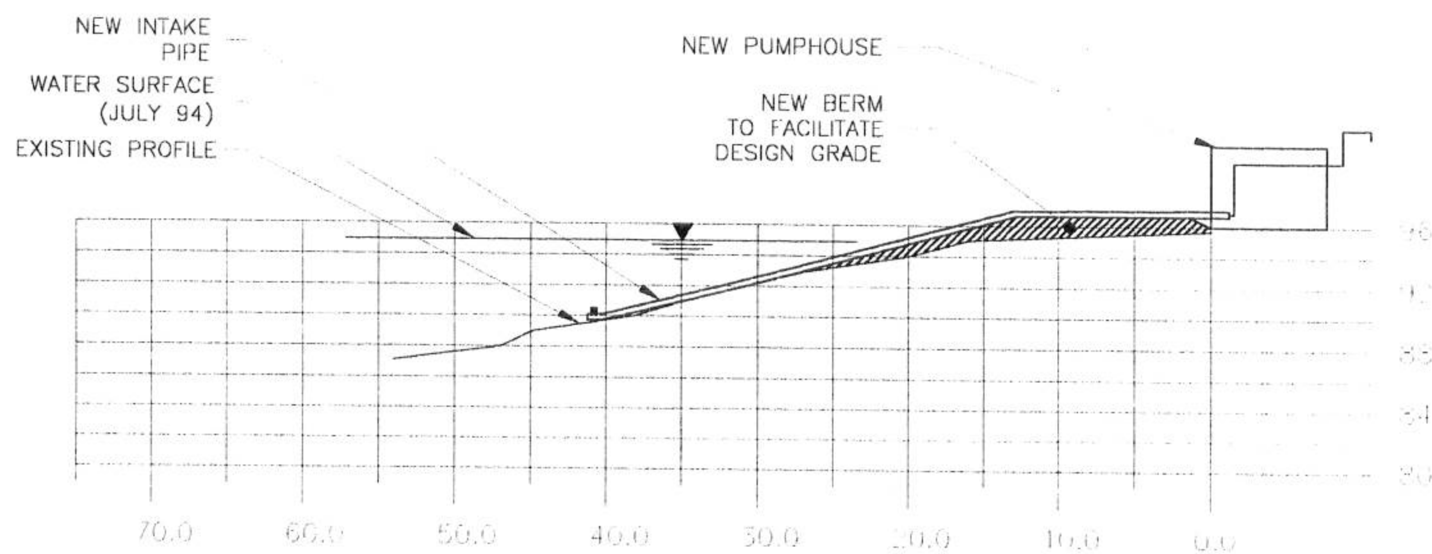

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PLOT DATE: 11/02/96 BASE NAME: SAME
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DILLON CONSULTING

TITLE
ARCTIC BAY AND CLYDE RIVER
TRUCKFILL STATIONS, NWT

PROJECT
ARCTIC BAY
INTAKE PROFILE

96-3817

4.9

NOV 96

4.10 Spares and Ancillary Components

The following is a list of spares, replacement parts, and ancillary components that will be included.

Spare Components	Parts
In-take Pump	• 1 complete submersible pump complete with power cable.
Calcium Hypochlorite Feed System	• 3 replacement part kits for chemical pump. • 1 chlorine flow switch. • 1 chemical feed pump. • Nylon tubing.
Eyewash	• 1 spare container of solution.
Lighting - exterior	• 2 spare lamps each type.
Distribution Panel	• 2 breakers of each size and type.
Terminal Blocks	• 1 set of blocks for each size and type installed including end caps, end plates, cross connectors and tear-off markers.
Fuses	• Unless noted elsewhere, 12 spares for each type required in facility.
Motor Starters	• 6 of each type of pilot light and over load heaters. • 1 of each type of coil and contact.
Control Devices	• 1 of each type of push button pilot light and lens. • 1 spare rotational water flow paddle wheel. • 1 spare flow display/totalizer. • 1 spare flow switch.
Alarm Panel	• 1 alarm annunciator.
6 of each Fuses or Mini-breaker	• 2 of each relay and timer. • 1 of each relay and timer base.
Generator (Arctic Bay Only)	• Fuel filters (12) • Oil filters (12) • Oil 30 @ 4L • Belts • Air filters (18)
K Valves	• 1 spare of each type of valve.
Themostats	• 1 spare of each type of thermostat.
Heat Trace	• Spare controller • Spare thermostat
Miscellaneous	• Damper motors • Fan motors • Timers

Miscellaneous Equipment

1. Fire Extinguisher: One (1) Ansul A20E, Class ABC, UL listed, 9 kg capacity, external nitrogen cartridge Foray powder with wall mounting brackets. Mount on wall near exterior door.

