Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

CAPE CHRISTIAN
LONG TERM MONITORING PLAN

February 10, 2009

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Appendices

1.0 Introduction

From 1954 to 1974, the United States Coast Guard operated a Long Range Navigation (LORAN) communications station at the Cape Christian site. The site was abandoned in 1975 without decommissioning. There were some remedial works carried out at the site in the past. However, there still exist significant environmental concerns at the site.

INAC has completed the site assessment of the site, developed a Remediation Action Plan (RAP), tendered and awarded contract for the RAP implementation and will be carrying out the remediation of the site between 2008 and 2010. The remediation will involve the demolition and disposal of buildings, structures and other debris; the clean up of hazardous materials; and the excavation and disposal of metals and petroleum hydrocarbon contaminated soils.

1.1 Location

The Cape Christian site is located at Latitude 70° 31' N and Longitude 68° 17' W, near the mouth of the River Clyde, on the northeast coast of Baffin Island, in the Territory of Nunavut. It is situated approximately 16 km northeast of the Hamlet of Clyde River (Figure 1 a & b)

1.2 Site Characteristics

The Cape Christian station comprised of five (5) buildings (the main station, garage, hazmat building, terminal building, and the survival hut). Six (6), Aboveground Storage Tanks (AST) (102,600L each) were also installed at the site for fuel storage. The ASTs are connected to the main station with pipes. Several oil barrels were also supplied to the station during its years of operation. The barrels, following the use of oils in them, were buried at the site. The station was abandoned in 1974.

Senes Consultants Limited conducted a Human Health Risk Assessment (HHRA) (Screening Level) and Ecological Risk Evaluation (ERE) on Cape Christian site and produced reports in November 2003 to characterize the risk levels at the site. The HHRA report shows high risk levels for the adult and composite receptors for carcinogenic contaminants, namely PCBs. The report also suggested that the Cape Christian site may pose a potential safety risk to human receptors. The ERE score is also high, showing that Cape Christian, could potentially pose some chemical and physical hazards to the humans and the environment.

A number of Environmental Site Assessments (ESAs) have been carried out at the site by Environmental Services group (ESG), PWGSC and Earth Tech. The site assessments identified 5 deteriorating buildings, 6 ASTs, power poles with associated cables, and piping, an equipment yard containing several abandoned equipment, 2 surface dumps

containing partially buried /surface placed debris, a water supply reservoir, and about 8 worked areas containing fully/partially buried barrels and debris.

Other environmental issues identified at the site include hazardous materials (lead acid batteries, compressed gas cylinders, asbestos, and building materials painted with polychlorinated biphenyls (PCBs) amended paints, soils contaminated with metals, soils contaminated with petroleum hydrocarbons (PHC), and soils contaminated with PCB's.

