CAPE DORSET
SEWAGE & SOLID WASTE RELOCATION
DESIGN & OPERATIONAL CONCEPTS BRIEF

Prepared For:

Hamlet of Cape Dorset
Cape Dorset, NWT

Prepared By:

Ferguson Simek Clark
Engineers & Architects
P. O. Box 1777
Yellowknife, NT
X1A 2P4

FSC Project No. 95-1190

June, 1996

Our File: 95-1190

June 21, 1996

Hamlet of Cape Dorset
Cape Dorset, NWT

Attention: ***Jim Strickland, Municipal Works Manager***

Re: CAPE DORSET
SEWAGE & SOLID WASTE RELOCATION
DESIGN & OPERATIONAL CONCEPTS BRIEF

Dear Sir:

We are pleased to submit to you 3 copies of the above noted report.

This report analyzes the needs for the waste management facilities in your community and makes recommendations for the implementation of such including the completion of the sewage lagoon system which was initiated in 1995.

We trust that this document will satisfy your immediate needs and offer our assistance in the completion of the project to your satisfaction and that of all regulatory and governing authorities.

Please feel free to contact me at any time to discuss our findings and recommendations.

Yours very truly,
FERGUSON SIMEK CLARK

Kevin Hodgins, P. Eng.
Principal

an.

TABLE OF CONTENTS

1. INTRODUCTION

The Hamlet of Cape Dorset has commissioned Ferguson Simek Clark (FSC) to assist with the design of a new sanitary landfill and sewage lagoon and make recommendations for the close-out of the existing facilities.

This document provides the basic planning considerations and pre-construction design for such a project.

1.1. Objectives

The objectives of this project are as listed below:

1. To meet the environmental requirements imposed by DIAND, NWT Water Board, the Baffin Regional Health Board and the intent of the Hamlet Council
2. To provide facilities satisfying the ten year needs and twenty year design life, with the design life horizon being 2016.
3. To confirm the site chosen for the sewage lagoon by the community.
4. To design a facility with adequate storage volume for approximately 12 months, based on ten and twenty year projected volumes.
5. To provide a method of draining the sewage lagoon in the fall.
6. To locate a solid waste and bulky waste disposal area within the vicinity of the proposed lagoon and proposed access road.
7. To provide divisions within the solid waste disposal area to allow for management of the varying types of refuse.
8. To provide a modified landfill facility which is simple to manage and operate by local personnel.
9. To provide a pit facility for the disposal of waste oil.
10. To provide a method of containment for hazardous wastes.
11. To provide recommendations for the decommissioning of the existing solid waste and sewage disposal facilities.

2. COMMUNITY INFORMATION

Cape Dorset is situated on Dorset Island, off the Foxe Peninsula, on the southwest of Baffin Island, NWT. The community is located approximately 402 air km southwest of Iqaluit and approximately 1,891 air km northeast of Yellowknife. The geographical coordinates of Cape Dorset are 64° 14' N and 76°32' W (NWT Data Book, Outcrop).

The community lies within two valleys of the Kingnait Range hills with large areas of exposed granite bedrock and extensive mud flats in the valley mouths. Soils within the area range from fine sand to gravel to cobbles and rock fragments (MACA, 1990) . Overburden conditions at the site consists of glacial till comprised mainly of sand and gravel. Bedrock outcrops adjacent to the site.

Cape Dorset lies within the continuos permafrost zone and landforms associated with permafrost are evident. The active layer in the areas of the proposed facilities varies from 0.5 to 1.0 metres

In Cape Dorset, winters are long and cold with a mean average temperature in January, the coldest month, of -23°C. The summers are short and cool with a mean daily temperature in July of 7°C. The mean annual rainfall in Cape Dorset is 152 mm and mean annual snowfall is 1180 mm. The prevailing wind is from the west with an average windspeed of 18.5 km/hr. (NWT Databook, Outcrop)

3. REVIEW OF CURRENT PRACTICE

Municipal services are provided to the community of Cape Dorset by the Hamlet of Cape Dorset through a contract with the GNWT. The facts in the following section regarding the current water supply, waste collection and waste disposal practices of the community were collected in discussions with Hamlet personnel and through observations during August 1995.

3.1. Water Supply and Distribution

Cape Dorset obtains its potable water supply from a truckfill station at Tee Lake, approximately 1 km south of the community . Water is pumped to a storage tank, then into delivery trucks where it is batch chlorinated prior to delivery to consumers.

Water is delivered to consumers 3 times per week by truck. The community has two water trucks with a capacity of 5,455 litres and one with a capacity of 6,819 litres. The trucks operate 5 days per week year round.

3.1.1. Water Consumption

There are presently 213 private and public residential units and 31 other units including government and commercial operations, receiving water delivery from the Hamlet. During the 12 month period from April 1, 1994 to March 31, 1995 the Hamlet delivered 25, 598,688 litres of water to local consumers.

The Hamlet does not currently hold a license for water use from the NWT Water Board.

3.2. Sewage Collection and Disposal

In Cape Dorset, 210 of the private and public residences are complete with a sewage pump out tank and 3 residences utilize honeybags for sewage disposal. There are 31 other units including government, retail and church occupied buildings. All of these units are fitted with sewage pump out facilities.

3.2.1. Pumped Sewage

The Hamlet of Cape Dorset utilizes 2 sewage trucks to pump out sewage holding tanks. The schedule is for 5 pickups per week per tank with the trucks operating 5 days per week The capacities of each truck is 4500 litres.

The existing lagoon system is located approximately 1.5 kilometers to the north of the hamlet. The lagoon is approximately 60 m by 50 m in size with a varying depth depending on the accumulations of solids and the subsurface topography prior to lagoon commission in the 1970's. The existing drainage outlet is at the east end of the lagoon. The effluent flows through oversized rip rap in the berm and through a culvert crossing a road. The sewage flows across a natural rock swale to the ocean approximately 300 m down slope. The lagoon capacity appears insufficient with a strong flow of effluent seeping from the discharge area. Honeybags have been observed in the sewage lagoon. The discharge stream flows within 25 m of the solid metal waste disposal area.

This sewage disposal facility is not licensed by the NWT Water Board.

3.2.2. Honeybag Collection and Disposal

As of the end of 1995 only three residences utilized honeybags. Honeybags are picked up with the sewage 5 times a week. The honeybags are deposited in a pit located adjacent to the sewage lagoon. The honeybag pit dimensions are approximately 20 m by 20 m. There are no containment berms at present and there is evidence of honeybags in the nearby sewage lagoon and beyond the perimeter of the pit. The proposed road accessing the new lagoon site runs along side the existing sewage lagoon and honeybag pit.

The three residences currently utilizing honeybags are being retrofitted with sewage pump out facilities. This transition is expected to be complete by the end of 1996.

