based on subsistence hunting, fishing, carving, and a growing tourism industry. The location plan is shown on Figure 1and an overall photo on Figure 2.

The community has the following services: health centre, diesel power generation, airport, Co-op and Northern stores, government offices, and annual resupply barges from Hay River. Access to Gjoa Haven is year round by commercial aircraft, and float plane in the summer months.

1.3 Geology and Terrain

Limestone bedrock, covered with a thin layer of frost-weathered in situ sand and boulders forms the characteristic terrain of the area. Bedrock predominates in the higher hills, which reach about 45 m. Lower areas are covered by a thick layer of fine sand and coarse rock. Permafrost conditions are prevalent, and the active layer ranges from 0.9 to 1.2 m.

1.4 Vegetation and Climate

Vegetation consists primarily of mosses, lichens, willows, and grasses in the summer. Gjoa Haven receives an average of 5.1 cm of rainfall and 25.4 cm of snowfall per year. Mean annual precipitation totals 8.4 cm. July mean high and low temperatures are 13.9°C and 7.2°C. January mean high and low are -23.3°C and -39.0°C. The winds are generally light and from the north.

1.5 Sewage and Solid Waste Facilities

The Hamlet of Gjoa Haven disposes of solid waste in a land fill located 1.1 km east of the community. The 15,000 m² site is fenced and surrounded by man made berms. Access to the site is via an all weather gravel road. The facility operates as a modified landfill using the trench method. Refuse is dumped onto the trenches, spread and compacted. Burning of refuse takes place when the prevailing winds assure any smoke is blowing away from the community in order to reduce the amount of waste entering the facility. Periodically a layer of cover material is placed on top and compacted, before adding more layers of refuse. Waste oil is stored adjacent to the solid waste site in 45 gallon drums. Bulky metal waste is segregated and stored away from the main landfill site.

Gjoa Haven disposes of wastewater and sewage using a lagoon. The sewage lagoon is approximately 22,700 m². The disposal site is located 1 km west of the town site. Three 4500 litre trucks are used to haul sewage to the facility. From the truck discharge point, through chutes the sewage enters the single cell lagoon for hydraulic retention of the sewage and settling of solids. The effluent percolates through the dyke in the summer, and flows approximately 1050 m to the ocean.

The location of the sewage and solid waste disposal facilities relative to the Hamlet are shown in **Figures 1 and 2**.

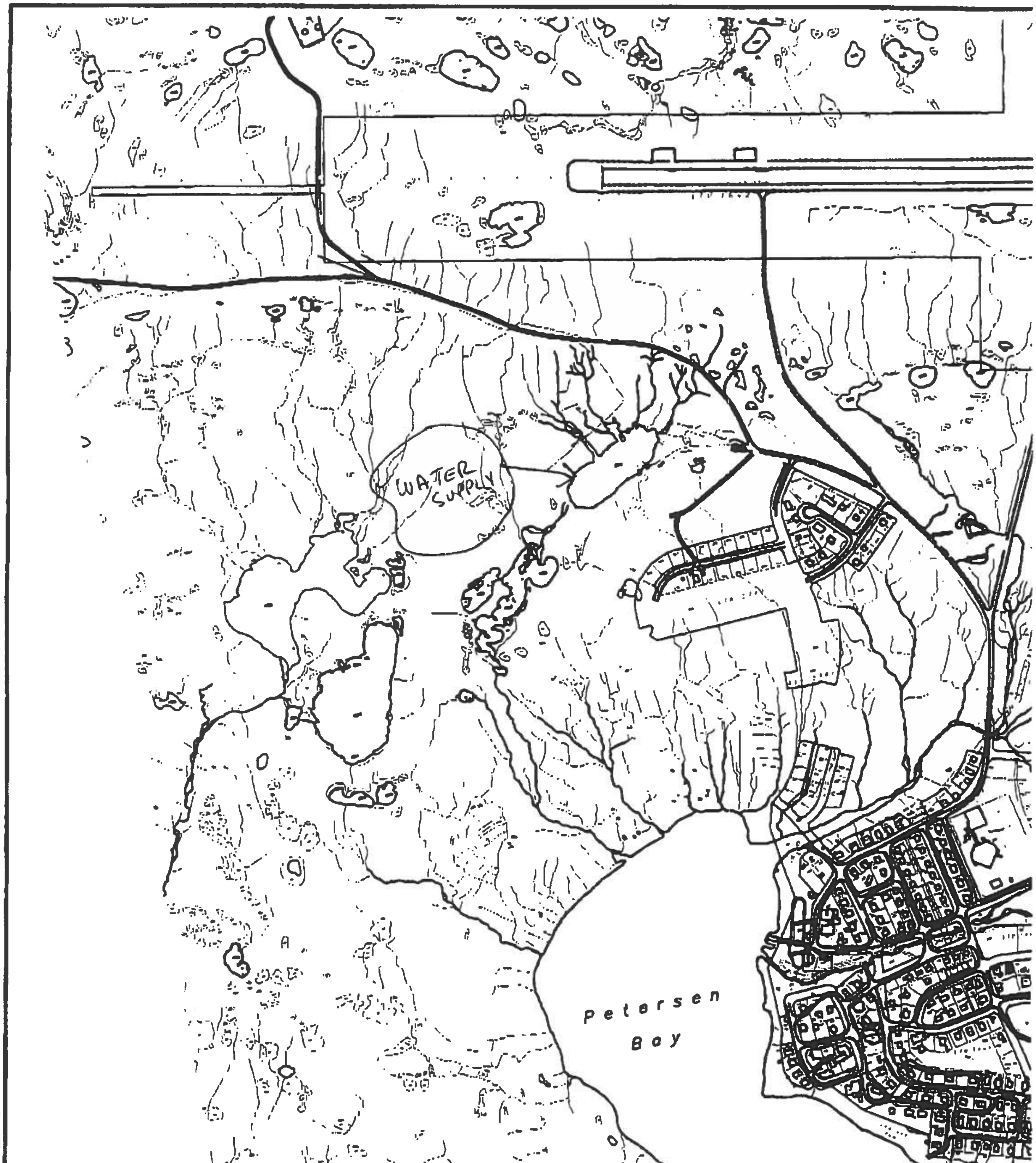
1.6 Population Projection

The Nunavut Bureau of Statistics has census records, and had developed population projections for Gjoa Haven until 2020. The projected population at the end of 20 years was calculated to be 1,435 residents in 2020. See Table 1.1. These population projections are

used to calculate the sewage and solid waste generation.

