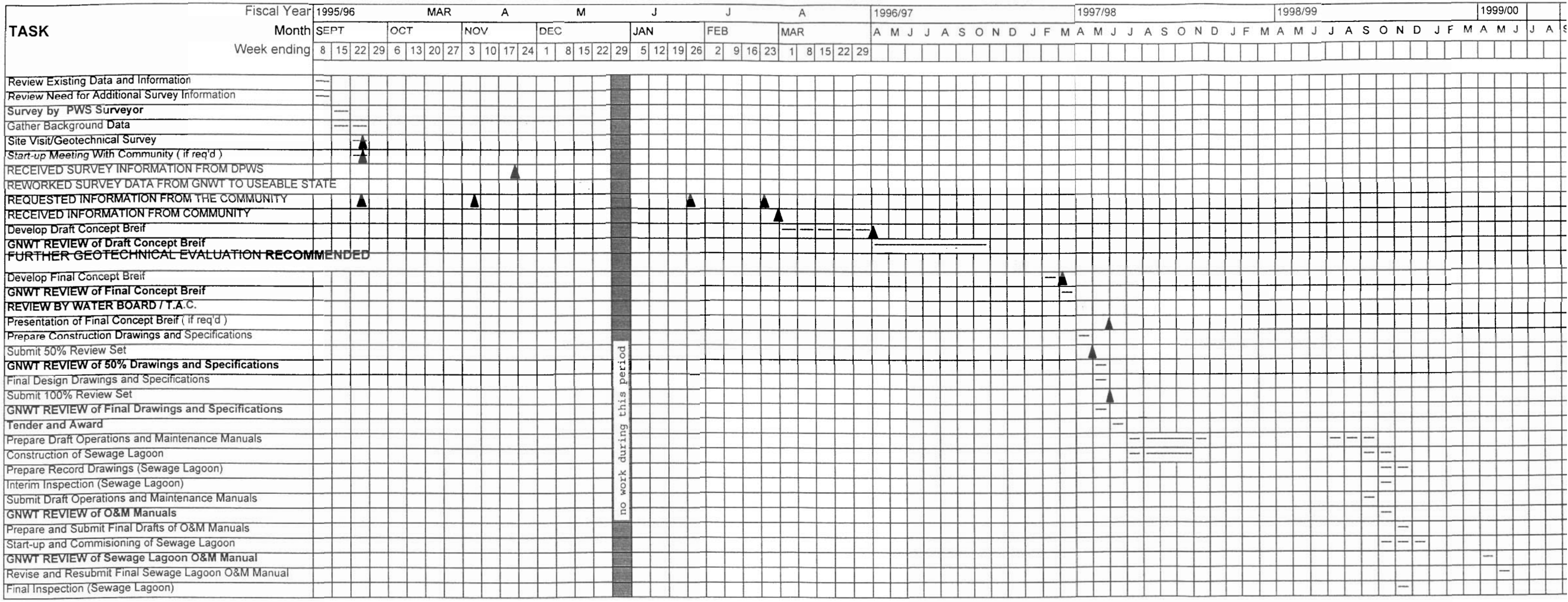
PROJECT SCHEDULE

The Rehabilitaion of Existing Sewage Lagoon and Solid Waste Disposal Sites
Arctic Bay, NT
GNWT Project No. 4-001-350



LEGEND : PROPOSED SCHEDULE — NO WORK ANTICIPATED (CHRISMAS HOLIDAYS)

MILESTONE FROM TERMS OF REFERENCE (Items in Bold) Work Performed by GNWT only

Reid Crowther & Partners Ltd.

However, we found this area to be rather small in size and not large enough to support a lagoon or lagoons of the size needed for the community.

During our introductory review of the area surrounding the community; and again during recent discussions with DPW&S personnel, we considered the possibility of using an existing lake or depression on the plateau. As with our initial review of the area, we decided against further consideration of this option because of:

1. a road to reach the area would have to be at least one (1) km long to reach the plateau and would still be at an average of 5% grade: and

2. the cost of such a road would be very costly to build **and** maintain.