2. Dustmasks: Fisher 11-875-54 disposable masks supply three(3) packs of 50 masks each.

3. Face Shield: One (1) Fisher 11-409-5, optically clear 1.5 mm polycarbonate shield with adjustable head band.

4. Gloves: Twelve(12) Fisher 11-394-30, large, extra long, heavyweight rubber gloves, 19 mm by 380 mm length.

5. Apron: One (1) Fisher 01-357 double coated abrasion resistant, rubberized cloth apron.

6. Fush Broom: One (1) Dustbane 403089, 600 mm wide, horse hair and synthetic bristle broom with handle.

7. Mop: One (1) Dustbane 481127, Syntex Flat size #20 with handle.

8. Mop Bucket and Wringer: One (1) Dustbane No. 2024X, 27 L, round, with Cam Squeezer Wringer.

9. Dust Pan: One (1) Dustbane No. 8 Hooded 300 mm.

10. Garbage Can: One (1) 100 L, galvanized, with cover.

11. Floor Cleaner: Dustbane No. 501379 Liquid cleaner, one (1) 20 L container.

12. Lighting: Two (2) fluorescent tubes and One (1) low temperature ballasts.

13. Storage Cabinet:

    1 Combination shelving/wardrobe unit.

    2 Two (2) doors.

    3 Four (4) half shelves.

    4 Pre-finished in grey.

    5 Standard of Acceptance: Par Equipment Ltd. Model No. 4273

14. Work Benches: (Supply one (1), 1200 mm x 760 mm x 825 mm high, heavy duty construction steel table, no shelves.

15. Cabinet Table: 610 mm x 610 mm x 860 mm high, 50 mm lip on three sides of top, locking cabinet door.

16. Stepstool: 400 mm diameter, treaded top, expanded step, one piece construction, anti-skid bottom with retractable castes.

17. Hand Winch: 1500 lbs. hand winch, 5,1:1 gear ratio.

18. Hach Kit Dr 100 c/w 1 year supply of consumables (100 pillows)

19. Hach pH Kit (Clyde River) c/w 1 year supply of consumables.

5.0 SUMMARY AND IMPLEMENTATION

Arctic Bay

The truckfill facility at Arctic Bay will consist of:

- A skid mounted building constructed on a 1.0 m thick well compacted granular pad.
- An intake pipeline constructed of a 300 mm HDPE casing pipe with 50 mm of insulation and protected with riprap.
- A intake screen, 6 kw pump, and 100 mm conveyance piping.
- Prime power will be by on site 11 kw diesel electric generator. On site fuel storage will be a 1,100 l tank mounted on the building skids.
- Freeze protection of the intakes will be by 2 self-limiting heat trace cables.
- The building will be constructed off site and be a cold stream building. Electric unit heaters will provide freeze protection.
- Disinfection will be by injection of calcium hypochlorite.
- The truckfill control will be from the truckfill arm, with one customer key.
- The alarm in the system will consist of:
  - Major
    - High building temperature
    - Generator failure
    - Low fuel level 2
  - Minor
    - Truckfill pump failure
    - Building low temperature
    - Low fuel level 1

Major alarms will be annunciated on site, and to the plant operator by auto dialler.

The estimated cost of construction for this facility is $550,000.00 GST and engineering not included. This estimate is based on the actual cost of construction for Lake Harbour, which is of similar construction.

The project is to go to tender in January 1997, with construction completed by November 1997.

