31 March 2010

YX00826

Community Planning Services
Baffin Region, Government of Nunavut
P.O. Box 379
Pond Inlet, NU, X0A 0S0

Attn: Mr. Bhabesh Roy, M.A.Sc, P.Eng.

Dear Mr. Roy,

Re: PART G Engineering Design, Drawings and Specifications for Monitoring Wells at Metal Dump Site, Solid Waste Site and P-Lake Sewage Lagoon, Cape Dorset, Nunavut.

As per your request, AMEC Earth & Environmental (AMEC) is pleased to submit PART G of the Engineering Design, Drawings and Specifications for Monitoring Wells at Metal Dump Site, Solid Waste Site and P-Lake Sewage Lagoon, Cape Dorset, Nunavut to Community Planning Services (CGS). As per the Scope of Work, PART G of the program consists of the detailed monitoring well and drilling specifications to be used by CGS in an upcoming tender call.

Background

The current water license (Nunavut Water Board License No.: 3BM-CAP0810) held by the community of Cape Dorset, NU requires the installation of five monitoring wells at the locations specified below:

- One monitoring well up gradient of the 2007 Sewage Disposal Facility (designated CAP-16);
- Two monitoring wells down gradient of the 2007 Sewage Disposal Facility (designated CAP-17 and CAP-18);
- One monitoring well up gradient of the Solid Waste Disposal Facility (designated CAP-19); and,
- One monitoring well down gradient of the Solid Waste Disposal Facility (designated CAP-20).

Drilling Specifications

The following specifications are to be used for the advancement of boreholes required for the installation of monitoring wells at the required locations.

Drilling Locations

The monitoring wells are to be installed at the following approximate locations as shown on Figures 1 and 2.

Table 1: Approximate Location of Monitoring Well Installations

Monitoring Well ID	UTM Coordinate (NAD 83, Zone 18)		Elevation (m asl)
	Northing (m)	Easting (m)	
CAP-16	7122632	424199	120
CAP-17	7122471	423970	117
CAP-18	7122534	423982	117
CAP-19	7123785	7123935	13
CAP-20	423957	423926	7

Active Layer Thickness Information

Cape Dorset lies within the continuous permafrost zone (NRCAN, 2010). The depth of seasonal thaw, or active layer, varies from 1.0 to 2.0 meters, depending on ground vegetative cover and surface disturbance (AMEC, 2005). The active layer will be less if bedrock is less than 2 meters below the ground surface.

During the design phase of the current sewage lagoon, AMEC (2006) conducted a field drilling program. Twenty-two shallow boreholes and two test pits were advanced throughout the lagoon site. The drilling method did not allow for accurate ice content of the overburden soils, but it did allow for the location of bedrock depths (AMEC, 2006). The results of the 2006 drilling program show that the depth to bedrock ranges from the surface (0 meters below ground surface (m bgs)) to over 3.1 m bgs. The average depth to bedrock, excluding surface exposed bedrock, at the site is 1.9 m bgs. Permafrost was identified in two of the boreholes and in both test pits. The active layer thickness at the lagoon site ranges from 1.8 to 2.0 m bgs.

No specific data for the landfill site is available. It assumed that the active layer thickness at the landfill site is less than or equal to 2.0 m based on other studies conducted at Cape Dorset. As mentioned above, the active layer thickness can be determined by climatic conditions, the aspect (north vs. south facing), ground cover, soil type, and precipitation. In addition, the active layer is at its thickest point in late August or early September.

Borehole Specification

The following borehole specification is required for the installation of monitoring wells at the Cape Dorset Landfill and Lagoon:

- Minimum 150 mm diameter (which assumes the installation of a 50 mm diameter monitoring well; and
- Minimum 1 m into sound bedrock, if encountered.

AMEC recommends the use of an air rotary tracked drilling rig, complete with a rock hammer drill bit to produce the required boreholes. The use of this type of drilling rig has been successful in the Cape Dorset area over the last 30+ years. A steel casing, approximately 2 – 3 m in length, is to be placed in the overburden section to reduce the likelihood of sloughing.