The concept of operation for the lagoon is that of providing some form of settling of solids and to allow the effluent to be exposed to the sun (enhance biological reactions) and wind (enhance mixing and minor aeration) and have a relatively large enough surface area to promote evaporation.

This method of sewage treatment was considered as opposed to mechanical/chemical treatment because of the additional capital and operational costs and operator expertise required for those systems. Another treatment, "snow effluent" was contemplated but due to the severity of the climate in the area was determined not to be a viable alternative.

Several constraints exist that dictate whether the existing lagoon could be feasibly incorporated into the new lagoon. The most significant constraints are that a lagoon is required during construction of the new lagoon and the existing lagoon is very close to the existing stream that flows down the hillside each spring and summer. Expansion of the existing site would result with a long, thin width

lagoon shape that would exhibit a low rate of capacity of lagoon compared to the amount of fill required to construct the lagoon.

In addition, a honey bag pit is required. The existing lagoon site would serve well as a honey bag pit once a new lagoon is put into service. This would save the cost of constructing a new honey bag disposal pit.

We have identified three options for the new sewage lagoon. The first site being adjacent to the existing lagoon, the second and third being to the east on the opposite side of the creek from the existing lagoon. These three locations are presented on Figures 1 and 2 on the following pages. Profiles of the three Options are presented in Figures 3, 4 and 5.

The three sites have storage capacities and fill requirements as follows:

Lagoon No. 1 and Lagoon No. 2 were sized to have storage capacities meeting the requirements of one year of sewage retention for the design year population (30,500 m^3). Lagoon No. 3 was sized to meet the available budget of $800,000 as identified by DPW&S in October 1996.

Option	Capacity	Berm Fill Quantities		
		Core	Protection	Total
1	31,000 m^3	60,000	40,000	100,000 m^3
2	31,000 m^3	29,000	18,000	47,000 m^3
3	11,100 m^3	13,830	9,475	23,300 m^3

The reason for the difference in fill quantities in Option No. 1 and No. 2 is due to the slope of the land available at the two sites.

To use Options No. 2 and No. 3 a short access road would be required with a culvert at the existing stream bed.

The required core fill quantities (this is the selected silty/clay material for the frozen core of the berm) for Site No. 1 is very high and sufficient material may not be available. In fact, an excavation 170 m x 170 m x 1 m deep would be required to obtain enough core material for the Site No. 2 option. The geotechnical evaluation performed in September 1995 by Thurber Engineering (a copy of this report is attached in Appendix A), stated that some 3500 m^3 of material could be recovered in the test area. This amount would not be sufficient, although the surrounding area is very similar to the "test area". We recommend performing further evaluations to confirm if more of this material is available.

Originally, the Unit Price costs that we used were developed under the assumption that an outside contractor would mobilize to the community to perform the work. The current Unit Prices used in this brief were provided by Mr. David Parker of DPW&S, Iqaluit. We feel these Unit Prices are possible only of the community was to acquire additional equipment to what they currently have. Even if they were to have two to three trucks (of the capacity of their current truck) and a reliable loader and dozer, the rates would have to be verified and confirmed by the Hamlet.

Currently, the Hamlet has a 20 year old loader, a 22 year old grader and a new 3.5 m^3 dump truck. With the present equipment and assuming that with the labour and equipment are consistently available for ten (10) hours per day seven (7) days per week, the time required to haul the material for the three options would be 82

weeks, 39 weeks and 19 weeks for Options No. 1, No. 2 and No. 3, respectively. Assuming a generous working season of 12 weeks per year, construction of the lagoons would require 6.8 years, 3.3 years and 1.6 years, respectively. Again, this assumed constant availability of the equipment and while the truck is relatively new, the loader and grader are 20+ years old and reportedly need a good deal of maintenance. A 70 hour work week would be hard on new equipment let alone equipment of that age.

In order to proceed to the point where a sewage lagoon option can be properly chosen, additional information must be collected. The information still required includes the following:

a) verify the existence and location of sufficient silty frost susceptible material to construct the frozen core portion of the lagoon berms.

b) verify and confirm the present and planned availability of equipment, with respect to the Hamlet's own equipment and any local contractors that may be purchasing equipment.

c) verify and confirm the availability of staff to operate and maintain the equipment.

d) Verify and confirm the local costs for labour, equipment and materials.