3.3. Solid Waste Collection and Disposal

Solid waste is stored outside residences in 205 L drums. Separate drums are used for honey bag and solid waste storage. Solid waste is collected with a 6.5 m^3 capacity garbage truck and crew. The schedule is for 5 pickups per week per disposal point with the trucks operating 5 days per week.

Solid waste is disposed of in the solid waste site which is located approximately 1.5 kilometers north of the community. The site measures approximately 200 m by 70 m and is located 50 m up slope of the honeybag and sewage lagoon areas. The solid waste site is adjacent to a gravel pit which supplies cover material for the landfill. It appears that insufficient cover material is placed over the leveled refuse despite the proximity of the granular source. It should be noted that the practice of placing and leveling cover material is an extremely difficult operation during the winter months The site is not sheltered from the wind and waste is scattered throughout the site and surrounding area. This solid waste site has been in use since the 1970's.

Reduction of solid waste is routinely practiced through burning, however, maximum reduction is not being accomplished as bulky wastes are not being properly segregated from the combustible refuse. Burning of refuse occurs two or three times per week according to demand. After incineration, the residual material is leveled and covered with granular material.

The solid waste generated in Cape Dorset is primarily domestic in nature consisting of food and packaging material. Solid waste is also generated from construction projects in the community. Very little industrial or hazardous waste is generated in Cape Dorset. It consists mainly of used lubricants from the operation of the power plant and the local maintenance garage. The majority of this waste is stored in drums located at the bulk solid waste site. The Hamlet intends to purchase waste oil heaters to utilize the waste oil as a heating source .

Bulky wastes (cars, appliances, furniture etc.) are partially segregated from the other solid waste and placed in an area just to the north of the solid waste disposal area. This bulky waste disposal area is disorganized, resulting in inefficient use of the area. The bulky waste disposal area measured approximately 150 m by 30 m. Soil staining typical of fuel oil spills are evident throughout the area. Numerous bulky waste articles can be observed along the east side of the access road, far beyond the apparent intended limits of the bulky waste disposal area. Hazardous or potentially hazardous materials are visible throughout the site (batteries, drums of unknown product, unknown waste). The Hamlet has no procedures or guide lines for the disposal of hazardous waste. Solid waste has been dumped outside the landfill area at random and there are no signs indicating disposal procedures or locations.

3.4. Previous Studies and Inspections

3.4.1. NWT Waters Act Inspections

The Hamlet does not have a license for water use or waste disposal required under the NWT Water's Act. In November 1994 an application for a license for municipal water use and waste disposal was filed with the NWT Water Board. Appended to the application was an outline of the Hamlet's proposal to construct a new sewage and solid waste disposal facility to replace the existing facility.

During his 1995 inspection, the NWT Waters Act Inspector indicated that the honeybag disposal pit was full and that sewage effluent was passing through or under the granular decant structure. He also commented that a small stream draining through the proposed site of the new sewage disposal facility would require diversion prior to construction of the facility. Similar concerns have been noted in inspection reports dating back to 1992.

4. DESIGN DATA

For design purposes a ten and twenty year design horizon is proposed. Therefore, the planning period to be considered is from 1996 to 2016.

4.1. Projected Population

Population projections for the community of Cape Dorset have been obtained from the Bureau of Statistics, Department of the Executive, GNWT and are summarized below. These population projections show the population to be growing at approximately 2.4% per year. The census population recorded in June 1991 was 961. Through the planning period the population is estimated to increase from approximately 1071 in 1996 to 1331 in 2006 and 1647 persons in 2016.

Actual population growth rates can vary from that predicted, especially in small northern communities. The Bureau of Statistics includes such factors as age of population to determine future growth but do not forecast such influences as in or out migration.

For the purposes of this study, population forecasts based on Bureau of Statistics data will be used as the most accurate available data for planning purposes.

4.2. Projected Housing Construction

The Housing Corporation has indicated that 11 single family units will be delivered to Cape Dorset during 1996. The Housing Corporation has not identified the number of housing units to be delivered to the community in future years, however it is unlikely to exceed the amount proposed for 1996. All new houses will include pressurized water and sewage pumpout systems.

4.3. Projected Honeybag Generation

As of late 1995 only three residences remained on the honeybag service. These three residences are being retrofitted with sewage pump out facilities. This transition is expected to be complete by the end of 1996. Therefore, it is assumed that the existing honeybag disposal pit can accommodate demand until the end of 1996.

4.4. Projected Sewage Generation

Projected sewage generation quantities for the community of Cape Dorset are presented in Table 4.1. Assumptions used to produce the projected quantities are listed below:

1. Population projections as prepared by Bureau of Statistics, Department of Executive, GNWT;

2. Future sewage generation is equal to the water consumption;

3. Design value for residential water use for residents serviced by trucked water delivery and sewage pumpout collection is 90 litres per person per day (DPW Design Value);

4. Total per capita consumption of water for residential and non-residential activities for a population between 0 to 2,000 is equal to:

   Residential Rate x (1.0 + 0.00023 x Population).

The projected annual sewage generation quantities for the projected population of 1331 in the year 2006 is approximately 57,100 m^3 and 75,500 m^3 in the year 2016 for a predicted population of 1663. These required capacities will determine the sizing of the sewage treatment reservoir.

Table 4.1 - PROJECTED SEWAGE PRODUCTION

YEAR	TOTAL POPULATION	SEWAGE PRODUCTION RATE (L/person day)	DAILY SEWAGE GENERATION RATE (L/day)	ANNUAL GENERATION RATE (cu. m. /year)
1996	1071	112.17	120,133.75	43,848.82
1997	1094	112.65	123,234.51	44,980.59
1998	1118	113.14	126,493.43	46,170.10
1999	1142	113.64	129,776.19	47,368.31
2000	1167	114.16	133,221.10	48,625.70
2001	1192	114.67	136,691.88	49,892.54
2002	1219	115.23	140,469.39	51,271.33
2003	1246	115.79	144,277.08	52,661.13
2004	1274	116.37	148,257.67	54,114.05
2005	1302	116.95	152,270.72	55,578.81
2006	1331	117.55	156,451.31	57,108.38
2007	1361	118.17	160,833.04	58,704.06
2008	1392	118.81	165,389.64	60,367.22
2009	1423	119.46	169,986.03	62,044.90
2010	1455	120.12	174,772.42	63,791.93
2011	1488	120.80	179,752.78	65,609.76
2012	1521	121.48	184,778.23	67,444.05
2013	1555	122.19	190,003.12	69,351.14
2014	1590	122.91	195,431.67	71,332.56
2015	1626	123.66	201,068.23	73,389.91
2016	1663	124.42	206,917.28	75,524.81

4.5. Projected Solid Waste Generation

Projected solid waste generation quantities for the community of Cape Dorset are presented in Table 4.2. Assumptions used to produce the projected quantities are listed below:

1. Population projections as prepared by Bureau of Statistics, Department of Executive, GNWT;

2. The solid waste generation rate (uncompacted) is equal to:

   0.014 m^3. per person per day for residential production

   0.001 m^3. per student per day (annual);

3. The full time equivalent (FTE) student population as of September 1995 was 377 students (Dept. of Education). Assume that student population will increase at rate projected for total population for community;

4. Total per capita generation of solid waste for residential and non-residential activities for a population between 0 to 2,000 is equal to:

   (Residential rate + school rate) x (1.0 + 0.00023 x Population);

5. Combination of burning and compaction of waste will result in a volume reduction of 70 percent.

The projected cumulative solid waste generation over the 20 year period from 1996 to 2016 equals 194,616 m^3 uncompacted or 58,385 m^3 after burning and compaction.