Monitoring Well Specification and Design

Pipe Specifications

- **Solid Pipe (Riser)**
  - 50 mm diameter (OD)
  - 1.5 m length
  - Schedule 80 PVC
  - ASTM F480 threads
  - O-Ring present on male threaded end to ensure seal
  - Each piece is individually cleaned and wrapped

- **Slotted Pipe (Screen)**
  - 50 mm diameter (OD)
  - 1.5 m length
  - Schedule 80 PVC
  - #10 (2.5 mm) horizontal slot
  - ASTM F480 threads
  - O-Ring present on male threaded end to ensure seal
  - Each piece is individually cleaned and wrapped

- **End Cap (Top and Bottom)**
  - 50 mm diameter (OD)
  - Schedule 80 PVC
  - Friction fit
  - Each piece is individually cleaned and wrapped

Protective Casing

- A 100 mm diameter x 1. 5 m length steel protective casing, with a hinged locking lid will be installed at the surface to protect the monitoring well and ensure it is not tampered with.
- The protective casing will be painted red.
- The protective casing will be installed with at least 0.61 m below ground surface.
- The area between the solid 50 mm pipe and the protective casing is to be filled with compacted drill cuttings.
- Sloped compacted drill cuttings are to be placed on the outside of the protective casing to promote drainage away from the monitoring well.
- A lock of suitable size is to be placed on the protective casing. All locks are to be keyed alike.

Monitoring Well Installation

Following the drilling of the individual boreholes, to at least 1 m into bedrock, the monitoring well pipe will be assembled at the surface and inserted into the borehole in the following configuration:

- 1 m solid section with an end cap will be inserted into the potion of the borehole advanced into the bedrock. 12.5 mm x 100 mm threaded rod will be inserted through holes drilled in the pipe. These will aid in securing the monitoring well to prevent possibility of frost heave.
- Depending on the depth of the borehole, slotted pipe will be installed in frozen and unfrozen sections of the overburden.
- Solid pipe, with an end cap, will be installed in the upper unfrozen portion of the borehole, extending a maximum of 0.6 m above ground surface.

Once the pipe is in place, the following will be added:

Grout

Sika® Grout Arctic 100 is to be used to grout the lower solid section of the monitoring well to the bedrock sidewalls of the borehole. The grout is to be mixed and applied as per the manufactures instructions. The top of the grout layer must not extend, no more than 0.2 m below the start of the slotted pipe section.

Filter Pack

10-20 Environmental grade silica sand is to be used as the filter pack between the sides of the borehole and slotted pipe. The sand is to extend from the grout layer to a minimum of 0.2 m above the slotted pipe section. The sand is to be poured in slowly to avoid bridging.

Seal

3/8" Bentonite chips are to be used to seal the monitoring well from surface water infiltration. The chips are extend from the sand layer to ground surface. The chips are to be hydrated with filtered water.

A summary of the required supplies and quantities is presented in Table 2.

Table 2: Summary of Monitoring Well Equipment

Item	Quantity
50 mm x 1.5 m Solid Sch 80	20
50 mm x 1.5 m Slotted Sch 80	10
50 mm End Cap Sch 80	10
100 mm x 1.5 m Steel Protective Casing	5
10-20 Environmental Quality Silica Sand (23 kg bags)	45
3/8" Environmental Quality Bentonite Chips (23 kg bags)	12
Grout (25 kg bag)	25
Lock (keyed alike)	5
Reflective Tape (Roll)	1
12.5 mm x 2.5 m Threaded Rod complete with 50 suitable fasteners (nuts)	1

Closure

This specification has been prepared based on AMEC’s understanding of the program. If you have any questions or concerns regarding the above, please contact the undersigned at your convenience.