Table 1.1
Gjoa Haven Population Projections, 2000-2020

Year	Population	Year	Population
2000	984	2011	1194
2001	1005	2012	1217
2002	1023	2013	1242
2003	1045	2014	1266
2004	1063	2015	1290
2005	1084	2016	1317
2006	1102	2017	1345
2007	1117	2018	1375
2008	1136	2019	1405
2009	1154	2020	1435
2010	1173		



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PROJECT

SOLID WAST
WATER TREAT

TITLE

GJOA HAV
SITE

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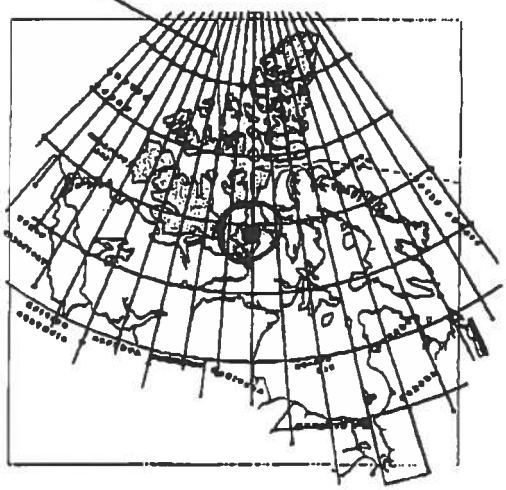

AIRSTRIP

SEWAGE LAGOON

LAND FILL SITE

Former solid waste and sewage upon?

TANK FARM

SEWAGE AND
NT FACILITIES

NUNAVUT
LAN

PROJECT NUMBER	99-6790
DATE	MAY 2000
FIGURE NUMBER	FIG 1

2.0 BACKGROUND

2.1 Water Supply and Distribution

The Hamlet of Gjoa Haven currently obtains its drinking from Water Lake just north of the community. It acts as a reservoir filled each fall from Swan Lake (fish lake?) via a 3.5 kilometre overland pipe north of the community. Water is pumped from Water Lake through a single 250 mm diameter insulated HDPE intake to the truckfill station, 170 m uphill from the lake. The intake is 9 m below the surface and extends 30 m into the lake secured by concrete blocks. Two water trucks are used to distribute water to the community seven days per week. Raw water treatment consists of hypochlorination. The location of the truckfill can be seen on Figures 1and 2.

2.2 Sewage Collection, Disposal, and Treatment

Sewage is collected daily from individual sewage tanks in the community using three 4500 L pumper trucks and transported to the lagoon. The trucks discharge the wastewater through chutes to the holding cell. Settling of solids and some treatment of sewage occurs as the wastewater is held in the lagoon. In the summer months effluent decants through a french drain and flows approximately 1050 m until it reaches the ocean. **Figure 3** shows the layout of the sewage discharge area.

2.3 Solid Waste Collection and Disposal

Solid waste is collected on a scheduled daily basis from the community and transported to the landfill by pick-up truck. Twice per year special collections are carried out for snowmobiles, mattresses or other bulky wastes. Separate disposal areas are provided for domestic waste, bulky metals, hazardous wastes and waste oil. The site is fenced and bermed. The facility operates as a modified landfill using the area method. Refuse is dumped onto the working face of the slope, and burned prior to spreading and compacting. Burning takes place approximately once a week, and only if wind are not blowing towards the community. Weekly a 300 mm layer of cover material is placed on top and compacted, before adding more layers of refuse. Runoff from the site enters the sewage treatment effluent system from the west near the primary settling pond. **Figure 4** shows the layout of the solid waste facility.

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PROJECT: SEWAGE LAGOON AND LAND FILL SITE	PROJECT NUMBER: 99-6790
	DATE: MAY 2000
TITLE: GJOA HAVEN NUNAVUT	FIGURE NUMBER: FIG 2

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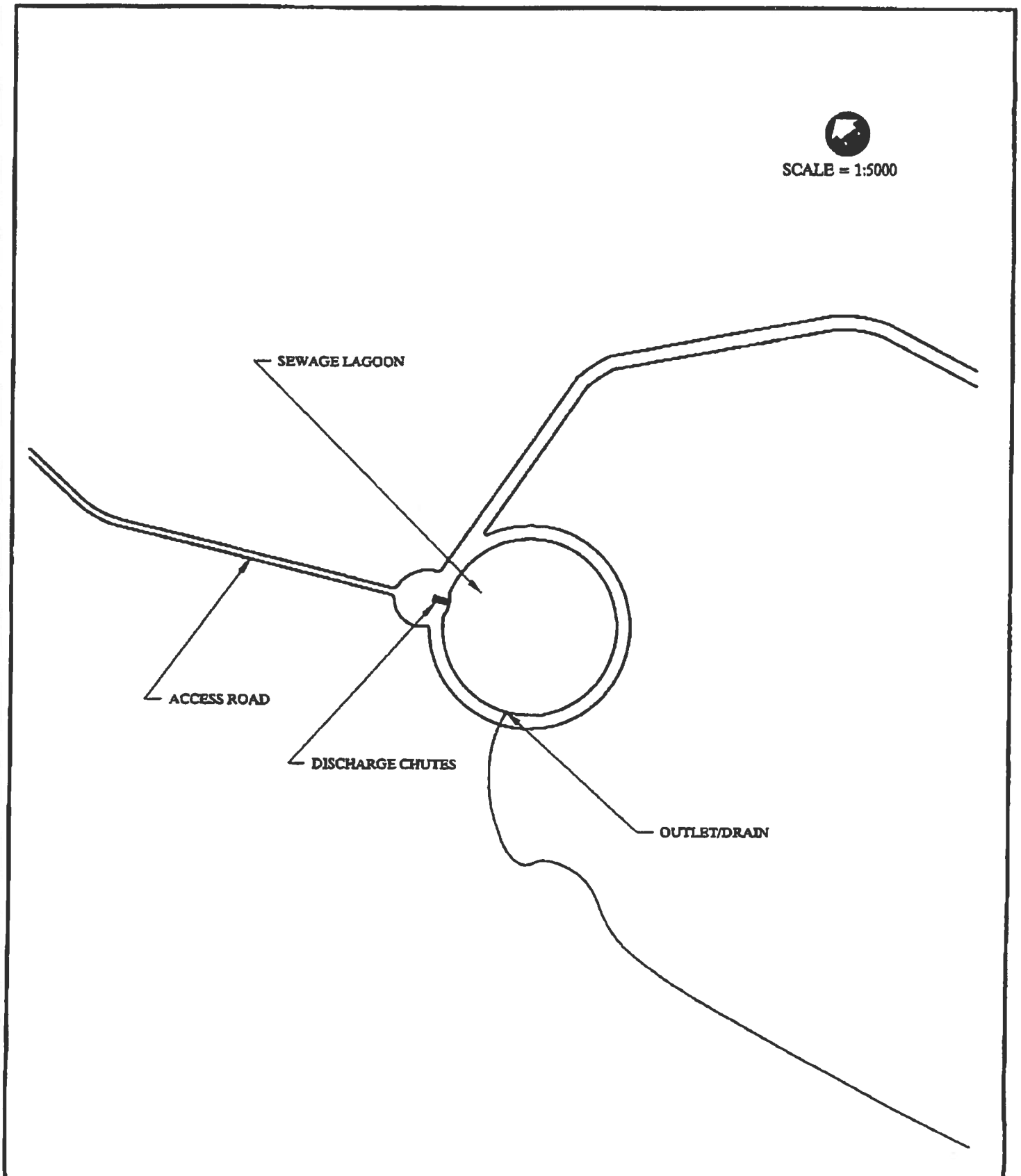