A cost comparison for the alternate lagoon sites is presented on the following page. Note that these are "Class D" estimates and Unit Prices must be confirmed with the Hamlet and/or available contractors prior to using the costs for decision making.

4.3 Solid Waste Site Alternatives

Given the layout of the existing area and the proximity to the community, the current area will serve well for the solid waste landfill. We have identified two possible sites for the landfill. For either of the sites, we propose the modified landfill method of disposal, covering each layer of waste as the working face proceeds. A description of this procedure is presented in "Section 5.0 - Operational Procedures".

We have shown the two landfill site options on Figures 1 and 2. Site No. 1 includes using the existing solid waste area. This would include decommissioning the existing honey bag pit, so that the area can be used for a modified landfill site. The existing sewage lagoon could then be used as the honey bag pit.

This site is large enough for approximately 2000 m^3 of compacted solid waste, based on two – one metre layers of waste using the modified landfill method for sloped ground.

An appreciable amount of cleanup would be required at this site, whether it is intended to be used or not. The current landfill working face is too steep to be worked as a modified landfill and this should be capped with approximately 0.5 m of granular cover. A new working face could be constructed in the location shown on Figure 1.

The second site (site No. 2 on the graphic) shows a new landfill area to the northwest of the existing area. This site is at the base of the steeper slope. The site is relatively flat and construction of a landfill working face would be quite

straightforward. Solid waste would be dumped along the face and, subsequently, compacted and buried.

Regardless of the solid waste site used, the existing site would still require a certain amount of fill to be capped and decommissioned. Also, each site would have an area designated for storage of a one year supply of fill material.

For either solid waste sites, a separate bermed "burning" area should be constructed to allow controlled burning for further reduction of waste volumes.

Bulk Waste Site

The existing bulk waste site will require some rehabilitation. The location for this site can be reused, but much cleanup is required. Bulky waste is strewn all along the disposal site access road and must be sorted and consolidated into the new site. We propose that a drainage ditch be constructed around the site and the area be graded to provide a flat storage area with an access for vehicles from the road. This will allow for a defined storage area with room to pull a vehicle off of the road thereby not blocking the road when off-loading (or loading, if scavenging useful material). The area could be graded in two stages by first moving all the material to the south side of the site, grading the north side and then moving the waste to the north side. Bulk waste from all along the access road would then be moved to the site. All items identified as being compactable fill material would be moved to the landfill area. All items identified as non-salvageable would be stacked tightly on one side of the site, while "salvageable" items would be stored on the other side.

Adjacent to the bulky waste site (or at one end of it) a lined, granular berm contaminant cell would be constructed. This lined cell would be used to store

containers for hazardous materials such as paints, solvents, oils, etc. The hazardous waste area will require fencing around its parameter with a gate to ensure the safety of the general public. This gate should be kept locked. The public could use a separate drop-off area to leave wastes and the waste could then be transferred into the fenced area by O & M staff.

At this time, we recommend that only bulky wastes that are compactable be disposed of in the landfill and that no other bulky waste materials be buried. With the bulky wastes sorted and after the area has been in use for a period of at least a year, the actual generation rate of the non-salvageable bulky wastes can be measured. At that time, with the generation rate and availability of room known, the need to bury bulky wastes can be determined.

A cost comparison for the alternatives is presented on the following page. Note that these are "Class D" estimates and could change up to ± 30% or more once the costs are confirmed as mentioned previously in Section 4.2 of this report.

4.4 Scheduling

A schedule for the Tender and construction of these facilities is presented on the second page following. The first stage of construction for the lagoons would be in the summer of 1997, taking at least two (2) years to complete. It may be necessary to complete the decommissioning of the existing facility in the third year, depending on the resources available to the community and the location of the Contractor. We will discuss these resources with the community once they have had a chance to review this Brief.