Table 4.2 PROJECT SOLID WASTE GENERATION

YEAR	TOTAL POP.	Est. Student Pop.	UNCOMPACTED VOLUME DAILY RATE	UNCOMPACTED VOLUME ANN. RATE	UNCOMPACTED VOLUME CUM.	COMPACTED VOLUME DAILY RATE	COMPACTED VOLUME ANN. RATE	COMPACTED VOLUME CUM.
			cu. m./d	cu. m.	cu. m.	cu. m./d	cu. m.	cu. m.
1996	1071	394	19.3	2000	7000	5.8	2100	2100
1997	1094	403	19.7	7182	14182	5.9	2155	4255
1998	1118	411	20.2	7369	21551	6.1	2211	6465
1999	1142	420	20.7	7561	29112	6.2	2268	8734
2000	1167	429	21.3	7759	36872	6.4	2328	11062
2001	1192	439	21.8	7965	44837	6.5	2390	13451
2002	1219	448	22.4	8182	53019	6.7	2455	15906
2003	1246	458	23.0	8405	61424	6.9	2522	18427
2004	1274	469	23.7	8635	70059	7.1	2591	21018
2005	1302	479	24.3	8872	78931	7.3	2662	23679
2006	1331	490	25.0	9117	88048	7.5	2735	26414
2007	1361	501	25.7	9371	97420	7.7	2811	29226
2008	1392	512	26.4	9634	107053	7.9	2890	32116
2009	1423	524	27.1	9904	116957	8.1	2971	35087
2010	1455	535	27.9	10183	127140	8.4	3055	38142
2011	1488	547	28.7	10471	137611	8.6	3141	41283
2012	1521	560	29.5	10768	148379	8.9	3230	44514
2013	1555	572	30.3	11074	159454	9.1	3322	47836
2014	1590	585	31.2	11391	170844	9.4	3417	51253
2015	1626	598	32.1	11717	182562	9.6	3515	54769
2016	1663	612	33.0	12054	194616	9.9	3616	58385

5. FACILITY DESIGN REQUIREMENTS

5.1. Sewage Disposal Facility

5.1.1. Lagoon Treatment

Sewage lagoons or modified lagoons are used to treat over 70% of municipal waste waters in the Northwest Territories. The relatively low cost, efficiency, ease of operation and ability to operate in harsh environment accounts for the wide spread use of sewage lagoons as the preferred form of treatment. When properly built and operated lagoons provide a high level of treatment

Mechanical treatment and maceration systems used to treat municipal wastewaters have not been successful in the NWT. Systems have been abandoned and thus a relative few are in operation at this time.

Lagoon treatment systems are the primary method of treatment for Canadian Arctic communities and have been found to perform satisfactorily. The evaluation of treatment methods will be limited to lagoon systems for the community of Cape Dorset.

Cape Dorset does not presently have a water license issued by the NWT Water Board. Cape Dorset therefore is not obliged to meet the maximum allowable contaminant limits legally discharged to the environment as stated by the Water Board. As the community has applied for a water license a proper sewage treatment facility such as a lagoon will be required to meet the allowable limits.

The Guidelines for Municipal Type Wastewater Discharge in the Northwest Territories published by the NWT Water Board provide guidelines for effluent limits based on sewage strength and the receiving environment. It should be noted that the specific license limits for a community may vary from these guidelines based on local conditions and public input as part of the licensing process.

MACA has developed guidelines (Heinke, 1988) for the design of sewage lagoon treatment systems based on the application of the NWT Water Board effluent criteria. These guidelines outline four basic types of lagoon system options; zero discharge lagoons, short detention lagoons, long detention lagoons and storage lagoons.

Arctic environments offer only approximately two months of active decomposition time. This process occurs during the months at which the temperatures are above freezing. We therefore recommend that for the maximum contaminant reduction, a twelve month retention system be utilized in Cape Dorset. The proposed system for

this sewage lagoon will be to provide storage capacity for twelve months and allow for one discharge annually.

5.1.2. Discharge Requirements

The selection of a sewage lagoon treatment system is governed primarily by the level of treatment required or the allowable level of contaminants in the discharge from the system.

The NWT Water Board publishes guidelines that set limits on discharge of municipal wastewaters to the environment. The guidelines were first published by the Board in 1981 with a recent update published in 1992. The parameters quoted in this report are from the latest publication.

Discharge limits for a community as set by the NWT Water Board are based on the type and relative size of the ultimate receiving environment versus the season in which the effluent is to be released and the community's per capita wastewater flow rate.

The receiving environment is determined by the type of water body into which the effluent will enter and the ability of the body of water to assimilate the contaminants present in the discharge stream. The receiving environment for the effluents that would be released in Cape Dorset fit into the Marine category as defined in the Guidelines.

Discharge limits for marine environments are subdivided into two categories depending on the mixing conditions. These mixing conditions are determined by whether the waters are open to the sea or to a bay or fjord. The discharge point at Cape Dorset is classified as a bay or fiord.

For the Community of Cape Dorset, the wastewater flow based on a trucked water system fits the category of less than 150 Lpcd and the effluent will be released in the summer.

From the information provided above, Table 4.1 of the NWT Water Board Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories (1992) the following effluent quality parameters should not be exceeded:

BOD_5	100 mg/L
SS	120 mg/L
Phosphorous	No treatment required

Fecal Coliforms need only be of concern in an open well flushed marine Bay or Fjord where the discharge might affect a fishery or water contact recreation. The proposed discharge point is within the same general location as the current lagoon discharge point.

5.1.3. Generated Sewage Parameters

The strength of the sewage entering the treatment system is a ratio of the solids and contaminants to the volume of water which conveys the wastes. This can be calculated by determining the mass of waste material produced and dividing this amount by the volume of water discharged per person per day.

The Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems (Heinke, 1988) provide average values for wastes produced by a person in southern locals based on the size of the community. No values are provided for waste generation in the Northwest Territories. Waste generation for a small rural community is the closest approximation to a community such as Cape Dorset provided in the guidelines. The following are waste generation values on a per person per day basis:

BOD_5	45 g
Suspended Solids	60 g
Fecal Coliform	1 x 10^9 organisms/L

For the 20 year period ending in the year 2016 the sewage production rate per person is estimated to be equal to 124.42 Lpcd. This will result in raw sewage strengths as listed below:

BOD_5 $= \frac{45 \text{ gpd}}{124.4 \text{ Lpcd}} = 362$ mg/L

Suspended Solids $= \frac{60 \text{ Lpcd}}{124.4 \text{ Lpcd}} = 482$ mg/L

Fecal Coliform $= 1.0 \times 10^8$ counts/100 ml

5.2. Solid Waste Disposal Facility

The solid waste disposal area must accommodate three general types of waste: domestic waste; bulky metal wastes such as appliances and vehicles; and hazardous wastes including used oil, batteries etc. Within the disposal facility separate areas for each type of waste are required.

Domestic waste comprises the majority of the waste generated in the community.

Through past experience and on-going evaluations of present solid waste disposal sites, DPW has directed that the minimum acceptable disposal method for domestic solid waste is a modified landfill operation.

A modified landfill requires that all aspects of the disposal site from planning, to design, to operation and maintenance are "engineered". In a modified landfill, wastes are deposited at a designated location and are compacted and covered on a regular basis. A properly designed modified landfill will reduce the potential for hazards and nuisances to people and the environment in an economic manner.

Bulky wastes are difficult to compact and incinerate. Disposal of bulky wastes reduces the efficient use of the domestic waste landfill and prevents the reuse or recycling of these wastes. A separate area within the solid waste disposal area is required for the disposal of bulky wastes.

Hazardous wastes in Cape Dorset are largely limited to small quantities of used lubricants from vehicles and stationary engines. These and other hazardous wastes generated within the community pose a hazard to the environment and public health and safety. A designated and secure site for the disposal of hazardous wastes is required within the overall solid waste disposal facility.

The projected volume of solid waste generated over the twenty year planning period is approximately 58,385 m^3 (compacted).

6. PROPOSED SEWAGE AND SOLID WASTE DISPOSAL SITE

6.1. Location

During the summer of 1995 the Hamlet of Cape Dorset received funds to construct a new sewage and solid waste disposal facility. The Hamlet selected a site for the new facility approximately 500 metres northeast of the existing site (Figure 1). The site is within a relatively steep valley which slopes to the ocean. The north side of the valley is bounded by a continuous rock outcrop while the south side of the valley is defined by several smaller outcrops and granular material. A small stream runs through the valley to the ocean. The approximate dimensions of the valley are 60 m wide with a depth varying to 5 m and an overall length of over 1 km. An access road reaches the valley approximately 175 metres upslope from the ocean.

The topography of Cape Dorset is rugged and as such it is impossible to find a site ideally suited for such an expansive structure. The community considered their options for the location of a facility and selected this site as the most appropriate location for their long term sewage disposal requirements. As the community had initiated construction of the facility prior to our becoming involved, we did not carry out a site selection process to evaluate any other potential sites.

From our analysis of the site, we find it to be satisfactory for the development of a sewage and solid waste disposal facility, however the steepness of the valley and the presence of the stream present a challenge.

6.2. Existing Site Development

The Hamlet has completed an access road to the lower part of the valley and has constructed three retention cells within the valley between the access road and the ocean. Sewage was deposited in these cells for a short period during the fall of 1995 until the Hamlet was ordered to stop using the facility by the NWT Water Board's Inspector.

The existing site development is illustrated in Figure 3. Lagoon Number One was constructed with the approximate dimensions of 30 m width by 160 m length with an average depth of approximately 4 m. Due to the overall slope of the terrain, in order to maximize the storage capacity of this cell, we recommend that an intermediate berm be constructed in this cell to provide for a tiered set of cells, thereby reducing the overall height requirements. Lagoon Number 1 is located immediately down slope of the access road. Two other smaller cells (Lagoons 2 & 3) are located down slope of this cell. The dimensions of these two cells are approximately 30 m x 30 m with an average estimated depth of 4 m. We estimate based on the early survey

information from the site and from information provided us by the community that once complete, these cells will provide a total storage capacity of approximately 25,000 m^3, less than the 44,000 m^3 required to meet 1996 requirements and significantly less than to meet the 10 and 20 year needs of 57,100m^3 and 75,500 m^3, respectively.

6.3. Facility Size

A 20 year planning horizon for this project has been determined. Sewage and solid waste generation rates for the community have been developed in Section 5.

Sewage treatment and disposal will be accomplished through a lagoon system with one discharge in the fall of each year. To meet the 10 year needs the annual storage volume required will be 57,100 m^3 and 75,500 m^3 to meet the 20 year demand.

Solid waste generation over the next twenty years has been estimated at 58,385 m^3.

7. FACILITY DESIGN

7.1. Sewage Lagoon Facility

The facility design recommended for the Hamlet of Cape Dorset includes a series of tiered intermittent discharge lagoons with a one year storage capacity. Due to the rough topography of the area this multi-celled (tiered) facility is required to provide an adequate storage volume. (See Figure 3).

As noted in the previous section, the 10 year design volume for the lagoon storage is some 57,100 m^3, over double what has been constructed to date and the 20 year needs estimate is for a total storage capacity of some 75,500 m^3.

We recommend that the storage capacity be increase to meet the 10 year projected storage requirements. This will require the construction of a fourth cell above the existing series of cells. We understand that the community has begun disposing of their solid waste in this area. We recommend that this practice be discontinued and that the solid waste site be relocated beyond the site requirements for the lagoon system. The waste that has been disposed in this area should be covered with a minimum of one metre of granular fill prior to being put in to service as a lagoon.

The lower two cells are not presently accessible by truck or recommended for access by disposal chutes due to the distance from the access road. We recommend that the sewage be offloaded into each of the top two large cells and decanted into the lower cells for seasonal storage and reduction.

In order to complete a proper design, a thorough survey of the property is required. We recommend that we be invited to return to Cape Dorset to complete an extensive site survey picking up the existing conditions including the limits and grades of the partially completed lagoons. From this survey, the existing volumes and design limits of the facility can be completed to determine the most appropriate action for the completion of a suitable facility for the community.

As the system is located in a drainage path, it is critical that diversion ditches be constructed around the structures to provide for a means of flow without risk of the runoff entering the lagoon system. We understand from discussions with the community personnel that there is an excavator in the community that would be suitable for this operation.

Each of the lagoons will require a discharge structure to decant from one lagoon structure to the next. The only practical time to operate these facilities will be during the summer season when the facilities are not at risk of being frozen.

The discharge structures recommended for Cape Dorset facility includes the following:

1. A vertical inlet complete with a screen to retain solids within the lagoon should be provided in each of the cells. The inlet elevation will be set to control the elevation of containment within the pond allowing for sludge accumulation through the design life of the facility.

2. A simple lockable gate valve allowing seasonal discharge of the effluent following the biological treatment of the waste.