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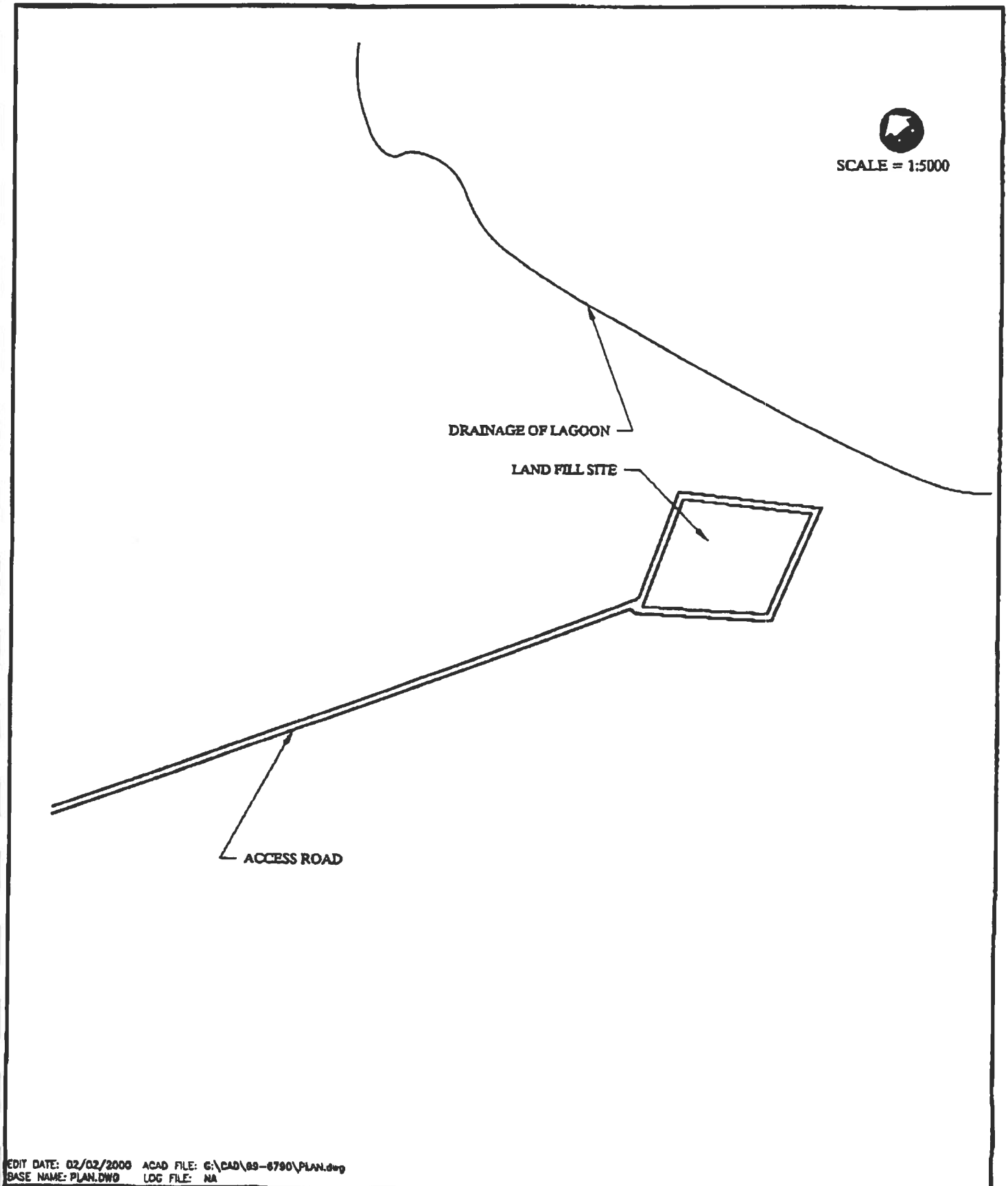
PROJECT	SEWAGE LAGOON SITE
TITLE	GJOA HAVEN NUNAVUT
PROJECT NUMBER	99-6790
DATE	MAY 2000
FIGURE NUMBER	FIG 3



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PROJECT: LAND FILL SITE

TITLE: GJOA HAVEN NUNAVUT

PROJECT NUMBER: 99-6790

DATE: MAY 2000

FIGURE NUMBER: FIG 4

2.4 Sewage Generation and Composition

In smaller communities where water delivery is provided by trucks, it can be assumed that the sewage generated is equal to the water consumption. Therefore, the daily and annual sewage generation rates for Gjoa Haven are approximately equal to the water consumption rates.

The MACA general Terms of Reference state that the standard criterion for water consumption in communities of less than 2000 residents, using trucked water can be estimated with the following equation:

$$\textit{Water Use (l/c/d)} = 90 \textit{ l/c/d} \times (1 + 0.00023 \times \textit{population})$$

The factors of 0.00023 x population represents the commercial and industrial water use.

The projected sewage generation at the end of the facility's expected design life (2003) was found to be 42,579 m³ per year by the above equation. Table 2.1 shows the annual sewage generation.

Table 2.1
Gjoa Haven Sewage Generation, 2000-2020

Year	Population	Sewage Generation (M^3)	Year	Population	Sewage Generation (M^3)
2000	984	39640	2011	1194	49994
2001	1005	40645	2012	1217	51169
2002	1023	41513	2013	1242	52455
2003	1045	42579	2014	1266	53698
2004	1063	43457	2015	1290	54950
2005	1084	44488	2016	1317	56368
2006	1102	45376	2017	1345	57851
2007	1117	46120	2018	1375	59453
2008	1136	47068	2019	1405	61069
2009	1154	47971	2020	1435	62698
2010	1173	48929			

The physical, chemical and biological characteristics of sewage are referred to as its composition. In communities where water delivery/sewage collection is by truck, the ratio of residential to commercial/industrial input is very high. Sewage composition is essentially "domestic" in nature. **Table 2.2** displays typical wastewater composition.