5.0 PROPOSED OPERATIONAL PROCEDURES

5.1 Introduction

This section summarizes the design and operations procedures for the new solid waste and sewage disposal facilities in Arctic Bay, N.W.T.

5.2 Solid Waste

Site Description

The solid waste site is located 2 km east of Arctic Bay, surrounded by shale gravel covered hills to the north and the Arctic Bay (water) to the south.. The site slopes gradually towards the south. The terrain is covered by grass and is relatively level and well drained. The following figure shows the location of the landfill, the orientation of the working face, and the bulky waste/metals area. (Figure not included in draft.)

The solid waste facility is accessed by a 0.5 km access road from the main road to Nanasivik.

Drainage ditches should be constructed to direct runoff around the site and either into the existing stream bed that passes by the existing site or away from the site in the case of Option No. 2.

We suggest the use of portable fencing for this site. Fencing along the working face will assist in keeping windblown debris contained on the site. Portable fencing can be built using crap metal from the bulky waste site to fabricate simple

fence sections with "skids" allowing the operator(s) to move the fence sections as the working area changes.

Waste disposed of during the winter will get mixed with snow and be difficult to compact. Because of this, the amount of the working face used will be reduced in the winter months to keep this problem to a minimum.

Method of Operation (Modified) Landfill

.1 *General Procedures*

In general, solid wastes, excluding honey bags, are to be separated into combustibles and non-combustibles whenever possible. Non-combustibles will be dumped on the working face, while combustibles will be moved into the burn pit. The burn pit will be built, preferably into the base of the cliff wall which will provide natural protection from the wind. On a regular basis, as the pit becomes full, the pit will be dug out and the contents moved to the working face and pushed into the current waste layer. Once the garbage accumulates to a depth of approximately one metre, the waste is spread, compacted and a 0.3 m layer of cover material is spread and compacted over the waste. The slope is then ready to receive the next layer of waste.

As the working face progresses to the south, a final capping layer of fill, 0.2 m in depth (for a total of 0.5 m over the compacted waste), is placed to provide a driving surface.

A shallow diversion ditch should be constructed between the slope to the north and the landfill site to reduce surface drainage through the waste material.

.2 *Detailed Procedures*

The steps outlined below are presented in the graphics on the following pages (Sketches 1 to 4).

.1 *Preparation*

Construct a working platform along the north side of the site. The platform is required to provide a working face for disposal on the south side.

.2 *Step 1 (Dump Waste)*

- Back up garbage truck to the edge of the working face.

- Dump waste over the sloped working face. Start at west end and move dumping location towards east as waste builds up to a one (1) metre high layer.

.3 *Step 2*

- When working face is covered with one (1) metre of waste for the full length, spread waste evenly over the entire working face.

.4 *Step 3*

- Work material back up the slope of the working face a little at a time, compacting the waste in small layers.

- Leave compacted waste 0.5 m below the top of working face.

.5 *Step 4*

- Cover compacted waste with a layer of fill and compact to depth of:

  - 0.5 m over top; and
  - 0.3 over sloped side (refer to Step 4 in Sketch 3).

- Grade top of working platform to get level, even edge to new working face.

.6 *Step 5*

- Extend lower working platform over existing ground.

.7 *Step 6*

- Dump waste over new working face.

- Repeat Steps 2 to 6 with new working face.

5.3 Bulky Metal Disposal

.1 The bulky metal disposal area will provide a storage area for bulky metal wastes, including derelict vehicles, snowmobiles, boats, tanks, etc.

.2 Potential hazardous materials such as batteries, crankcase oils and fuel should be segregated from items to be discarded in this area and stored at the site identified in the community.

.3 Keep area clear of loose snow throughout the winter.

5.4 Sewage Lagoon

Site Description

The site is located adjacent the solid waste site, approximately 2 km west of the community. The site plan is presented on the following page.

Discharge from the lagoon will drain south along the existing drainage path, through the culverts at the highway and into Arctic Bay. The drainage path near the highway is generally poorly defined.

Method of Operation

.1 *General Procedures*

Sewage is discharged from the truck via a flexible rubber hose, through the discharge chute and into the lagoon.