3. An outlet pipe constructed through the berm directed toward path leading to shore.

4. All components of the system vulnerable to freezing should be insulated and have either heat tape or a thaw tube to facilitate thawing.

7.2. Solid Waste Disposal Facility

As noted is Section 5, the solid waste disposal area must accommodate three general types of waste: domestic waste, bulky metal wastes such as appliances and vehicles, and hazardous wastes including used oil, batteries etc. Within the disposal facility separate areas for each type of waste are required.

Domestic waste comprises the majority of the waste generated in the community.

Through past experience and on-going evaluations of present solid waste disposal sites, DPW has directed that the minimum acceptable disposal method for domestic solid waste is a modified landfill operation.

A modified landfill requires that all aspects of the disposal site from planning, to design, to operation and maintenance are "engineered". In a modified landfill, wastes are deposited at a designated location and are compacted and covered on a regular basis. A properly designed modified landfill will reduce the potential for hazards and nuisances to people and the environment in an economic manner.

Bulky wastes are difficult to compact and incinerate. Disposal of bulky wastes reduces the efficient use of the domestic waste landfill and prevents the reuse or recycling of these wastes. A separate area within the solid waste disposal area is required for the disposal of bulky wastes.

Hazardous wastes in Cape Dorset are largely limited to small quantities of used lubricants from vehicles and stationary engines. These and other hazardous wastes generated within the community pose a hazard to the environment and public health

and safety. A designated and secure site for the disposal of hazardous wastes is required within the overall solid waste disposal facility.

The projected volume of solid waste generated over the twenty year planning period is approximately 58,385 m^3 (compacted).

8. RECOMMENDED METHODE OF OPERATION

8.1. Sewage Disposal Facility

8.1.1. Sewage Lagoon - Recommended Method of Operation

The sewage lagoon system will provide 365 days of storage to meet the requirements of the NWT Water Board for the discharge of treated municipal waste water. The lagoon (s) should be discharged in the fall of each year to allow for maximum natural treatment during the summer period. The following general operational procedures should be followed.

1. Sewage will be deposited on the spillway into one of the top two lagoons.

2. By a process of filtration or through transfer sewage will pass on through each cell until it reaches the last cell

3. In the fall wastewater will be pumped from the last cell into overland flow to ocean

4. Only sewage and municipal wastewater should be deposited in the lagoon system.

5. Honeybags should be placed in the current disposal pit until such time as there are no other users. After which the existing pit should be covered with a minimum of one metre of granular material and contoured to suit the surrounding area.

8.2. Solid Waste Disposal Facility

8.2.1. Solid Waste Site - Recommended Method of Operation

A modified landfill facility is to be constructed at Cape Dorset. The following operational procedures should be followed to minimize the environmental effects of the landfill and ensure efficient operation of the site:

1. Waste should be dumped in the active area of the landfill only.

2. The active area should be kept to a small manageable area.

3. The trench method requires a trench of at least 2 metres depth and should be wide enough to accommodate 1 years supply of . Excavated material should be stored nearby to be used as cover material .

4. As waste accumulates burning can be undertaken to reduce the volume of the waste.

4. After burning the waste it should be compacted with heavy equipment to further reduce its volume.

5. After compaction the layer of waste should be no greater than 2.5 metres thick

6. A layer of granular material at least 15 - 20 cm thick should be spread over the compacted waste.

7. Each layer should be sloped slightly to provide positive drainage.

7. Additional layers of waste can be disposed of in this manner until the trench is full. The final layer of waste, after burning and compacting should be covered with 0.5 metres of granular fill and contoured to encourage positive drainage.

8. Dig a new trench.

8.2.2. Bulky Waste Disposal Pad - Recommended Method of Operation

The bulky waste disposal area consists of an elevated granular pad. The boundaries of this disposal area should be clearly marked. Wastes should be deposited in an orderly manner to allow for efficient use of the space, salvaging of materials and to minimize the aesthetic and environmental effects of the site. Bulky wastes should not be covered with fill.

8.2.3. Waste Oil Retention Cell - Recommended Method of Operation

Waste oils should be deposited in 205 litre drums placed within the cell. Drums should be capped to prevent overflowing due to overfilling or filling up with precipitation. After the drum(s) within the cell are full the drums should be capped and covered with at least 0.5 metres of fill. The location of the cell should be clearly marked to prevent further excavation and potential damage to the storage containers. Alternatively, the waste oil may be stockpiled within the cell and used in local waste oil heaters

9. REMEDIATION OF EXISTING FACILITIES

Upon completion of construction and acquisition of a license from the NWT Water Board the new sewage and solid waste disposal facilities can be commissioned.

9.1. Sewage Disposal Facility

9.1.1. Sewage Lagoon

The existing lagoon should be emptied of liquid, either through the current drainage regime or assisted by a pump. The solids should be covered with a minimum of 1 meter of fill and graded to match existing topography. The stability of the terrain on and around the lagoon should be monitored to ensure its integrity

9.1.2. Honey Bag Facility

The Honey Bag waste disposal area should not be closed until all buildings/homes currently using honey bags have been retrofitted with pressurized water systems and sewage pumpout facilities. Upon closure all honeybags outside of the disposal pit should be centralized in the pit and a minimum of 1 metre granular fill should be placed over the pit. The area should then be contoured to suit the surrounding area.

9.2. Solid Waste Disposal Facility

9.2.1. Solid Waste Site

Some segregation of wastes should occur prior to close out of the existing solid waste disposal site. Hazardous wastes such as waste oils, batteries, etc. should be retrieved if possible as should bulky wastes. The remaining wastes should be burned, compacted and covered with 0.5 m of granular fill.

9.2.2. Bulky Wastes

Bulky non-combustible wastes should be consolidated in one location, compacted with heavy equipment and buried with a minimum of 0.5 m of granular fill.

9.2.3. Hazardous Wastes

Waste oil at the existing site should be transferred to the new waste oil disposal facility. Other hazardous wastes at the existing landfill should be transferred to the new waste disposal site for disposal in the modified landfill.

10. PRELIMINARY COST ESTIMATES - LAGOON SYSTEM

As noted is Section 6.2 - Existing Site Development, we have carried out preliminary storage volume calculations based upon findings at the time of our inspection and estimating progress since. We estimate the existing total storage volume for the three reservoirs to be in the order of 25,000 m^3. Based upon our calculations, the required storage volume for 1996 is 44,000 m^3 while that required for year 10 is 57,100 m^3 and year 20 is 75,500 m^3.

We have carried out preliminary granular material requirements to provide the ten year storage capacity and estimate that an additional 26,000 m3 of granular material must be pushed into berms in order to provide the adequate storage capacity for the lagoon. Utilizing a rate of $10/m3 of granular material for a cut/fill operation, we estimate the total granular cost requirement to be in the order of $260,000 to meet the ten year needs horizon.

In addition to this sum, we estimate that an additional $50,000 will be required for the offload and discharge structures.