Table 2.2
Typical Raw Sewage Characteristics[1]

Parameter	Concentration
Biological Oxygen Demand (BOD_5)	400 mg/ℓ
Total Suspended Solids (TSS)	350 mg/ℓ
Volatile Suspended Solids (VSS)	275 mg/ℓ
Ammonia (NH_3)	50 mg/ℓ
Total Phosphorous (TP)	15 mg/ℓ

[1]Source: Wastewater Engineering Treatment/Disposal/Reuse, Metcalf & Eddy, 1979, 2nd Edition.

2.5 Solid Waste Generation and Composition

The MACA general Terms of Reference include a standard for solid waste generation in communities of less than 2000 residents. The equation for calculating solid waste generation is:

$$\textit{Solid Waste Generation } (m^3/d) = 0.01\ m^3/cd \times (1 + 0.00023 \times \textit{population})$$

The factors of 0.00023 x population represents the commercial and industrial solid waste use.

The projected additional cumulative solid waste at the end of the design life of the solid waste facility (2005) was found to be 28,036 m^3. Table 2.3 shows the annual and cumulative solid waste generation from the present. These volumes are based on the site being operated as a modified landfill which will include compaction of the waste mass with a dozer and weekly cover with a granular layer.

Table 2.3
Gjoa Haven Solid Waste Generation, 2000-2020

Year	Pop.	Solid Waste Generation (M^3)	Cummulative Waste (M^3)	Year	Pop.	Solid Waste Generation (M^3)	Cummulative Waste (M^3)
2000	984	4404	4404	2011	1194	5555	59753
2001	1005	4516	8921	2012	1217	5685	65439
2002	1023	4613	13533	2013	1242	5828	71267
2003	1045	4731	18264	2014	1266	5966	77233
2004	1063	4829	23093	2015	1290	6106	83339
2005	1084	4943	28036	2016	1317	6263	89602
2006	1102	5042	33078	2017	1345	6428	96030
2007	1117	5124	38202	2018	1375	6606	102636
2008	1136	5230	43432	2019	1405	6785	109421
2009	1154	5330	48762	2020	1435	66966	116388
2010	1173	5437	54198				

The characteristics of solid waste generated by the community of Gjoa Haven can be described as domestic and commercial. Domestic wastes are comprised of typical household wastes such as food, packaging materials, cardboard, and household articles. Bulky goods such as appliances, oil drums, equipment and recreational vehicles are also considered household waste. Commercial wastes are those generated by local business, services and facilities, and government agencies. Commercial waste may include large packaging materials, oil drums, building materials, paper and arts and crafts wastes. Table 2.4 shows typical waste composition for a small northern community.

Table 2.4

Component	% by Weight
Food	15.9
Cardboard	9.3
Newsprint	0.3
Other Paper Products	14.0
Cans	5
Other Metal Products	6.5
Plastic/Rubber/Leather	8.9
Glass/Ceramics	1.7
Textiles	3.3
Wood	20.0
Dirt	4.8
Diapers	10.3
Total	100

[1]Source: Guidelines for the Planning, Design, Operation & Maintenance of Solid Waste Modified Landfill Sites in the Northwest Territories, Heinke & Wong, 1991.

2.6 Previous Solid Waste and Sewage Disposal Facilities

Prior to the construction of the existing facilities both solid waste and sewage were disposed at a common location at the east edge of town. The sanitation site included a solid waste disposal area, a trucked sewage dumping area, and a bulky metals area. The former facility is shown on Figure 1.

3.0 OPERATION AND MAINTENANCE OF SEWAGE DISPOSAL FACILITY

3.1 Site Description

The site consists of a truck discharge point and turn around pad approximately 55 m wide, two 15 m discharge chutes and a 22,700 m^2 primary cell for hydraulic retention of the sewage. Drainage from the facility is through a 1050 metre natural channel to the ocean. The total linear distance from the truck off loading point to the ocean is approximately 1275 m. See Figure 2 and 3.

3.2 Type of Facility

A primary settling pond is used to treat the sewage and waste water through settling of solids and some retention time. Daily trucks discharge wastewater to a primary holding cell with an semi-permeable berm. The lagoon maintains freeboard via a french drain cut into a southerly section of the berm and through percolation.

Some treatment of the sewage may occur naturally as the effluent travels through the natural channel in the tundra toward the ocean.

3.3 Discharge Method

Waste water and sewage is naturally discharged through the semi-permeable berm and the french drain in the summer months while temperatures are above freezing. In the winter the discharge forms an ice pack in the lagoon which will melt and flow through the system the following spring and summer.

3.4 Equipment List

The following equipment is used to operate the Gjoa Haven sewage treatment system:

-
-

3.5 Site Personnel

The Hamlet Foreman is responsible for the overall operation of the sewage treatment facility, as well as the general operation and maintenance of the facility. One person is employed by the Hamlet to operate each sewage truck.

Name	Title	Phone number
	Hamlet Foreman	(867)360-6042

3.6 Operational Procedures

These procedures must be carried out frequently to ensure the smooth operation of the treatment system.

1. Wastewater in Gjoa Haven is collected in holding tanks at each residence or commercial building,
2. Suction trucks pump the wastewater out of the holding tanks and transport it to the sewage treatment area,
3. The wastewater is discharged through the discharge chutes where it passes into the holding cell of the lagoon,
4. The effluent is retained for primary treatment and then flows out of the holding cell and continues to the ocean.

3.7 Maintenance Procedures

The following maintenance procedures should be carried out to ensure the wastewater treatment infrastructure operates efficiently.

3.7.1 Sewage Trucks and Holding Tanks

The transport of sewage to the treatment facility is critical to the whole process. As such,

it is important that the sewage trucks be kept in good repair.

- Repairs to sewage trucks should be completed as a priority,
- Sewage trucks should not sit full for long periods in the winter,
- Holding tanks must be kept in good working order and prevented from freezing during the winter.