During the summer months, the solids from the sewage will settle in the area adjacent the shoreline of the lagoon.

During the winter months, the sewage will form a "frozen" hill of raw sewage at the edge of the lagoon. Due to the darker colour of the "hill" it will generally be the first area to thaw in the spring and will settle out into the lagoon as thawing becomes complete.

Initially, (until a second lagoon is constructed below the first) the lagoon may require some amount of decanting in early summer, and be fully decanted in the fall prior to freeze up. The lagoon will be decanted using a 50 to 75 mm hose and pump. The intake end of the hose will be pushed out onto the surface, and held near the surface of the sewage using a floating device. This device may be made of a combination of wood and styrofoam; or alternatively a floater hose may be utilized with a wooden structure at the end of the intake to hold the end of the hose below the surface. The discharge pipe will be long enough to reach down to the end of the protective berm layer and either into a second lagoon or onto the flattest area of ground available. The pump is then started and once the discharge hose is full the pump can be turned off and the sewage left to be siphoned out of the lagoon. Periodic checking will be necessary to ensure

the flow is not interrupted and the "short circuiting" of the effluent directly to the culverts at the road is not occurring.

Once a second (and subsequent cells) are constructed, the method of discharge will be the same, except that prior to the upper lagoon (highest lagoon) reaching its maximum depth of 1.0 m freeboard on the frozen core (1.5 m from the top of the finished berm), the next lagoon will need to be decanted sufficiently to allow the first berm to be decanted into it. If the need for decanting is close to the winter freeze up period, a sufficient quantity of effluent will need to be decanted into the lower berm(s) in order to allow for enough free capacity in the first lagoon to last through the winter and hold all of the sewage after spring melt.

.2 *Detailed Procedures*

The steps outlined below are represented in the graphic on the following page.

.1 Upon arrival of the sewage truck to the turnaround areas, the truck should be backed up to the bollards at the discharge chute.

.2 Pull the flexible rubber hose out from the discharge pipe and connect the Kamlock coupling on the hose to the discharge coupling on the truck.

.3 Look through the discharge pipe to ensure it is open and unblocked. Remove any blockage if it is not clear.

.4 Open discharge valve on the truck and discharge sewage through the chute.

.5 Close discharge valve. Disconnect Kamlock coupling and set discharge hose so that coupling rests "hooked" on the angle iron bar that runs between the bollards.

ARCTIC BAY
REHABILITATION OF EXISTING SEWAGE AND SOLID WASTE SITES

****ESTIMATE****

SEWAGE LAGOON SITES

SCHEDULE OF QUANTITIES AND
UNIT PRICE TABLE

ITEM NO.	DESCRIPTION	EST. QUANTITY SITE 1	SITE 2	SITE 3	UNIT	UNIT PRICE	EXTENSION	SITE 2A	SITE 2B
1	ACCESS ROAD (Granular Fill	360	1860	1860	cu. m.	$ 24	$ 8,640	$ 44,640	$ 44,640
2	BERM FILL - CORE	60000	28570	13830	cu. m.	$ 24	$ 1,440,000	$ 685,680	$ 331,920
3	BERM FILL - PROTECTION	29000	18000	9475	cu. m.	$ 24	$ 696,000	$ 432,000	$ 227,400
4	ROAD GRAVEL (Granular Fill	45	233	233	cu. m.	$ 24	$ 1,080	$ 5,592	$ 5,592
5	CORE EXCAVATION	1140	1140	900	cu. m.	$ 12	$ 13,680	$ 13,680	$ 10,800
	Excavation For Berm Fill - Cor	60000	28570	13830	cu. m.	$ 12	$ 720,000	$ 342,840	$ 165,960
6	Road Gravel (crushed Gravel)	50	50	50	cu. m.	$ 45	$ 2,250	$ 2,250	$ 2,250
7	TRUCK DUMP CHUTE	2	2	2	each	$ 2,000	$ 4,000	$ 4,000	$ 4,000
8	Culvert	0	1	1		$ 2,000	$ -	$ 2,000	$ 2,000
	TOTAL ESTIMATED CAPITAL COST						**$ 2,885,650**	**$ 1,532,682**	**$ 794,562**