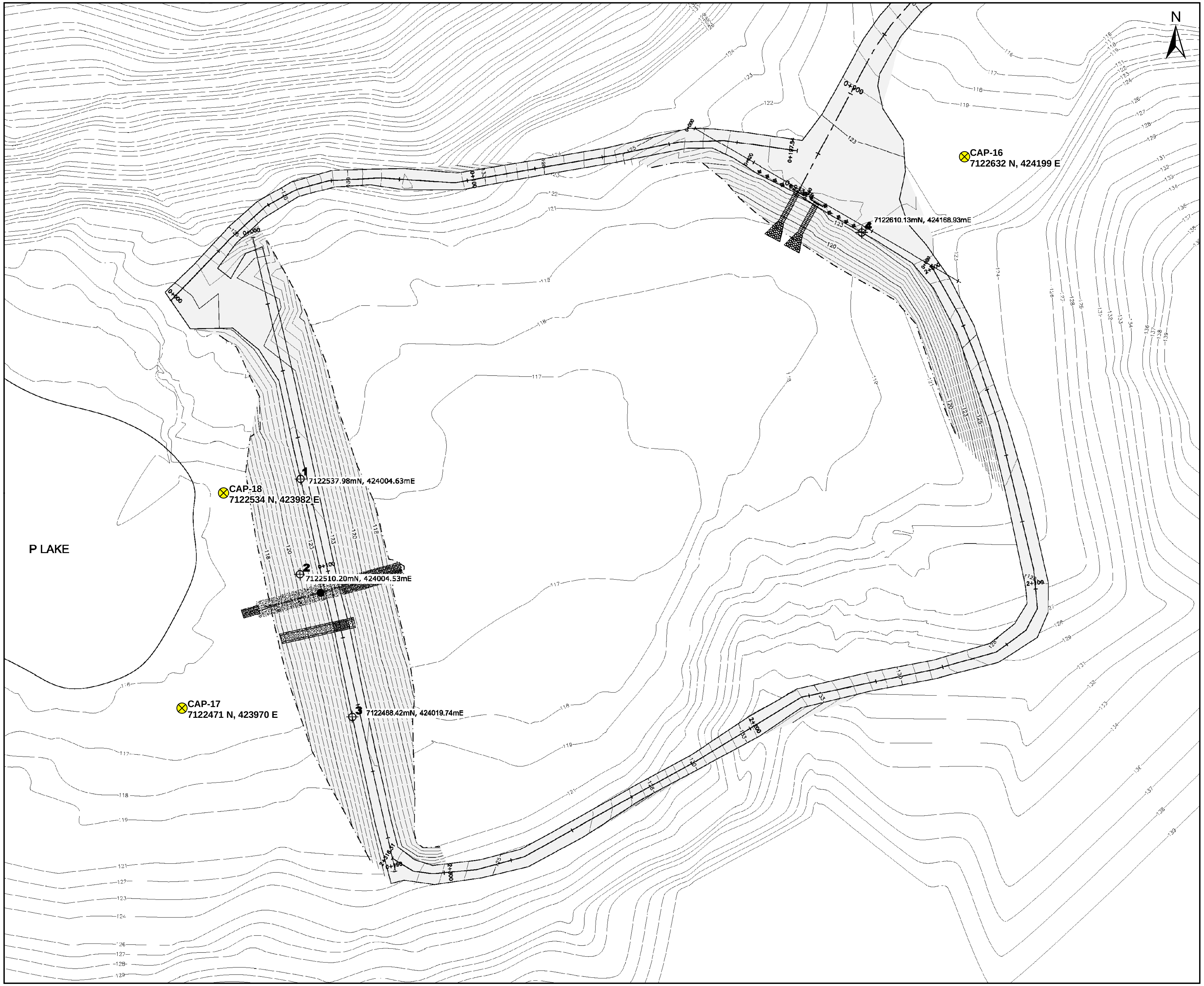
Yours truly,

AMEC Earth & Environmental,
a division of AMEC Americas Limited

David Wells M.A.Sc

Reviewed by:
Cheryl Heseltine, P.Ag.

Encl. Figure 1: Proposed Monitoring Wells – Sewage Disposal Site
Figure 2: Proposed Monitoring Wells – Solid Waste Disposal Site
Figure 3: Typical Monitoring Well Installation – Cape Dorset



Legend

⊗ Monitoring Well

Note: Base map modified from Dillon Consulting drawing 114 "Thermister Locations" from May 2009.