Clyde River

The truckfill facility at Clyde River will consist of:

- A skid mounted building constructed on a 1.0 m thick well compacted granular pad.
- An intake pipeline constructed of a 300 mm HDPE casing pipe with 50 mm of insulation and protected with riprap.
- A intake screen, 6 kw pump, and 100 mm conveyance piping.
- Prime power will be by Grid power from NWTPC.
- Standby power will be by UPS system.
- Freeze protection of the intakes will be by 2 self-limiting heat trace cables.
- The building will be constructed off site and be of wood construction. Electric unit heaters will provide freeze protection.
- Disinfection will be by injection of calcium hypochlorite. Soda Ash will be supplied for possible pH control.
- The truckfill control will be from the truckfill arm, with one customer key.
- The alarm in the system will consist of
  - Major
    - High building temperature alarms
    - UPS failure with power on power off / UPS with less than 1 hour
  - Minor
    - Truckfill pump failure
    - Building low temperature
    - Power off / UPS on

Major alarms will be annunciated on site, and to the plant operator by auto dialler.

The estimated cost of construction for this facility is $380,000.00 GST and engineering not included. The power line to the facility is estimated to cost $95,000. This estimate is based on the annual cost of construction for Trout Lake, which is of similar construction. The estimate has been adjusted to the community location. The project is to go to tender in January 1997, with construction completed by November 1997.

APPENDIX A

GEOTECHNICAL REPORT ARCTIC BAY

AGRA
Earth & Environmental

AGRA Earth &
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P.O. Box 2245
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January 16, 1995

File No. YX00387

M. M. Dillon Limited
201-5102 51 Street
Yellowknife, N.W.T.
X1A 1S7

Attention: Mr. Gary Strong, P.Eng.
Manager

Dear Sir:

Re: Report on Geotechnical Conditions
Water Supply Improvements
Arctic Bay, N.W.T.

This letter summarizes the results of a geotechnical investigation undertaken by AGRA Earth & Environmental Limited at two alternate sites for the proposed Water Supply Improvements and Truckfill Station in Arctic Bay, N.W.T.

1.0 TERMS OF REFERENCE

The Terms of Reference for the investigation, as outlined in the GNWT's Request for Proposal, and AGRA E&E's proposal of June 7, 1994 were to include:

- review available geotechnical information and examine aerial photographs;
- conduct a field investigation limited to test pits (with locally contracted equipment) in order to identify the soil and bedrock conditions at the proposed truckfill sites and turn-around areas;
- provide recommendations for the design and construction of the foundation for the pumphouse/truckfill station, water intake line, and armour rock/rip-rap; and,
- provide comments as to the availability of suitable granular materials in the community.

2.0 FIELD INVESTIGATION

The field investigation was conducted under the supervision of Mr. James Anklewich, P.Eng., of AGRA Earth and Environmental's Yellowknife Office. Mr. Gary Strong, P.Eng., of M. M. Dillon's (MMD) Yellowknife Office was also present during the field investigation. The field program included a visual recconaissance of the sites, excavating test pits in the vicinity of the proposed pumphouse/truckfill station, and inspection of potential granular borrow sources.

Asistance was provided by AGRA Earth and Environmental to MMD in conducting the topographic and bathometric surveys, the results of which are reported by M. M. Dillon separately.

The following sections summarize the geotechnical observations.

2.1 BACKGROUND

The hamlet of Arctic Bay receives its potable water from Marcil Lake, which is some 9 kilometres from the community toward Nanisivik. Two sites on Marcil Lake presently are being used for the water supply. The selection of sites is dependent on the season (that is, winter versus summer) as access to the relatively closer winter location is not available during the warmer periods of the year. The relative locations of the two sites, and the major topographic features of the general area are shown on Figure 1.1 attached to this letter-report.

As it is desired to have a single, all-season truckfill/water supply station, the objective of the present study was to provide an assessment of the geotechnical conditions at the respective sites. It is anticipated that the results of this assessment and the geotechnical recommendations contained herein would assist in the selection of a permanent facility. However, non-geotechnical considerations may govern the site selection.