We estimate that the engineering fees & disbursements to complete the design phase of this project is in the order of $10,000 plus costs for the final inspections..

11. RECOMMENDATIONS AND CONCLUSIONS

1. The site selected and partially developed by the Hamlet is recommended as the future sewage and solid waste disposal site for Cape Dorset. This site is approximately 500 metres north west of the existing facilities

2. The sewage disposal facility should be constructed as a series of storage lagoons, utilizing the structures already partially completed. The system will provide 365 days of storage at the design life of the facility to meet the recommendations of the NWT Water Board's "Guidelines for the Discharge of Treated Municipal Wastewater. The facility should be discharged in the fall of each year to provide maximum available treatment for the sewage.

3. It is recommended that another survey be carried out to measure the state of the existing development. This survey information will be critical in completing the design as the volumes of the existing facility will be calculated and design recommendations will follow for the provision of suitable storage to meet the required planning horizon.

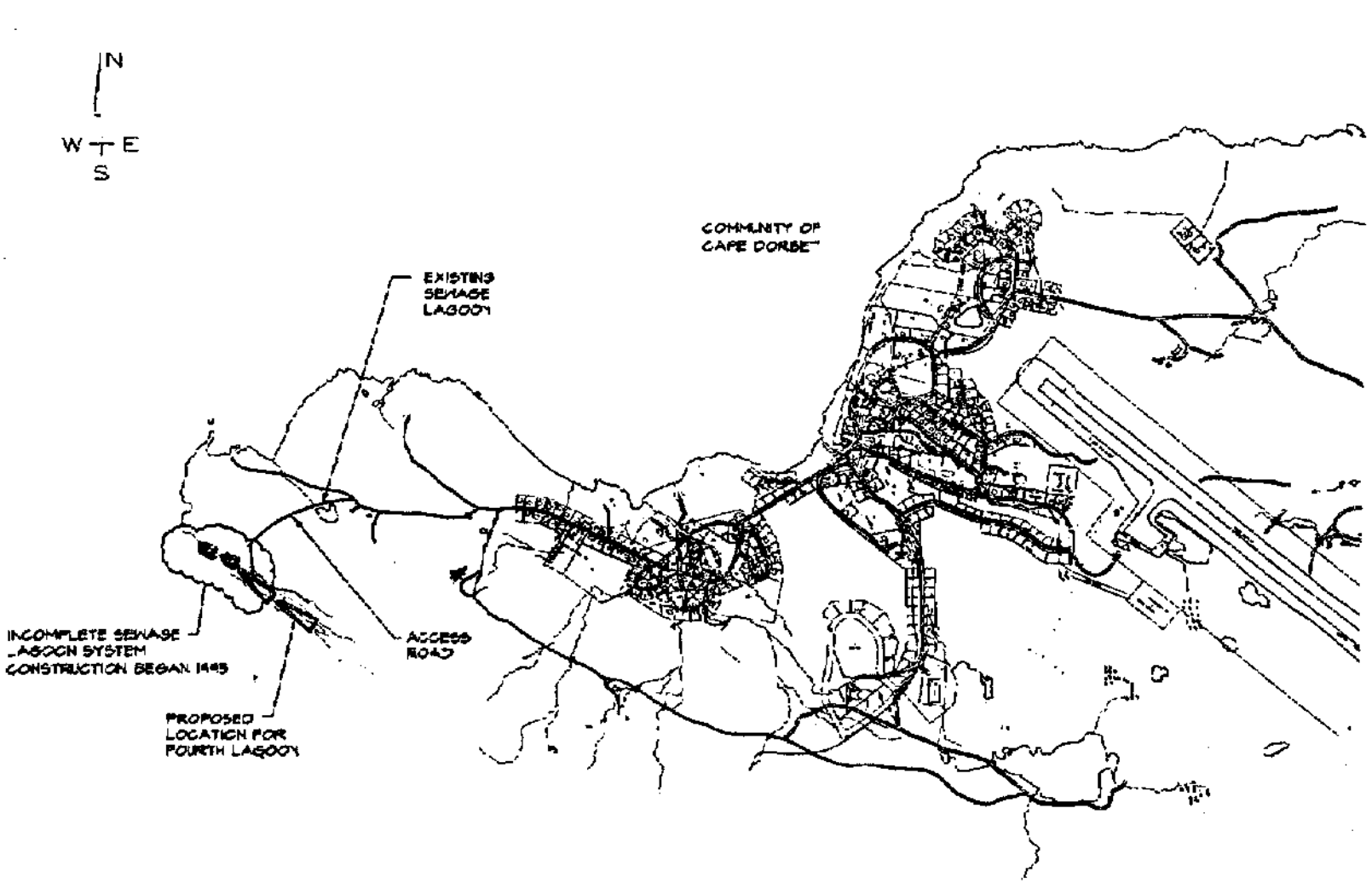
4. The solid waste facility should include separate disposal areas for domestic waste, bulky metal wastes and waste oils.

5. The domestic waste disposal area should be operated as a modified landfill. A trench method of disposal should be used as it will reduce the requirement for imported fill and reduce operating costs. Existing subsurface conditions appear to be suitable for the trenching operation.

6. A granular pad should be provided for the disposal of bulky metal wastes.

7. A waste oil disposal cell should be provided within the disposal facility

8. The existing sewage and solid waste disposal facilities should be decommissioned according to Section 9.0 of this report.