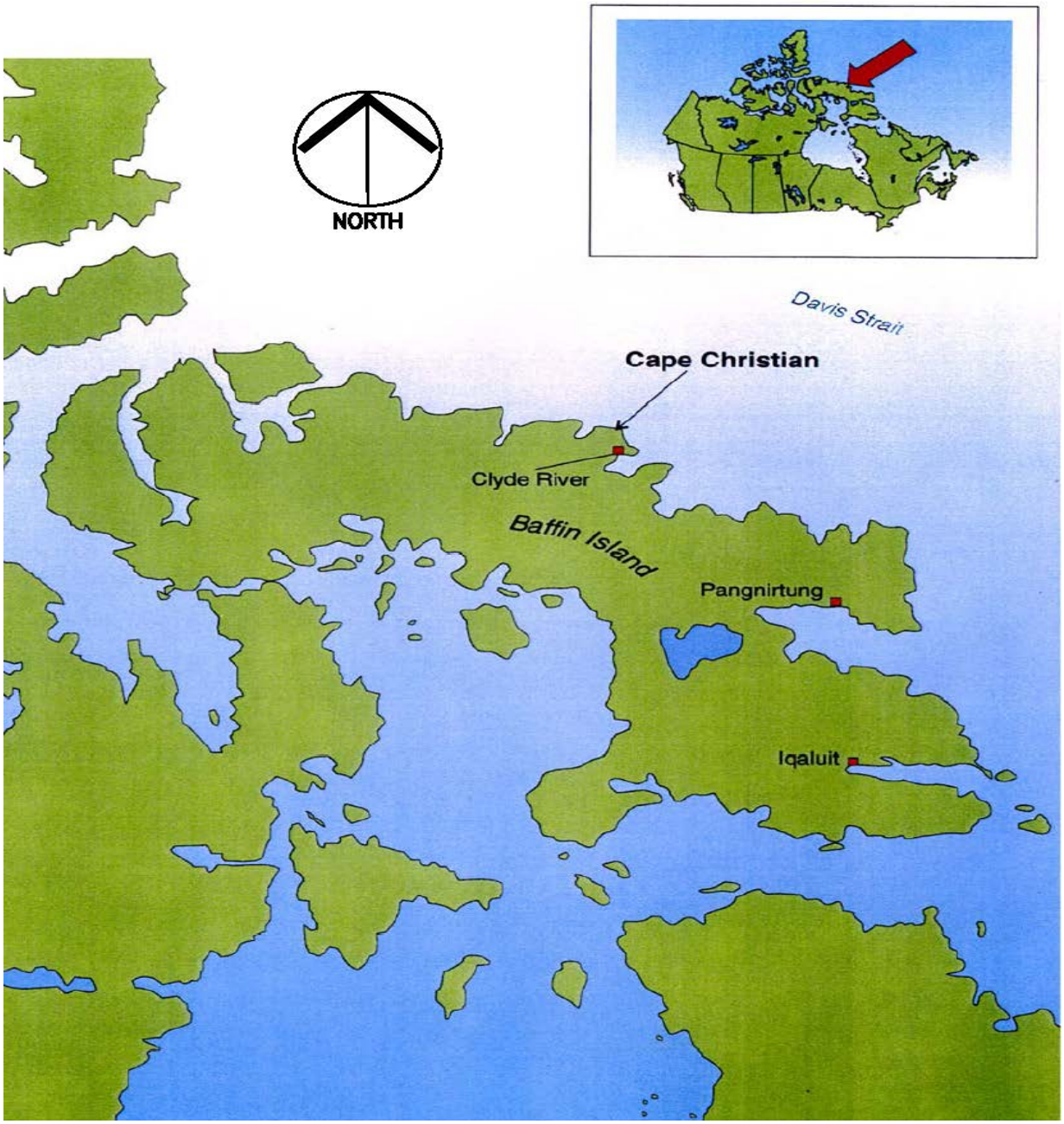


Figure 1a: Cape Christian Location Map

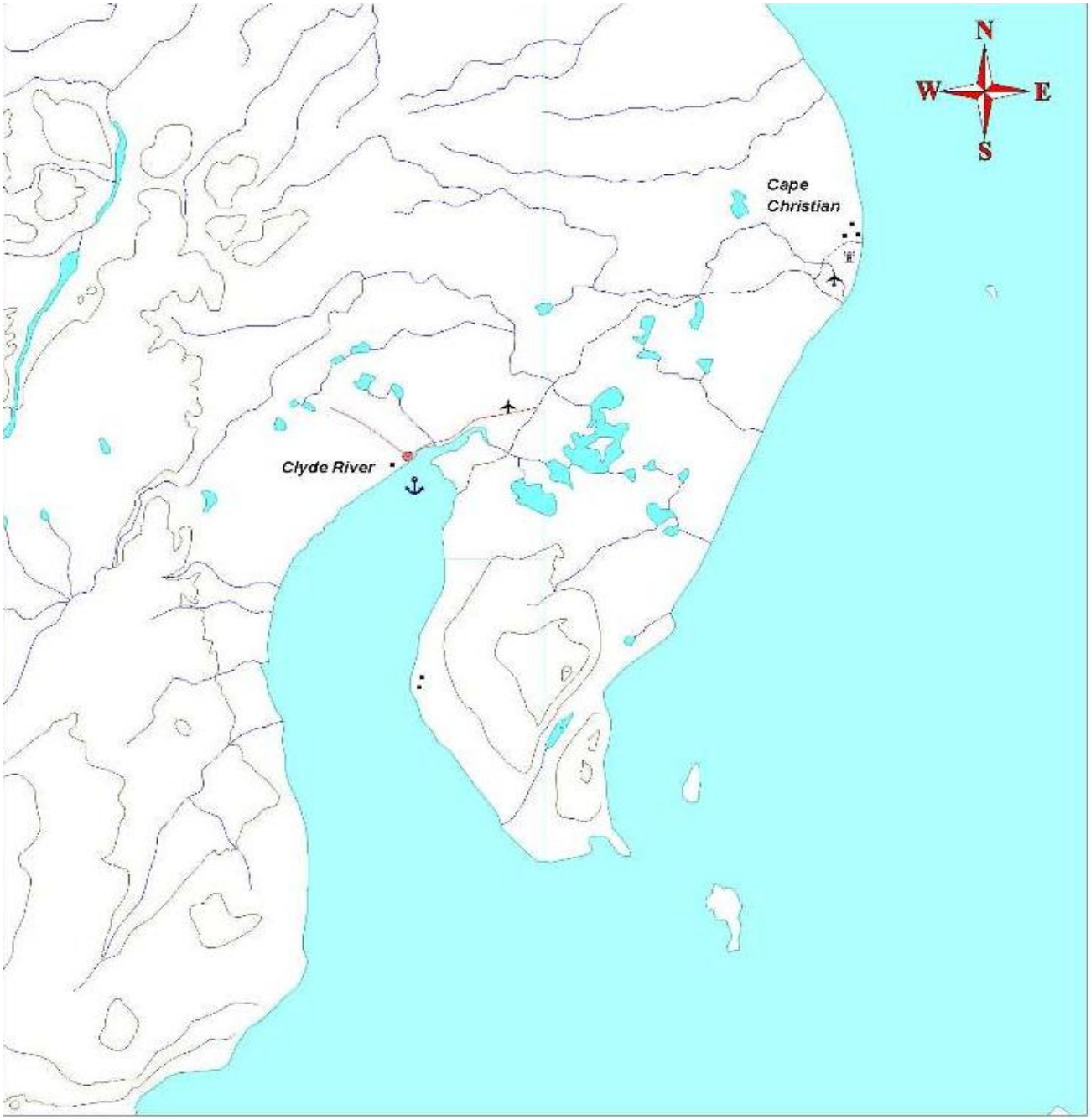


Figure 1b: Cape Christian Location Map – Cape Christian relative to Clyde River

1.3 Climate

The Cape Christian Site has a humid, cold arctic climate, marked by short cold summers and long winters. Meteorological data collected at Clyde River between 1933 and 1990 identify mean daily temperatures ranging from -28oC in February to +4.2oC in July. The

average mean daily temperature over the year is 12.4oC. The annual precipitation of 225.6 mm falls in this area, 87% of which is in the form of snow.

1.4 Flora and Fauna

The flora in this region is characterized by a sparse vegetative cover of mixed low-growing herbs and shrub. Typical plants found in this region include moss, purple saxifrage, arctic willow, kobresia, sedge, and arctic poppy.

The wildlife typically found in this region includes arctic hare, arctic fox, lemming, and caribou. Marine mammals, such as walrus, seal, whale, and polar bears are also common. King eider, rock ptarmigan, northern fulmar, plover, hoary redpoll and snow bunting are representative birds, which can be found in this area.

2.0 Monitoring Program

After the completion of remediation at the Cape Christian site the only structure that will be constructed and remain at the site is the Non-Hazardous Waste Landfill (NHWL). Due to the small amounts of metals and PCB contaminated (TIER II) soils at the site, there will not be any need for a Secure Soil Disposal Facility (SSDF).

The monitoring program for the Cape Christian site will be in accordance to the INAC's Abandoned Military Site Remediation Protocol, AMSRP (2008) involving (i) The baseline monitoring and the post-closure monitoring of the NHWL; and (ii) the natural environment monitoring of the site.

2.1 Non-Hazardous Waste Landfill Monitoring

2.1.1 Baseline Monitoring

The baseline monitoring procedure recommended by INAC AMSRP (2008) involves soil monitoring and groundwater monitoring.

- ***Soil Monitoring:***

  INAC AMSRP (2008) specifies that, for baseline monitoring, soil samples will be taken at a grid spacing of 50 m x 50 m. For the Cape Christian Site, a minimum of four samples will be taken around the perimeter of the proposed landfill taking into consideration, the site topography. The GPS of these locations will be provided to the regulators following the commencement of work at the site.

  The samples will be analyzed for:

- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc;
- Polychlorinated biphenyls (PCBs); and
- Hydrocarbon Fractions, F1, F2, F3 and F4.

These data will supplement the soil information collected during the assessment phase of the site and will be used as the baseline soil data to which subsequent monitoring data would be compared.

- ***Water (Runoff) Monitoring:***

Water samples will be collected (following spring melt) from locations that could hold water during spring melt.