Trial for Costs by Hamlet/D. Parker

ARCTIC BAY

REHABILITATION OF EXISTING SEWAGE AND SOLID WASTE SITES

ESTIMATE

SEWAGE LAGOON SITES

SCHEDULE OF QUANTITIES AND
UNIT PRICE TABLE

ITEM NO.	DESCRIPTION	EST. QUANTITY SITE 1	SITE 2	SITE 3	UNIT	UNIT PRICE	EXTENSION	SITE 2A	SITE 2B
1	ACCESS ROAD (Granular Fill	360	1860	1860	cu. m.	$ 15	$ 5,400	$ 27,900	$ 27,900
2	BERM FILL - CORE	60000	28570	13830	cu. m.	$ 15	$ 900,000	$ 428,550	$ 207,450
3	BERM FILL - PROTECTION	22860	8860	5855	cu. m.	$ 15	$ 342,900	$ 132,900	$ 87,825
4	ROAD GRAVEL (Granular Fill	45	233	233	cu. m.	$ 15	$ 675	$ 3,495	$ 3,495
5	CORE EXCAVATION	1140	1140	900	cu. m.	$ 10	$ 11,400	$ 11,400	$ 9,000
	Excavation For Berm Fill - Cor	60000	28570	13830	cu. m.	$ 10	$ 600,000	$ 285,700	$ 138,300
6	Road Gravel (crushed Gravel)	50	50	50	cu. m.	$ 35	$ 1,750	$ 1,750	$ 1,750
7	TRUCK DUMP CHUTE	2	2	2	each	$ 2,000	$ 4,000	$ 4,000	$ 4,000
8	Culvert	0	1	1		$ 2,000	$ -	$ 2,000	$ 2,000
	TOTAL ESTIMATED CAPITAL COST						**$ 1,866,125**	**$ 897,695**	**$ 481,720**

ARCTIC BAY

REHABILITATION OF EXISTING SEWAGE AND SOLID WASTE SITES

UNIT PRICE CONTRACT

****ESTIMATE****

SCHEDULE OF QUANTITIES AND

SOLID WASTE SITES

UNIT PRICE TABLE

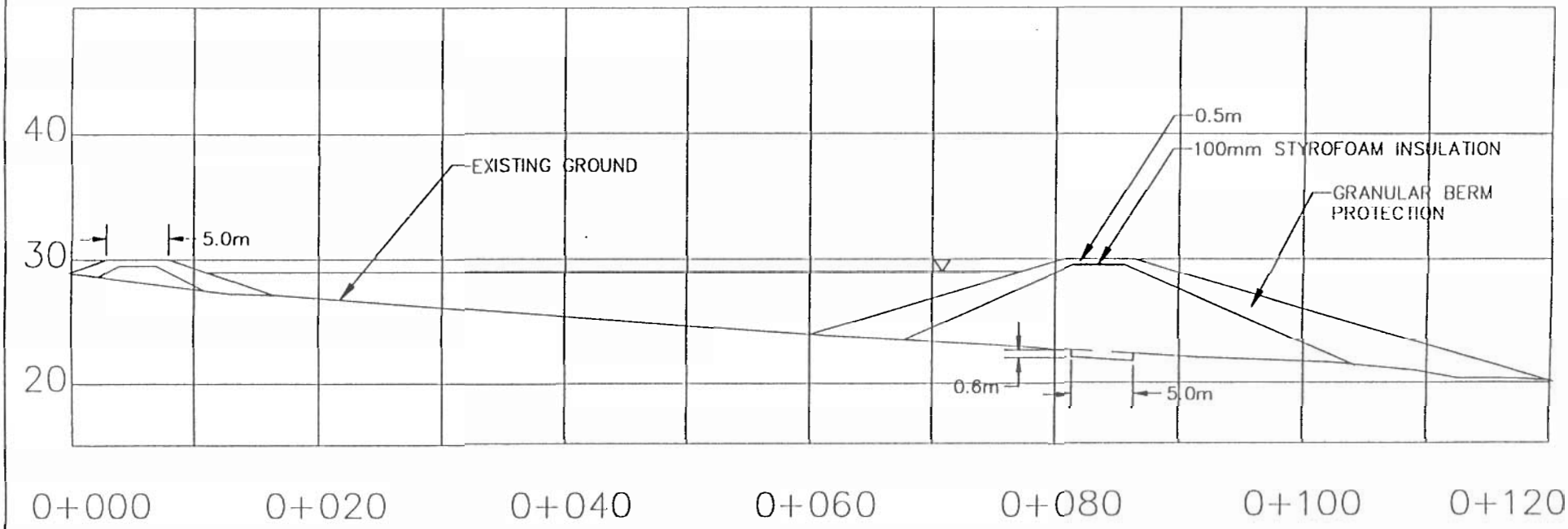
ITEM NO.	DESCRIPTION	EST. QUANTITY SIT 1	EST. QUANTITY SITE 2	UNIT	UNIT PRICE	EXTENSION SITE 1	EXTENSION SITE 2
1	ACCESS ROAD (Granular Fill)	300	300	cu. m.	$ 24	$ 7,200	$ 7,200
2	BERM FILL - WORKING FACE	600	300	cu. m.	$ 24	$ 14,400	$ 7,200
3	DECOMMISSION HONEYBAG PI	1	1	cu. m.	$5,000	$ 5,000	$ 5,000
4	ROAD GRAVEL (Granular Fill)	45	233	cu. m.	$ 45	$ 2,025	$ 10,485
5	DECOMMISSION EXISTING SITE	1	1	each	$5,000	$ 5,000	$ 5,000
6	Fencing	50	50	m	$ 50	$ 2,500	$ 2,500
TOTAL ESTIMATED CAPITAL COST						**$ 36,125**	**$ 37,385**