20 10 0 20 40

Meters

1:1,100

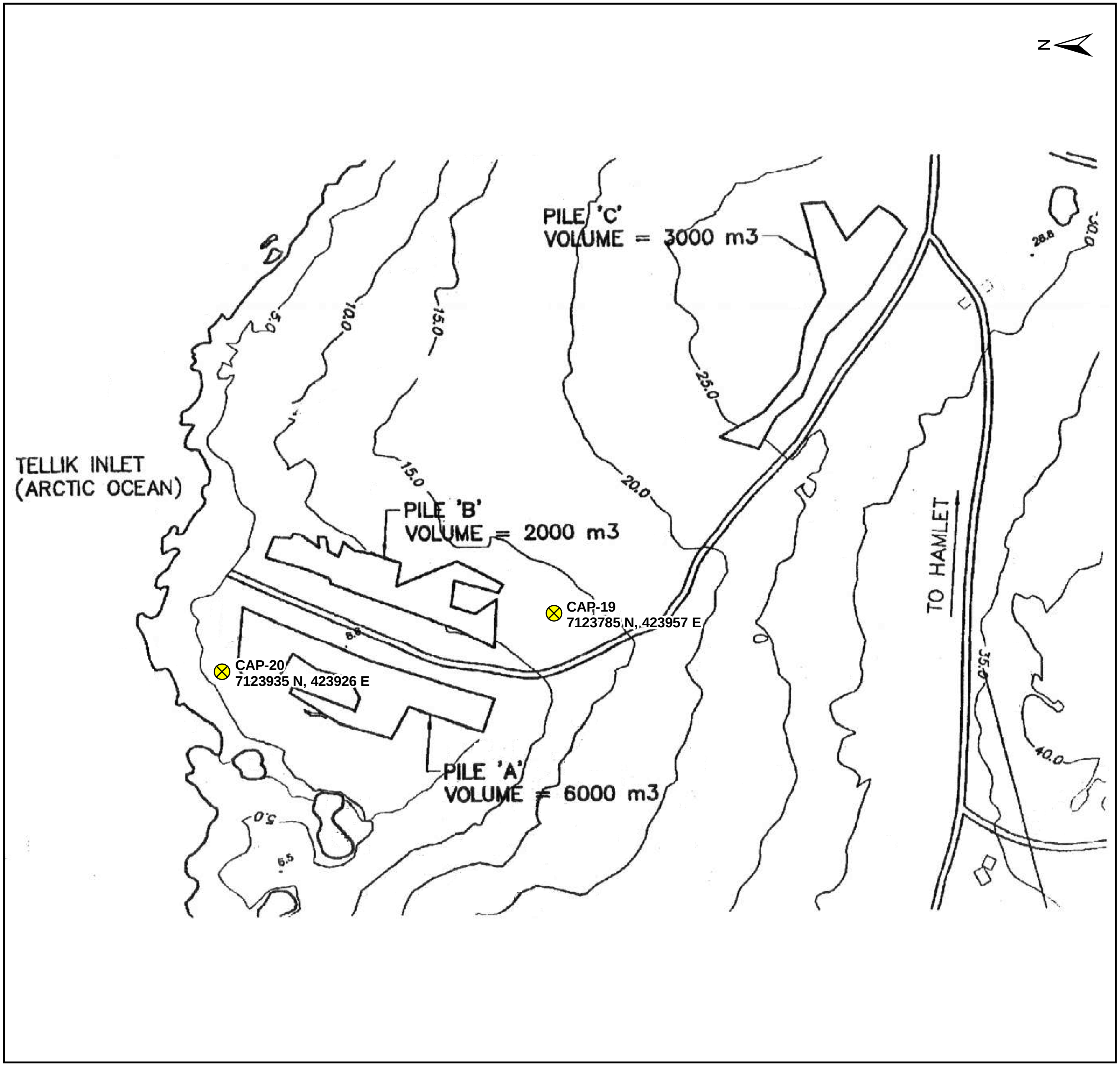
Government of Nunavut

Groundwater Monitoring
Cape Dorset Lagoon and Landfill

Proposed Monitoring Wells
Sewage Lagoon

DATE: February 2010	**Figure 1**
PROJECT: YX00826.200	Fig 1 Prop Mntr Wells Lagoon 10-02-12
ANALYST: TR QA/QC: CP DW	
PROJECTION/DATUM: UTM Zone 18 WGS84	

S:\Gis\Projects\YX00826_Cape_Dorset\ArcGIS\Cape_Dorset_1.mxd



Legend

⊗ Monitoring Well

Note: Base map modified from Dillon Consulting Figure 4 "Existing Bulk Waste Piles" from September 23, 2003.