3.0 SITE CONDITIONS

3.1 WINTER FILL LOCATION

3.1.1 Site Description

The winter fill site, which is situated furthest to the west, is accessed from the Arctic Bay-Nanisivik Road by an all-weather, narrow road over a distance of about 600 metres. Based on visual observations, the road was constructed by dozing local gravel materials from the slopes of an adjacent ridge on to the native tundra terrain which prevails along the lake shore at the winter fill location. The thickness of the road embankment was estimated to be in the order of 1 to 1.5 metres. The surface of the road is rutted extensively suggesting that the granular materials were not compacted during construction and that possible soft, unfrozen native soils exist beneath the fill.

In the winter time, the trucks must travel beyond the end of this road on the frozen tundra and ice for a distance of approximately 45 metres to the fill point on Marcil Lake. When thawing conditions exist, truck access to the fill point over the tundra and ice is not possible.

At the time of the field reconnaissance, the water level in the lake appeared to be raised (from winter levels) such that the truck fill location and the possible area for the proposed pumphouse was flooded. The ground surface of the possible pumphouse location is about 2 metres below the top of the access road. The adjacent tundra terrain above the water level in the lake was observed to be soft and spongy.

As noted above, the winter fill site and the access road lie adjacent to an elevated ridge, the height of which is in excess of 25 metres above the level of the road. The slopes of the ridge are inclined at at about 2H:1V and are underlain by coarse gravel beneath a thin cover of lichen and moss. On some slopes, the organic cover was stripped. The materials comprising the ridge are likely similar to that observed on an exposed portion of the ridge near the end of the existing access road (sand and gravel).

A substantial quantity of cobble and boulder sized rocks, some as large as 600mm diameter, have accumulated along a stretch of the shoreline in the vicinity of the proposed water intake line at the winter truckfill site. These rocks were piled along the lake shoreline to a height of 1 to 1.5 metres above the water level in the lake on that date (July 21/94). It is conceivable that the rocks piled against the shoreline were deposited by ice movements resulting from wave action and frost processes.

3.1.2 Subsurface Conditions

A single test pit was excavated near the end of the access road using a front end loader contracted from Enokseot Holdings of Arctic Bay. The soils observed at the test pit location generally consisted of a nominal 300mm thick cover of sandy, gravel fill underlain by a sand with a high silt content and scattered gravel sizes up to 150mm. Based on the relative ease of excavation by a loader, the gravel fill is considered to be loose. Organic soil inclusions were observed in the upper portions of the native soil. The native brown sand was observed to be saturated and in a loose state. Due to the fines content, the sand displayed a low plasticity.

Movement of the front end loader on the tundra immediately beyond the access road was difficult as it soon became bogged down in the saturated organic and sandy soils. Manoeuvring became increasingly difficult as the excavation proceeded, indicating that the native sand is somewhat sensitive to disturbance.

Groundwater seepage into the excavation was noted. After a period of several minutes, approximately 150mm of water was recorded. Frozen ground was encountered at a depth of 1 metre; however, the depth to frozen ground may be deeper in the immediate vicinity of the lake shoreline. The excavation was terminated at this depth and immediately backfilled.

3.2 SUMMER FILL LOCATION

3.2.1 Site Description

The summer fill location is located approximately 1 km east along the lake shore from the winter fill location. It is located some 150 metres away from the main road and is accessed by a sloping all-weather road. A turn-around pad is available for the trucks at the fill location. The existing summer fill location is not used during the winter due to the greater distance.

Drainage down the access road is poorly defined with the surface runoff flowing over the road in a random fashion. Several runoff gulleys have been created near the shoulders of the road.

Marcil Creek provides drainage of the uplands to the north and drains into Marcil Lake in the immediately vicinity of the fill location. Within approximately 100 to 150 metres upstream from the point of discharge at the lake shore, the river is braided with numerous wide and shallow channels. The soils in the vicinity of the point of discharge at the lake shore are generally rounded, gravel and cobble sizes with an abundance of particles exceeding 200mm to 300mm (boulders) in average diameter. The ground surface in this area is strewn with many such cobbles and boulders. Similar sizes of granular materials were noted in the water in the immediate vicinity of the shoreline.