Profile of Lagoon 1

Northwest Territories
DEPARTMENT of PUBLIC WORKS & SERVICES

REHABILITATION AND EXPANSION
ARCTIC BAY SEWAGE LAGOON
AND SOLID WASTE SITES

DESIGN BRIEF



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SECTION A-A

Figure 3

Profile of Lagoon 2

Northwest Territories
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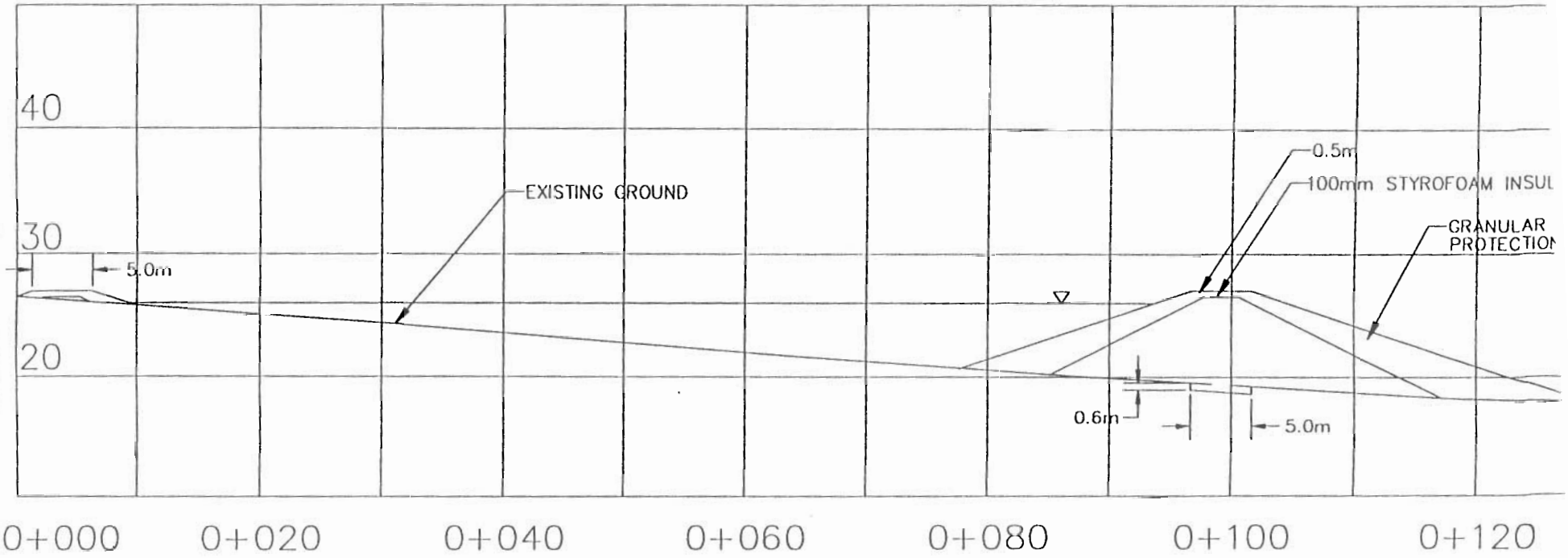
REHABILITATION AND EXPANSIO ARCTIC BAY SEWAGE LAGOON AND SOLID WASTE SITES