3.7.2 Access Road and Truck Pad

The 1.4 km access road is constructed of gravel. Basic road maintenance is to be conducted as follows:

- At least twice per year, the road and truck pad is to be graded to smooth and reshape the surface,
- As necessary during the winter, snow is to be removed to ensure unrestricted access to the sewage discharge point is maintained,
- During snow removal care is to be taken not to damage the discharge chutes or the rails demarcating the edge of the discharge point,
- Any spilled and frozen wastewater should be removed with the snow,
- The discharge point should be monitored for erosion problems,
- If required, rip rap or other protective material may be placed at the discharge location to reduce erosion.

3.7.3 Fence and Signs

Fences are to be examined for holes and fence posts checked for frost heave. Windblown debris should be removed from the fence to reduce lateral loading and improve appearance of the site.

Signs are to be posted at the discharge location informing the public of the presence of the sewage treatment area and warning of the potential health risks associated with it. A sign should also be posted at the monitoring location, identifying it as a wastewater discharge monitoring station.

- On a monthly basis, the signs are to be checked to insure they are present, have not become obstructed and are readable.

3.7.4 Drainage

The truck pad at the sewage discharge point should be graded such that any wastewater spilled during the off loading procedure will flow into the sewage treatment system.

3.7.5 Sampling Procedures and Requirements

Monitoring the wastewater effluent is an important step in the efficient operation of the wastewater treatment system in Gjoa Haven. Six factors are particularly important to producing meaningful results:

1. Collecting the samples at the designated time,
2. Using the correct clean sampling container for the parameter being tested,
3. Collecting the samples from the correct location and completing any necessary field tests at that time,
4. Labelling the samples correctly and filling out a record sheet,
5. Using the correct procedure for field tested parameters,
6. Shipping the samples quickly and in the correct containers to the designated analytical laboratory.

The sampling location for the Gjoa Haven sewage treatment system (GJO-3) required in the water licence established by the Nunavut Water Board is the runoff discharge from the sewage lagoon just prior to entering the ocean. See Figure 3. Sampling and monitoring is to be conducted by collecting grab samples annually during periods of open water for the following parameters:

- BOD,
- pH,
- Total Suspended Solids,
- Nitrate-Nitrite,
- Total Phenols,

- Sodium,
- Magnesium,
- Faecal Coliform.
- Conductivity,
- Ammonia-Nitrogen,
- Oil and Grease (visual),
- Sulphate,
- Potassium,
- Calcium.

3.7.6 Record Keeping

Records should be kept to assist in planning for yearly operations and to assist in the evaluation of the effectiveness of the sewage treatment facility. The records should be stored in the Hamlet Office and be maintained by the Operations Manager. As a minimum, the following information should be recorded:

- The number of trips the sewage truck makes to the site per day, the approximate volume of sewage discharged to the system,
- The dates any monitoring is conducted,
- The results of the monitoring program,
- Any maintenance activities carried out on the facility.

3.7.8 Safety

Due to the potential health hazards associated with sewage handling and treatment, the following safety precautions should be taken by sewage treatment personnel:

- Equipment is to be kept clean,
- Hands are to be washed frequently, as a minimum after work and before eating,
- Work clothes should not be worn home. Clothing should be changed at the public works yard building,
- Work gloves and boots should be worn at all times,
- Personnel should receive appropriate vaccinations and ensure they are kept up to date.

3.8 Operational and Maintenance Summary

Daily

- Collect waste water from the holding tanks and transport it to the sewage truck discharge point,
- Clean up any spills immediately,
- Clear snow from road and truck pads as required,
- Record O&M information.

Weekly

- Ensure significant erosion is not occurring at the discharge location,
- Record O&M information.

Monthly

- Grade and maintain the access road and truck pads if required,
- Check signs to ensure they are present and in readable condition,
- Record O&M information.

Yearly

- Review the O&M records to evaluate the effectiveness of the sewage treatment system and plan for the upcoming year.
- Conduct the annual monitoring program,

4.0 SOLID WASTE FACILITY

4.1 Site Description

The solid waste disposal facility servicing the Hamlet of Gjoa Haven is located approximately 975 metres east of the community, to the south of the sewage lagoon. Access to the site is via an all weather gravel road. The facility operates as a modified landfill using the trench and cover method. The site is divided into three main areas, refuse disposal, bulky waste and hazardous waste. The site layout is shown in Figure 4.

4.2 Acceptable Waste

The disposal site is organized into three separate disposal areas:

Refuse disposal area:

This is the largest disposal area at the landfill. General household, restaurant, institution, store and construction wastes are placed here. The disposal area extends approximately 140 m east of the access road and is approximately 120 m wide. An earthen berm surrounding the site helps control drainage by preventing runoff from entering the site and directing any flow with in the site to the south corner. A 2.4 m high fence surrounds the site to help prevent the off site migration of wind blown debris and to restrict access during off hours.

Bulky waste area:

Large non-combustible items such as automobiles, snowmobiles, appliances, old furnaces and holding tanks are placed in the bulky waste disposal area. It consists of

Hazardous materials area:

A portion of the bulky waste area has been designated for storing hazardous materials. A container has been provided for the disposal of materials such as paints, household hazardous wastes and aerosol containers. Pallets are in place for the storage of used batteries.

4.3 Equipment List

The following equipment is available as required to perform maintenance activities at the site:

Additionally, the following equipment is dedicated to the landfill full time:

4.4 Site Personnel

The Hamlet Foreman is responsible for the overall operation of the solid waste facility, as well as the general operation and maintenance of the facility. Two or three people are employed by the Hamlet to operate the garbage collection vehicle.

Name	Title	Phone number
	Hamlet Foreman	(867)360-6042

4.5 Operational Procedures

These procedures must be carried out on a regular basis to ensure the landfill operates safely and efficiently.

4.5.1 Basic Operations

1. All wastes are to be dumped in the appropriate area as indicated on the dumping plan posted at the landfill entrance,
2. Dumping should be restricted to a manageable portion of each area at a time,
3. 2 to 3 times per week (when winds are blowing away from the community) the combustible wastes in the refuse disposal area are to be burned,

4. As required, the waste should be compacted using the Cat D6H,
5. After compaction, each layer should be not more than 2.5 m thick,
6. The compacted waste should be covered with material, from the borrow pit adjacent to the landfill, to a depth of 0.15 m to 0.20 m for intermediate layers and 0.50 m for the final cover,
7. Each layer of solid waste and cover material should be sloped to allow drainage.

4.5.2 Cover Operations

A minimum of twice per year, a compaction and cover cycle is to be conducted at the landfill. Using the Cat D6H:

- The accumulated waste is spread with the Cat and compacted by driving over it several times with the Cat,
- The compacted material is worked back up slope a bit at a time to form compacted layers of waste, not more that 2.5 m thick,
- Each 2.5 m layer is covered with material obtained from the borrow pit immediately south of the landfill,
- Cover material should form a layer 0.15 m to 0.20 m thick between compacted layers and a layer 0.5 m thick on top of the compacted layers,
- Compact the cover material,
- Slope the compacted cover and waste to allow drainage. See **Appendix A**.