FSC GROUP

FERGUSON SIMEK CLARK

CAPE DORSET SEWAGE LAGOON RELOCATION

CAPE DORSET, NT

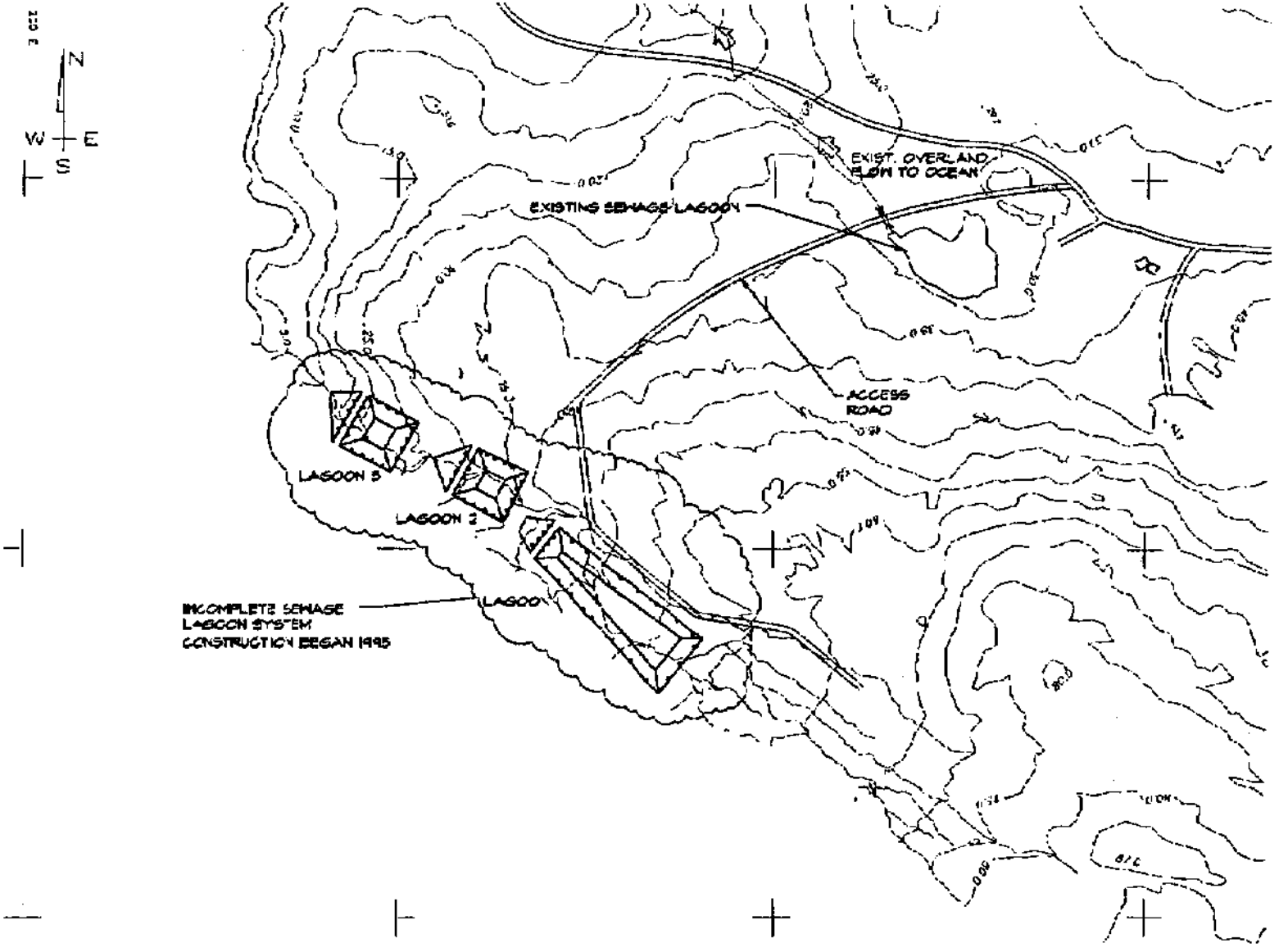
LOCATION PLAN

PJR

1:20000

JPW

JUNE 20, 1996



FSC GROUP

FERGUSON SIMEK CLARK

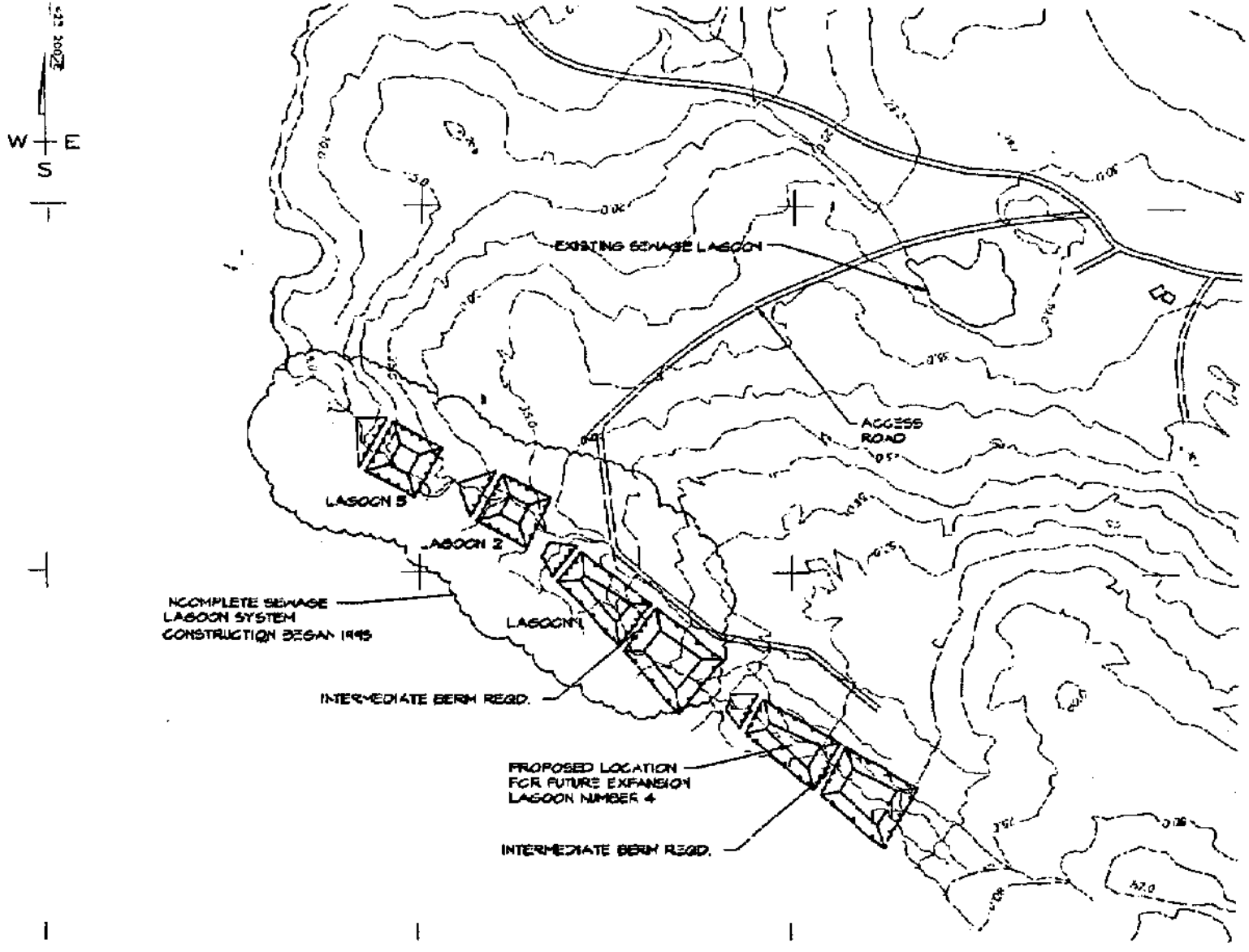
CAPE DORSET
SEWAGE LAGOON
RELOCATION

CAPE DORSET, NT

EXISTING CONDITIONS

1:2000

JUNE 20, 1994



FSC GROUP

FERGUSON SIMEK CLARK

CAPE DORSET SEWAGE LAGOON RELOCATION

CAPE DORSET NT

PROPOSED LOCATION OF FOURTH LAGOON + PROPOSED DUMPING SEQUENCE

BERM CONSTRUCTION

- Berms to be constructed of acceptable granular F.I.L
- Borrow source to be determined by the engineer.