DESIGN BRIEF



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SECTION B-B

Figure 4

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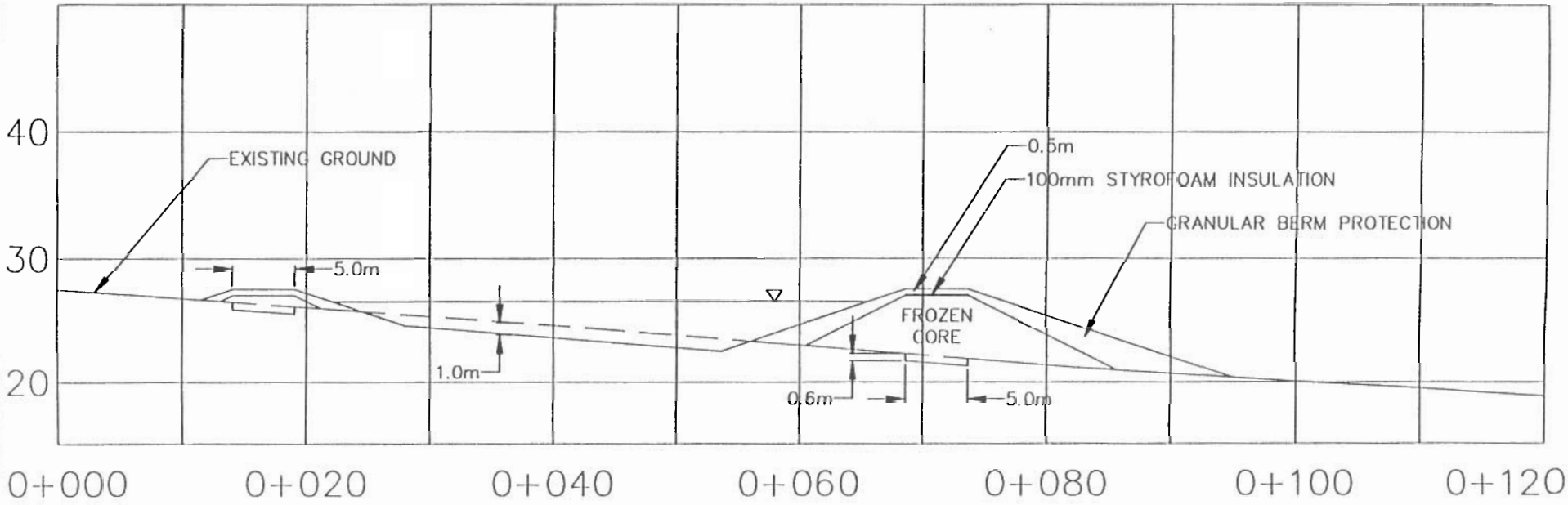
Profile of Lagoon 3

Northwest Territories
DEPARTMENT of PUBLIC WORKS & SERVICES

REHABILITATION AND EXPANSION
ARCTIC BAY SEWAGE LAGOON
AND SOLID WASTE SITES

DESIGN BRIEF



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SECTION C-C
Figure 5