4.5.3 Bulky Waste Area Operation

The bulky waste disposal area is a levelled pad located west(?) of the general disposal area. To ensure effective operation:

- Place bulky wastes in an organized manner, starting from the back and working towards the front,
- Stack bulky wastes whenever possible to conserve space,
- Ensure that wastes are stacked in such a way that it is safe to walk through the site.

4.5.4 Hazardous Waste Area Operation

The hazardous materials storage area is an area(?) within the bulky waste disposal area. Used batteries are to be placed on pallets in this area. Specific information on handling hazardous waste materials can be found in the following GNWT Dept. of Resources, Wildlife and Economic Development Guidelines:

- Environmental Guideline for Industrial Waste Discharges,
- Environmental Guideline for the General Management of Hazardous Waste,
- Environmental Guideline for Waste Asbestos,
- Environmental Guideline for Waste Paint,
- Environmental Guideline for Waste Solvents,
- Environmental Guideline for Ozone Depleting Substances,
- Environmental Guideline for Waste Batteries,
- Environmental Guideline for Waste Antifreeze.

4.5.5 Special Considerations

Winter Operation A compaction and covering cycle is completed in the fall to prepare for the onset of winter.

Wind A chain link and wire mesh fence has been constructed around the perimeter of the landfill to help control the movement of wind driven material off the landfill site.(?)

Scavenging Public access is permitted during working hours but several steps are being taken to reduce the occurrence of scavenging. Regular burning is conducted to reduce the volume of scavengeable waste present on the site. Perimeter fencing with a gate across the access road has been constructed to restrict access to the facility during off hours. A dumping plan has been posted at the landfill entrance to direct private disposal.(?)

Spring clean-up A spring clean-up is conducted after the snow has melted to collect waste that has accumulated around the Hamlet over the winter.

Safety Due to the nature of the facility, safety precautions should be taken by those personnel involved in the operation and maintenance of the landfill.

- Water and puncture proof gloves and safety boots are to be worn at all times,
- Work clothes should not be worn home. Change at the public works yard building,
- Hands are to be washed frequently, as a minimum after work and before eating,
- During waste burning, personnel should stand clear to reduce exposure to toxic fumes and smoke,
- Burning wastes should not be left unsupervised,
- Personnel should receive appropriate vaccinations and ensure they are kept up to date,
- Proper lifting technique should be exercised, lift with your legs and not your back,
- Only personnel trained to handle hazardous materials should do so.

4.5.6 Site Records

Records should be kept to assist in planning for yearly operations and future expansion. The information should be reviewed yearly to evaluate the effectiveness of the operation and to forecast future operational requirements. The records should be kept in the Hamlet Office and maintained by the Operations Manager. As a minimum, the following information should be recorded:

Refuse

- The number of trips and loads per day,
- The dates of burning,
- The dates of compaction and cover.

Bulky Wastes

- Itemize the site contents,
- The number of trips to the site and the dates,
- The date when the site is full.

Hazardous Materials

- The number of trips to the site and the dates,
- The type of material placed there,
- The party using the site,
- The date when the site is full.

4.6 Maintenance Procedures

Proper maintenance of a landfill facility is crucial to ensuring the efficient operation of all the components. Activities can be divided into two categories: storage/collection maintenance and site maintenance.

4.6.1 Storage and Collection Maintenance

Garbage collection is conducted from Monday to Friday. Residential collection is twice per week, commercial and institutional collection is also twice per week but may be increased to daily for an extra fee. A monthly tipping fee is collected from those parties not receiving regular collection.

4.6.1.1 Storage Maintenance

As the first step in the waste collection process, residential and commercial storage containers should be adequately maintained. The following points should be considered:

- Private burning of wastes within the Hamlet boundaries should be discouraged as the smoke and fire hazards generally outweigh any benefit from reducing the volume of

waste,

- Garbage containers should be covered to prevent wind blown debris from littering the community and to prevent animals from getting into the garbage,
- Bulky wastes should not be left in residential areas for long periods due to aesthetic and safety concerns.

4.6.1.2 Collection Maintenance

The waste collection vehicle should be maintained in good operating condition to ensure the collection service is not interrupted for extended periods. Other maintenance considerations include the following:

- The collection vehicle should be equipped with a shovel to clean up accidental spills during collection,
- The collection vehicle should be cleaned periodically,
- The standby stake truck or pick-up is to be used when the primary truck is down for maintenance or repair.

4.6.1.3 Access Road Maintenance

The access road is gravel and approximately 975 m long. Basic road maintenance is to be conducted as follows:

- At least twice per year, the road is to be graded to smooth and reshape the surface,
- As necessary during the winter, snow is to be removed to ensure unrestricted access to the site for the garbage collection vehicles.

4.6.1.4 Fence Maintenance

A 2.4 m high fence is in place around the perimeter of the landfill. The fence serves the dual purpose of restricting public access to the site and reducing the migration of windblown debris out of the landfill area. On a monthly basis, the following maintenance procedures should be carried out on the fence:

- The fence should be examined for holes in the mesh,
- The fence posts should be inspected for frost heave,
- Wind blown material should be removed from the fence to reduce lateral loading and to improve the aesthetics of the site.

4.6.1.5 Sign Maintenance

A sign posted at the entrance to the site identifies the different disposal areas at the facility and outlines permissible dumping practices for each. The separate disposal areas are identified with their own signs. A warning sign indicating the potential hazards associated with the site is also located at the entrance.

- On a monthly basis, check to insure the signs are present, have not become obstructed and are readable.

4.6.1.6 Drainage Maintenance

Culverts have been installed along the ? berm surrounding the general disposal area to provide drainage. The landfill drains into the sewage wetlands system. Maintenance should be conducted on the culverts to ensure the site drains as intended and to prevent unwanted pooling of water:

- Weekly, the culverts should be inspected to ensure they have not become blocked,
- Obstructions should be removed to ensure drainage is unrestricted.

4.6.1.7 Fire Maintenance

Fires are set at the landfill to reduce the overall waste volume and to discourage scavenging. Controlled burns occur two to three times per week as required. The following practices should be adhered to when burning waste:

- Only burn when conditions permit and keep the fire under control at all times,
- Measures should be taken to ensure the fires do not become deeply seated, making

extinguishment difficult,
- Open and deep seated fires may be extinguished by smothering with cover material,
- Open fires should not be left unattended.