Water samples will be analyzed for:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals.
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity.
- PCBs

These data will supplement the surface water information collected during the assessment phase of the site and will be used as the baseline surface water data to which subsequent monitoring data would be compared.

2.1.2 Post –closure monitoring of the NHWL

- ***Design***

The NHWL will be designed to contain non-hazardous materials only. It will be constructed on native ground with the organic matter stripped and consists of four perimeter berms constructed of granular material. The non-hazardous waste will be placed in the landfill in layers consisting of 0.5 metre lifts of waste covered by 0.15 metres of granular fill. Once all the layers were completed a final cover consisting of a minimum of 1.0 metres of granular fill will be used to cap the landfill. See Appendix B for a detailed schematic of the design.

- ***Contents***

The NHWL at FOX-C contains the following:

- Tier I contaminated soil (see Table 1)
- F3 and F4 fraction hydrocarbon contaminated soil
- Non-hazardous demolition debris, such as timbers, plywood, and sheet metal
- Non-hazardous site debris, such as scrap metal and wood
- Non-hazardous debris/soil excavated from landfills
- Creosote timbers
- Double-bagged asbestos

Table #1: DEW Line Cleanup Criteria Tier I Contaminant Criteria

Parameter	Criteria
Lead	200 to 500 ppm
PCBs	1 to <5 ppm

- ***Monitoring Requirements***

The NHWL will be monitored by:

- Visual Monitoring
  - This will check the physical integrity of the NHWL and look for evidence of settlement, erosion, frost action, animal burrows, vegetation, staining, vegetation stress, seepage points, exposed debris, and condition of monitoring instruments (Appendix E contains a Visual Monitoring Checklist).
  - Photographs will be taken to document the condition of the NHWL and substantiate the recorded observations.

- Active Layer Water Monitoring
  - Samples will be taken from the 4 monitoring wells (Appendix D) installed around the NHWL. These samples will be analysed and the results will be compared to those from background samples. The parameters that will be analysed include:
    - Petroleum Hydrocarbon Fractions, F1 and F2
    - Total and Dissolved Metals
    - Major Ions

- Hardness
- Total Dissolved Solids
- Total Suspended Solids
- pH
- Conductivity
- Polychlorinated biphenyls (PCBs)

- Soil Monitoring (as required)
  - Soil sampling will be limited to locations where seepage or staining has been identified as part of the visual inspection. When required soil samples will be collected over the interval of 0 to 0.15 metres and 0.35 to 0.50 metres depth. The parameters that will be analysed include:
    - Petroleum Hydrocarbon Fractions, F1 to F4
    - Arsenic, Cadmium, Cobalt, Chromium, Lead, Nickel, and Zinc
    - Polychlorinated biphenyls (PCBs)

2.2 Natural Environment Monitoring

The natural environment will be assessed immediately after site remediation. Both site specific and regional information will be collected. For full details of the site specific data and regional data that are required, reference can be made to the INAC AMSRP (2008). For the Cape Christian site, the natural environment monitoring data that will be collected have been incorporated into Appendix E – the Visual Monitoring Checklist.

In essence, the natural environment monitoring data should be collected at the same time that the first visual inspection data immediately after site remediation and during subsequent site visits in the course of the long term monitoring process.

2.3 Monitoring Frequency

The post construction monitoring frequency will follow the schedule recommended in the INAC AMSRP (2008). The three phases recommended by the protocol are:

- Phase I: years 1, 3 and 5.
- Phase II (*if required*): Years 7, 10, 15 and 25
- Phase III: beyond 25 years

The monitoring program will be stopped if after the phase I (5 years post remediation) the evaluation of the program confirms that there are no stability issues. Otherwise, monitoring continues to phase II. (i.e. up to 25 years post remediation). Another evaluation will be conducted at the end of 25 years to determine if monitoring should end

or go to phase III. If required, the phase III monitoring requirements will be decided on at that stage.

Monitoring at the Cape Christian site will begin in 2011. Phase I monitoring will take place in years 2011, 2013, and 2015. Each of the four monitoring events discussed above (i.e. visual monitoring, soil monitoring, water (runoff) monitoring and natural environment monitoring) will be conducted during each of the three site visits. The visits will be carried out once in a year between the months of months of July and September. An evaluation of Phase I monitoring data would be carried out at the end of the 2015 program to confirm whether or not additional monitoring is required.