At the time of the field reconnaissance (July 21/94), a considerable number of ice blocks were shoved on to the shoreline from the lake. At one location, which was situated approximately 30 metres southwest of the proposed fill location, the ice was pushed some 3 to 5 metres on to the shore. These blocks of ice were not observed the previous day, suggesting that the lake ice is relatively mobile during the breakup season.

3.2.2 Subsurface Conditions

Two test pits were excavated in the immediate vicinity of the proposed pumphouse location and turn-around pad. The soils encountered at these two test pit locations comprise a sandy gravel with a trace to little silt (less than 20 percent passing 0.075mm/#200 sieve screen). Cobble-sized materials (greater than 100mm diameter) were frequently noted in the test pits. The soils were moist to wet near the surface, but became saturated at a depth of approximately 500mm. Excavating beyond this depth was difficult as caving conditions prevailed in response to the groundwater seepage. Frozen ground was observed at a depth of 1 metre; however, the depth to frozen ground may be deeper in the immediate vicinity of the lake shoreline. The excavations were terminated at this depth and the test pits were immediately backfilled.

4.0 GRANULAR RESOURCES

Observations from the field reconnaissance indicate that suitable granular resources can be obtained at locations in the near vicinity of each proposed truck fill sites. Utilization of these natural gravelly materials would likely require that the boulders and cobbles be removed prior to transport and placement.

It is understood that a crusher operation was producing aggregate for the community in recent years at a location situated on a ridge to the northeast of the winter fill location. A sieve analysis on a sample indicates that the source is a reasonably well graded gravelly sand (25mm minus) with approximately 8 percent fines. Based on this result, the material would be suitable for the construction of the foundation pads for the truckfill/pumphouse.

5.0 RECOMMENDATIONS

5.1 PUMPHOUSE FOUNDATION

Based on the typical configurations at other truckfill sites, it is envisaged that the pumphouse for the truckfill station will consist of an insulated building of wood construction that is mounted on skids and supported on a compacted granular pad. Such a foundation is considered to be feasible for both of the proposed truckfill sites. It is not likely that other foundation types, such as piles (adfreeze or bedrock grouted) or spread footings would be necessary or economical.

It is conceivable that the new pumphouse building would be located in the immediate vicinity of the existing truckfill at the summer location and in the vicinity of the shoreline at the winter location. However, the actual location of the pumphouse at the selected site should be established with shoreline engineering input. The pumphouse must be positioned at locations where the safety of the structure would not be jeopardized by shoved ice blocks.

For both sites, the granular pad should be placed directly on the existing surface underlain by permafrost ground. The granular pad should be a minimum of 1 metre thick such that the annual depth of thaw is maintained within the granular pad and not in the native soils. At the winter location, the pad should be 1 to 1.5 metres thick and placed directly on the existing organic mat.

Backfill for pad construction should be a well graded gravel that is free of organics and compressible material. Ideally, the backfill should contain less than 5% fines (particles passing the 0.075mm/#200 screen) to reduce the potential for frost heave. The maximum particle size is dependent on the compactive equipment available for construction; however, in the absence of a specified value, a maximum size of 75mm is recommended.

At the existing truckfill location and approach pad at the summer location, which has been in use for several years, the surficial soils at this location are expected to be moderately dense due to the daily truck traffic. Although the test pits did not encounter any "soft" spots or weak zones, such zones may still exist elsewhere in the near vicinity.

The gravel fill should be placed in lifts not exceeding 200 mm in loose thickness and should be compacted to at least 95% of standard Proctor maximum dry density (ASTM D698). The compacted fill pad should be placed a minimum of 2 metres beyond the perimeter of the building. To facilitate the recommended compaction of the gravel fill in the pad construction, a geotextile should be placed on the existing surface. The geotextile would act as a separator and minimize the potential of displacement of the gravel into the soft subgrade. The initial lift of gravel fill may be increased to 300mm, and spread over the geotextile with light tracked equipment.

The allowable soil bearing of a well compacted pad may be taken as 150 kPa. Long term settlement of the fill structure,. if constructed according to the above guidelines, may be expected to be in the order of 2% of the fill thickness. Monitoring of the construction of the granular pad would verify that good construction construction procedures are implemented and reduce the potential for differential settlement.