Government of Nunavut

Groundwater Monitoring
Cape Dorset Lagoon and Landfill

Proposed Monitoring Wells Landfill

Figure 2

DATE: February 2010

PROJECT: YX00826.200

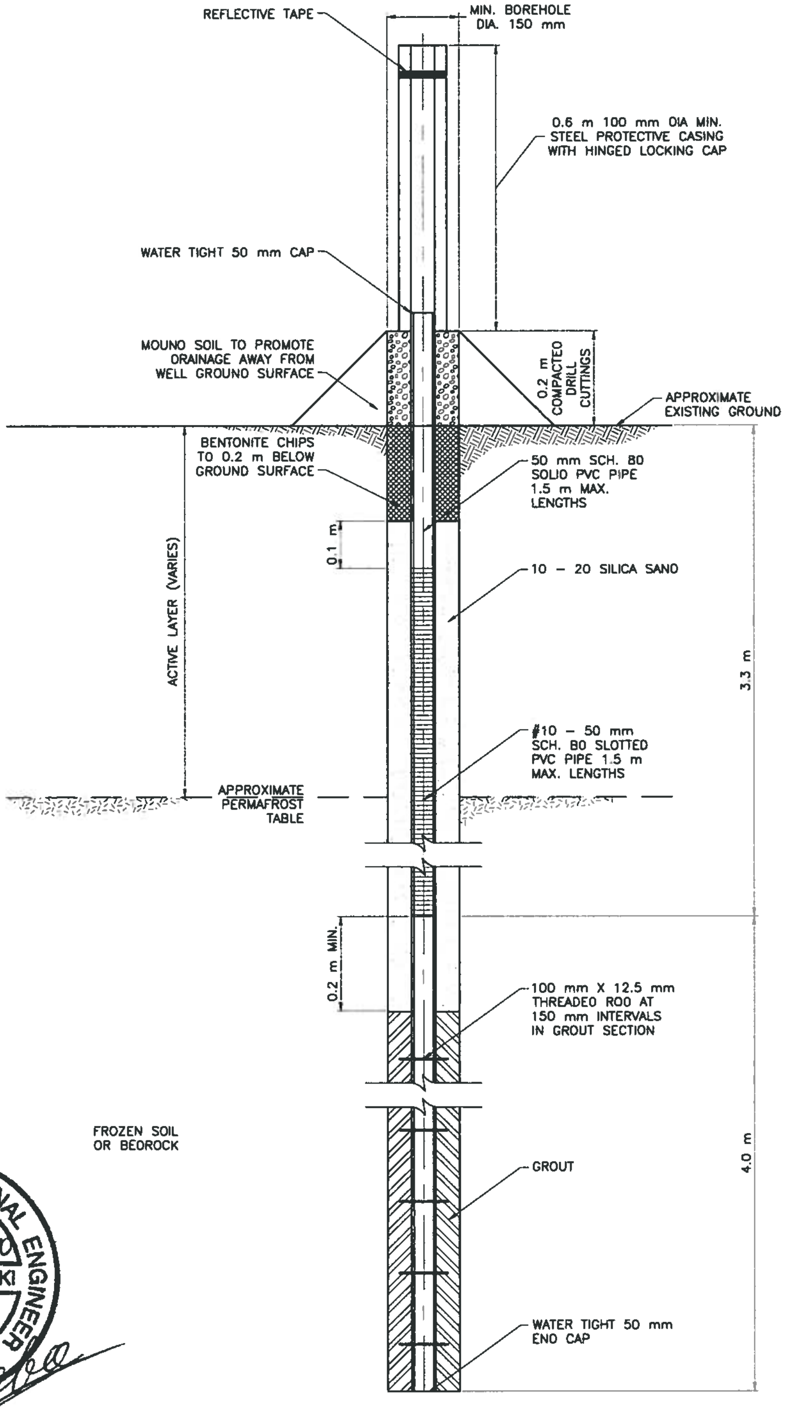
Fig 2 Prop Mntr Wells Landfill 10-02-12

ANALYST: TR

QA/QC: CP DW

PROJECTION/DATUM: UTM Zone 18 WGS84

S:\Gis\Projects\YX\00826_Cape_Dorset\ArcGIS\Cape_Dorset_2.mxd



April 6, 2010
A. TCHEKHOVSKI
LICENSEE

DISCLAIMER:
AMEC CANNOT GUARANTEE THE INTEGRITY OF PVC PIPE DUE TO POTENTIAL FOR CONSIDERABLE FROST JACKING FORCES WHEN ACTIVE LAYER FREEZES.
AMEC CANNOT GUARANTEE THE PRODUCTION OF GROUNDWATER

SCALE
1:10
0 100 200 mm

amec

CLIENT: **COMMUNITY AND GOVERNMENT SERVICES, GOVERNMENT OF NUNAVUT**

PROJECT: **CAPE DORSET GROUNDWATER MONITORING PROGRAM**

TITLE: **TYPICAL MONITORING WELL INSTALLATION - CAPE DORSET**

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
MARCH 2010	YX00826	00826ND2.dwg	FIGURE 3	A

I:\YX\00826\00826ND2.dwg - FIGURE 3 - Apr. 06, 2010 10:31am - michelle.hayer