If additional monitoring (phase II) is required, it will be carried out during the years 2017, 2020, 2025 and 2035. At the completion of the 25 year monitoring program a review will take place and the need for continued monitoring (phase III) will be assessed.

Table 3, below, outlines the monitoring schedule.

Table #3: Monitoring Schedule

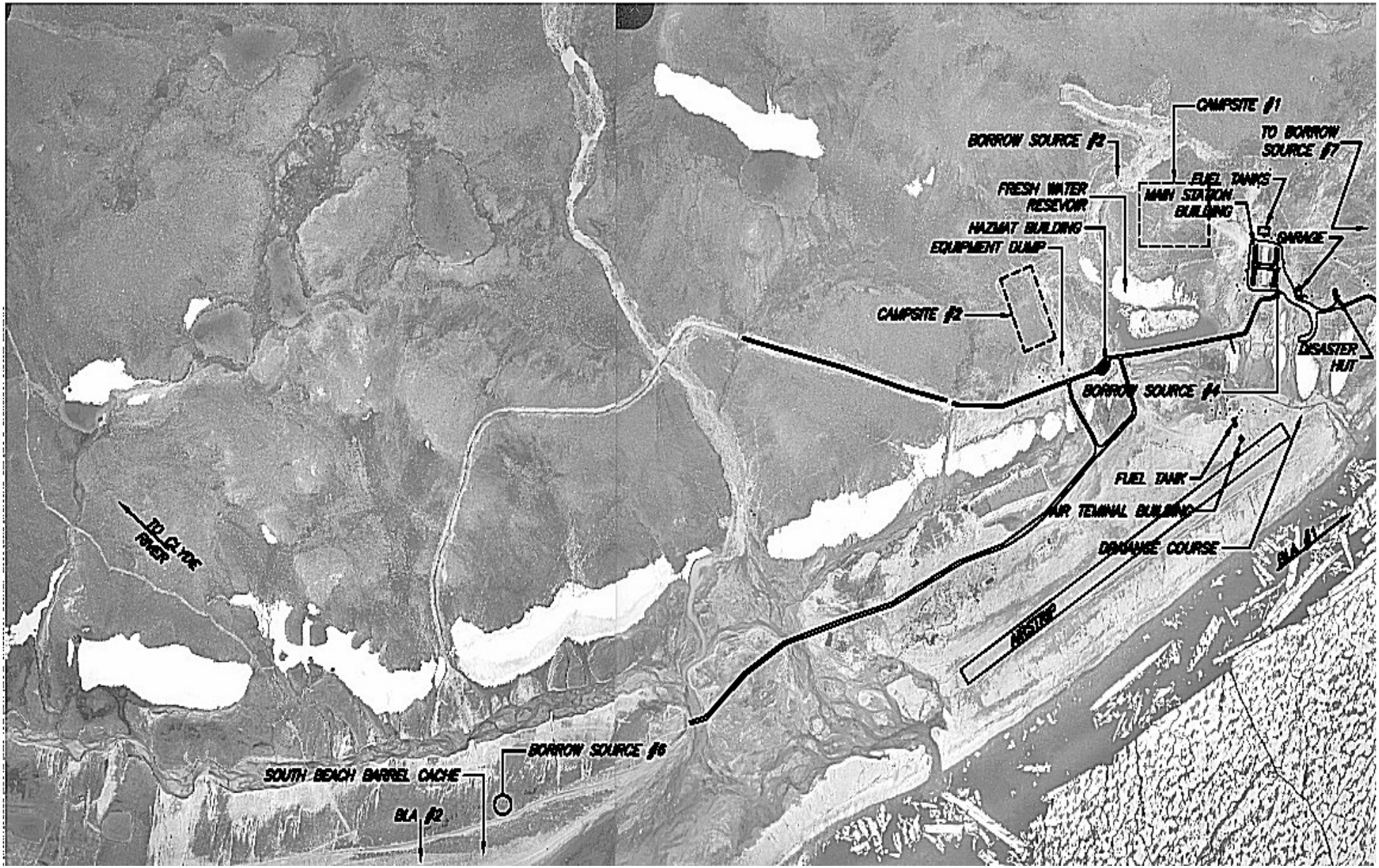
Year	Site Monitoring Scheduled (X)
2011	X
2012	
2013	X
2014	
2015	X
2016	
2017	X
2018	
2019	
2020	X
2021	
2022	
2023	
2024	
2025	X
2026	
2027	
2028	
2029	
2030	
2031	
2032	
2033	
2034	
2035	X