5.2 WATER INTAKE LINE AND EROSION PROTECTION

The potential ice forces and ice shove at the intake have been analyzed using the following data:

- a design wind speed of 85 kph. This is equivalent to the maximum hourly wind speed observed at Resolute Bay in July, when the breakup occurs. At Resolute, the maximum observed wind speeds in summer are consistently from the east, but the same value was assumed for the southeast exposure at the site.
- a fetch of 1 km from the southeast
- a beach slope of 1V:44H, based on the bathymetry data obtained during the site reconnaissance.

The 85 kph wind over the 1 km wide ice sheet would generate a force of 1.5 kN/m of shoreline. Assuming an ice thickness of 0.6

metres, such a force would push the ice almost 13 metres up the beach. Thicker ice may not be pushed as far. The ice shove could be greater than 13 m at exposed structures or points of land. If the pumphouse is located at A1 (bathymetry profile, as shown on Figure 1.3 attached), the site does not project into the lake and is in fact sheltered slightly by the adjacent shoreline. At this location, a setback of 13 metres is considered to be adequate to protect the pumphouse against ice shove.

If a location closer to the shoreline is desired, or for additional protection against ice forces, the pumphouse could be located northeast of A1 to take advantage of the shelter provided by the protruding shoreline between A1 and A2. Moving the site northeast would require a review of the bathymetry to verify that the mouth of the intake would have enough submergence to function under the assumed 2 metre ice thickness.

For the winter fill location, this 13 metre setback would be conservative, as the prevailing wind direction is from the east. A setback distance in the order of 10 to 13 metres is considered appropriate for the winter location.

To protect the intake pipeline against ice damage, it may be covered by a riprap berm. Details of the berm design are shown on the appended Figures 1, and 2. The riprap size is based on ice damage experienced at other site. The riprap should be angular in shape, and have an average diameter (D_{50}) of 400mm. It should consist of rock sizes from 200mm to 600mm diameter.

Although the riprap will provide a good degree of protection, it can not be considered to be immune to damage. Some maintenance is likely to be necessary because the berm protrudes from the shore and is therefore subject to much higher forces than the rest of the shoreline.

An alternative solution is to bury the pipeline for all or part of its length as shown on the appended Figure 3. Option 1, complete burial requires no riprap at all. In this case, the ice forces are not concentrated at the pipeline, but are spread out along the beach. Complete burial is preferable from the point of view of mitigating the effects of ice forces, but may have other drawbacks related to disturbing the permafrost by trenching. Therefore, a second option, partial burial, is also presented. In this case, the above-ground portion of the pipeline is protected by a riprap berm. The berm does not extend into the lake and as such, it is easier to construct and requires much less riprap than the complete riprap protection.

This assessment was limited strictly to the assessment of ice shove. Other hydrotechnical issues which should be addressed are:

- the potential range of water levels which could occur on the lake and the impact of extremely high or low levels on the intake;
- wave effects on the shoreline and the design of wave erosion protection; and,
- design of the water intake.

AGRA Earth & Environmental would be pleased to address any of these issues and provide a hydrotechnical review of the proposed pumphouse and water intake on request.

5.3 SLOPE STABILITY

As stated in Section 2.2.1 above, the large ridge located at the winter fill location rises to an elevation in excess of 25 metres higher than the surrounding area with a slope angle that is locally as steep as 2H:1V. At this angle, the slope is stable with factors of safety against failure in the range of 1.4 to 1.5 or greater.

Any construction activities that would adversely affect the stability of the slope should be avoided. Examples of these activities would include, but are not limited to, the following:

- excavation or cuts near the toe of the slope;
- scraping the surficial materials from the slope, thereby creating a deeper zone of thaw; and,

- restricting active layer and surficial seepage along the slope by constructing, for example, a swale or berm immediately adjacent to the toe of the slope.

5.0 CLOSURE

We trust the foregoing is sufficient for your present purposes. Should any questions arise, please contact the undersigned at your convenience.

Yours truly,

AGRA Earth and Environmental Limited

REGISTERED PROFESSIONAL ENGINEER
J. L. ANKLEWICH
N.W.T.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
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