4.6.1.8 Sampling Procedures and Requirements

Monitoring the solid waste site effluent is an important step in maintining the solid waste operation in Gjoa Haven. Six factors are particularly important to producing meaningful results:

1. Collecting the samples at the designated time,
2. Using the correct clean sampling container for the parameter being tested,
3. Collecting the samples from the correct location and completing any necessary field tests at that time,
4. Labelling the samples correctly and filling out a record sheet,
5. Using the correct procedure for field tested parameters,
6. Shipping the samples quickly and in the correct containers to the designated analytical laboratory.

The sampling location for the Gjoa Haven solid waste site (GJO-2) required in the water licence established by the Nunavut Water Board is the runoff from the solid waste disposal facilities (if present). See Figure 4. Sampling and monitoring is to be conducted by collecting grab samples anually during periods of flow for the following parameters:

- pH,
- Total Suspended Solids,
- Nitrate-Nitrite,
- Total Phenols,
- Sodium,
- Magnesium,
- Total Arsenic,
- Total Copper,
- Total Iron,
- Total Mercury,
- Conductivity,
- Ammonia-Nitrogen,

- Oil and Grease (visual),
- Sulphate,
- Potassium,
- Calcium,
- Total Cadmium,
- Total Chromium,
- Total Lead,
- Total Nickel.

4.7 Operational and Maintenance Summary

Daily

- Collect waste from the Hamlet and transport it to the landfill,
- Keep the entrance gate locked after hours of operation,
- Ensure all wastes stay in designated areas,
- Clean up any spills immediately,
- Clear snow from roads and disposal areas as required,
- Record O&M information.

Weekly

- Burn waste material as required,
- Check to ensure the culverts have not become obstructed,
- Pick up windblown materials which have migrated past the debris fences,
- Remove wind blown debris off fence,
- Record O&M information.

Monthly

- Grade and maintain access roads if required,
- Check and fix fences if required,
- Check signs to ensure they are in readable condition,
- Record O&M information.

Yearly

- Conduct the annual monitoring program,
- Compact and cover refuse in the spring and fall,
- Review O&M records to assist in planning for the upcoming year.

5.0 EMERGENCY RESPONSE

Due to the nature of the facilities, uncontrolled fires and spills of unknown or hazardous materials should be treated with extreme caution. Hamlet personnel responsible for the solid waste and sewage disposal facilities should be trained in WHMIS, TDG and First Aid, and should ensure that appropriate vaccinations are kept current.

5.1 Fire

A contingency plan should be developed by the Hamlet Fire Department for responding to a fire at the solid waste disposal site. Special precautions should be implemented as burning refuse can produce poisonous vapours. The following procedures should be used in case of an uncontrolled fire:

- Evacuate area around landfill immediately,
- Keep all personnel up-wind of the site,
- Notify the Hamlet Fire Department at 360-6333.

5.2 Spills

Spills of unknown substances or hazardous substances at the landfill should be treated with extreme caution. Spilled materials should only be handled by properly trained and equipped personnel. The following actions should be undertaken by personnel in the event of a hazardous materials spill at the landfill:

- **Be alert and consider your personal safety first,**
- Assess the hazard to persons in the vicinity of the spill and where possible take action to control danger to human life. If possible, identify the material or products spilled,
- If the spill creates a fire, explosion or other hazard to human life, remove all potential ignition sources, if possible evacuate the area and contact the RCMP, 360-6201 and the Fire Department, 360-6333,
- If safe and practical, try to take appropriate action to stop the release of material,

- Contact the Municipal Services Foreman and report the spill,
- Mark the spill scene to warn the public and prevent access.

Once contacted, the Municipal Services Foreman shall:

- Proceed to the spill location,
- Make the necessary arrangements for first aid and removal of injured personnel. Take the necessary action, where possible, to secure the site to protect human safety,
- If not already done and if it is safe to do so, take the appropriate action to stop the flow or release of material. If at all possible take the necessary action to contain or prevent the spread of the spilled material,
- Contact the 24 Hour Spill Line at (867) 920-8130,
- Contact the Hamlet Operations Manager,
- Contact the Fire Department if required, 360-6333,

Throughout the spill response, personnel should place their personal safety as the highest priority.

REFERENCES AND RELATED STUDIES

Duong, D. and Kent, R., "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories", Produced for MACA, October, 1996.

Heinke, G.W. and Smith, D.W., "Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems in the Northwest Territories, Volume II - Operations and Maintenance", Produced for MACA, November, 1988.

Heinke, G.W. and Wong, J., "Guidelines for the Planning, Design, Operation and Maintenance of Solid Waste Modified Landfill Sites in the Northwest Territories, Volume I - Planning and Design, Volume II - Operation and Maintenance", Produced for MACA, March, 1990.

www.infonorth.org Web Site.