DISPOSAL PROCESS

- Waste to be dumped from the truck directly into the sewage retaining lagoon
- Effluent to be discharged annually in the fall through the well-vegetated drainage course to the ocean.

1 Fig 3 SEWAGE LAGOON

NTS

PAD CONSTRUCTION

- Pad to be constructed of acceptable granular fill
- Pad dimensions to be 300 mm in height backslopes not to be steeper than 3:1 top to be graded for drainage at 1% (minimum)

DISPOSAL PROCESS

Existing Bulky Waste to be relocated and disposed of at the new bulky waste disposal pad.
Waste to be disposed of on the pad in a neat and orderly manner

3 Fig 3 BULK WASTE DISPOSAL PAD

NTS

CELL CONSTRUCTION

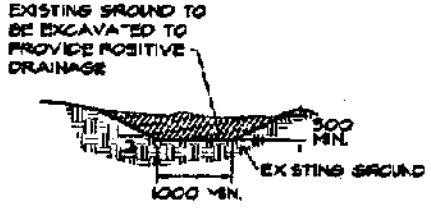
- Berms to be constructed of acceptable granular fill
- Berm dimensions to be 2 metres in height with a 2 metres top width backslopes not to be steeper than 3:1
- impermeable liner to be placed within berm and keyed to top
- Granular protective cover to be provided over liner

DISPOSAL PROCESS

- Waste oil currently stored within sealed containers to be collected and relocated to the new retention cell for disposal.
- Waste oil to be stored within sealed containers and disposed of within the retention cell.

2 Fig 3 WASTE OIL RETENTION CELL

NTS



4 Fig 3 DRAINAGE DITCH SECTION (TYP.)

NTS

FSC GROUP

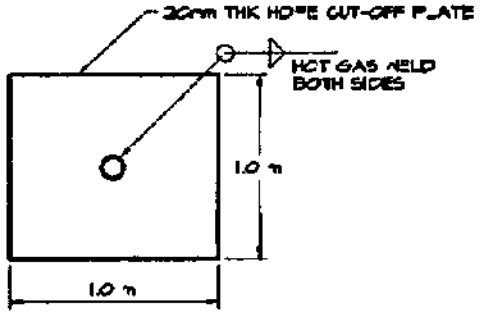
FERGUSON SIMEK CLARK

CAPE DORSET SEWAGE LAGOON RELOCATION

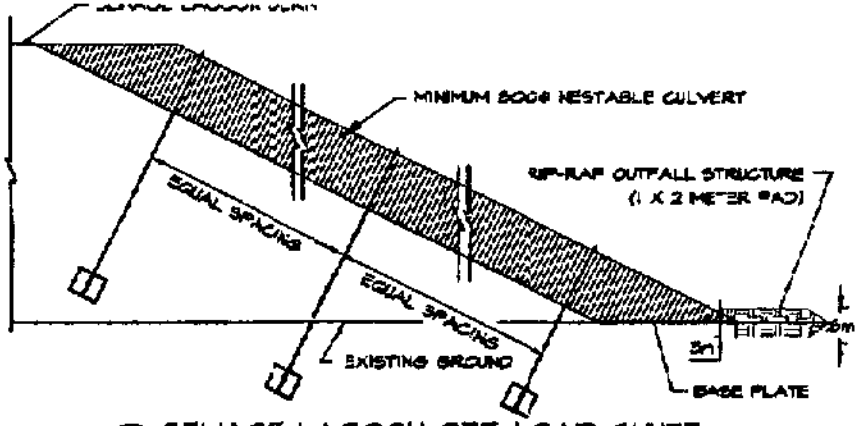
CAPE DORSET, NT

LAGOON DETAILS

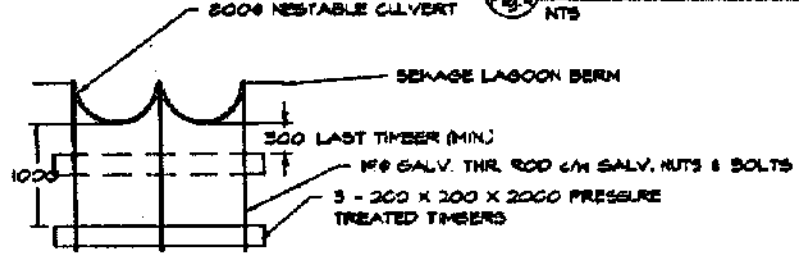
E.M.	NTS
	JUNE 28 1996
E.M.	
ES43.Dwg	93-1190
A - 1	Fig 3



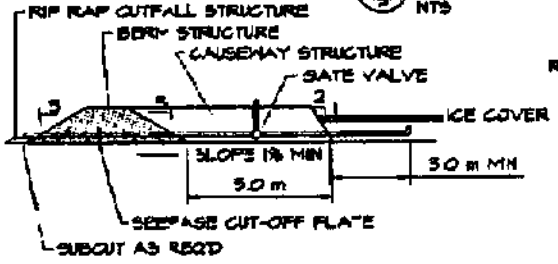
2 Fig.4 SEEPAGE CUT-OFF PLATE NTS



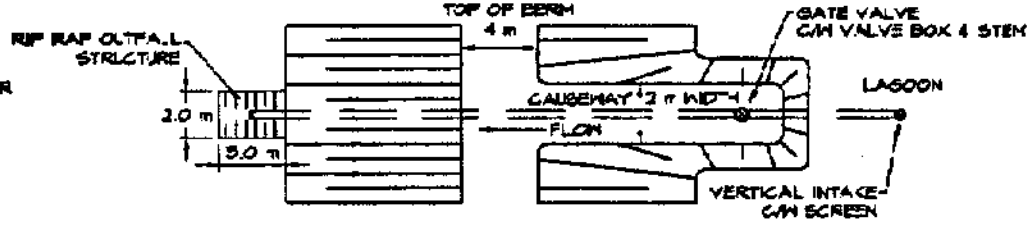
4 Fig.4 SEWAGE LAGOON OFF-LOAD CHUTE NTS



5 Fig.4 EFFLUENT DISCHARGE SYSTEM DETAILS NTS



3 Fig.4 EFFLUENT DISCHARGE SYSTEM DETAILS NTS



5 Fig.4 EFFLUENT DISCHARGE SYSTEM DETAILS NTS

FSC GROUP

FERGUSON SIMEK CLARK

CAPE DORSET SEWAGE LAGOON RELOCATION

CAPE DORSET, NT

OFFLOAD CHUTE + EFFLUENT DISCHARGE SYSTEM DETAILS

D.M.	NTS
J.P.M.	JUNE 28, 1994
D.M.	
CAD/DFR	86-1180
4 OF 5	FIG 4