Government of Nunavut Bureau of Statistics

APPENDIX A

Cover Operations

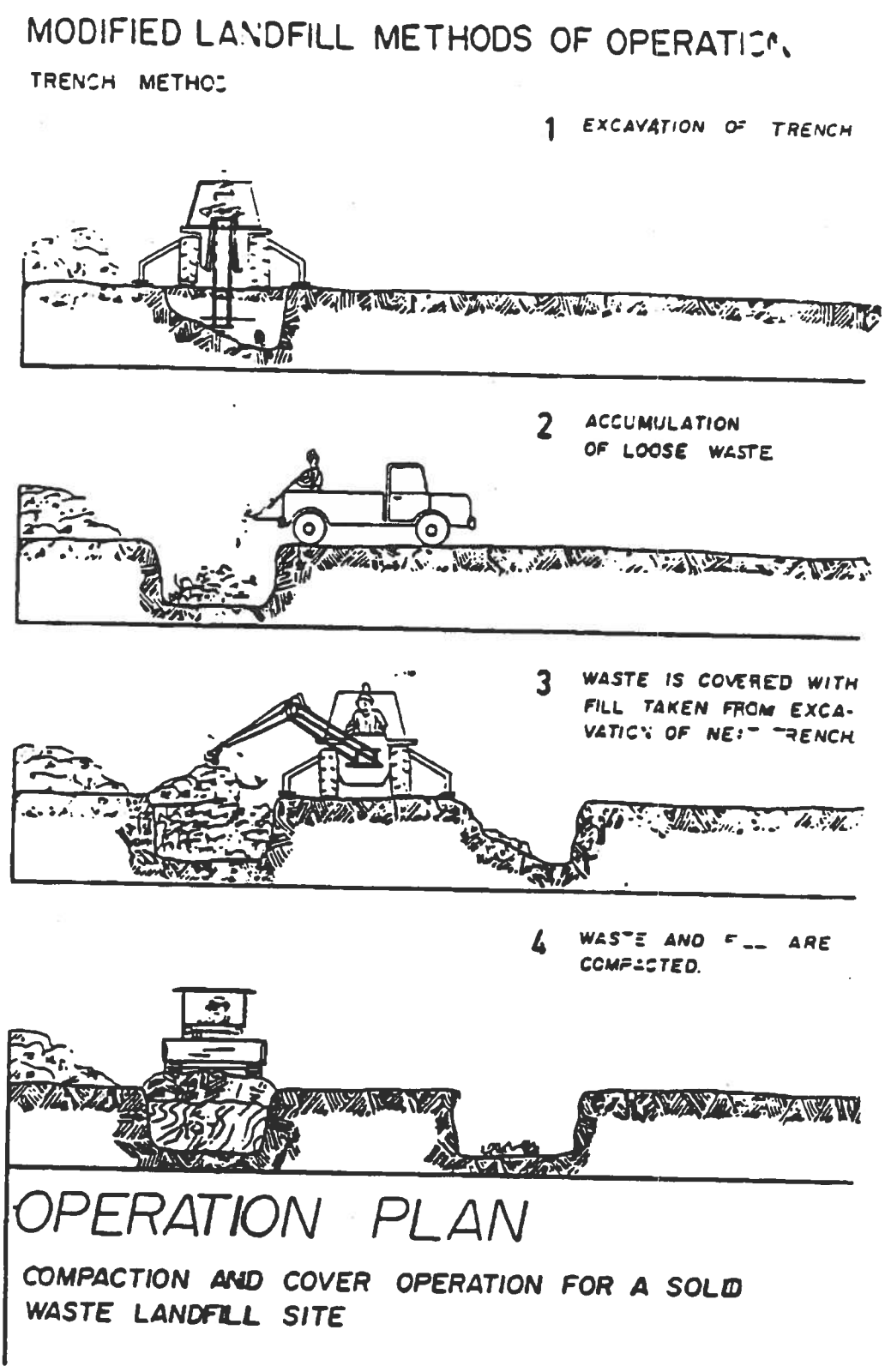

FIGURE 6.3 TRENCH METHOD

Source: General Terms of Reference for a Community Solid Waste Management Study, Government of the Northwest Territories.

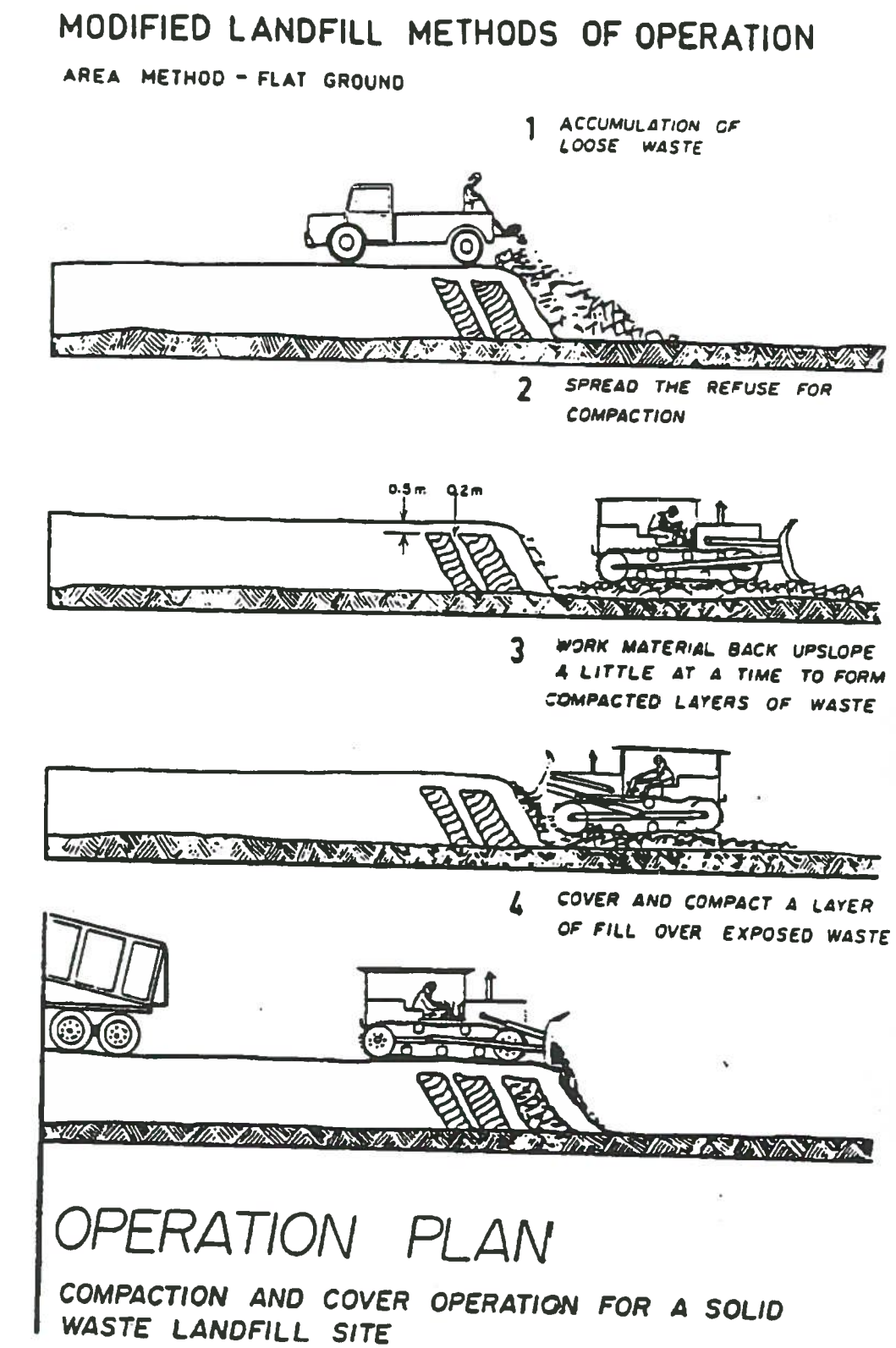

FIGURE 6.2 AREA METHOD ON FLAT GROUND

Source: General Terms of Reference for a Community Solid Waste Management Study, Government of the Northwest Territories.

APPENDIX B

Hamlet of Gjoa Haven
Garbage Rate Bylaw

APPENDIX C

Hamlet of Gjoa Haven
Water Licence