3.0 Quality Assurance/Quality Control

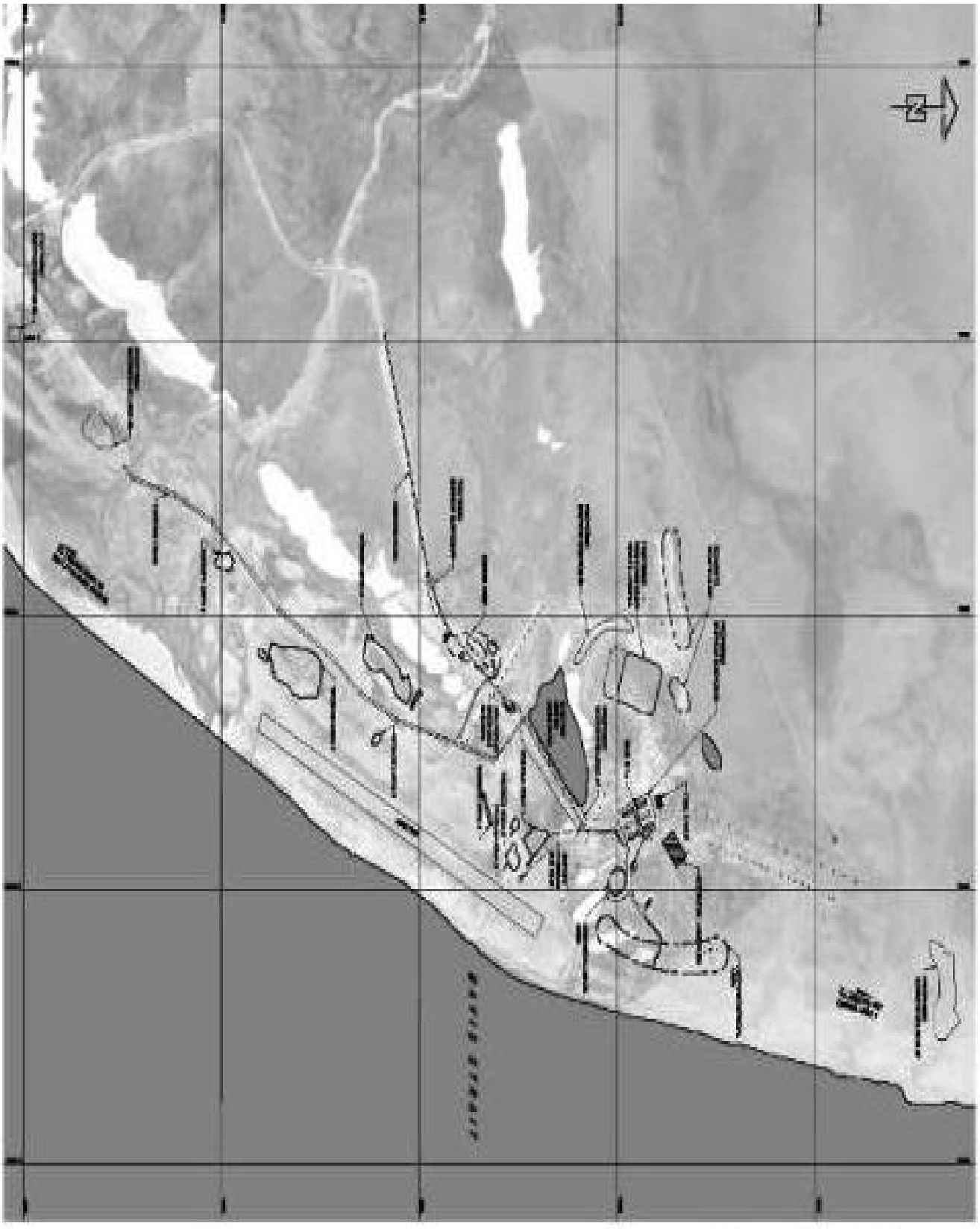
All sampling, sample preservation and analyses will be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater". All analysis will be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Accredited Laboratory.

Quality Assurance/Quality Control (QA/QC) will be consistent with CAEAL regulations and guidelines. At least 20% of samples will be taken and analyzed in duplicate and all appropriate QA/QC data will be generated and reported.

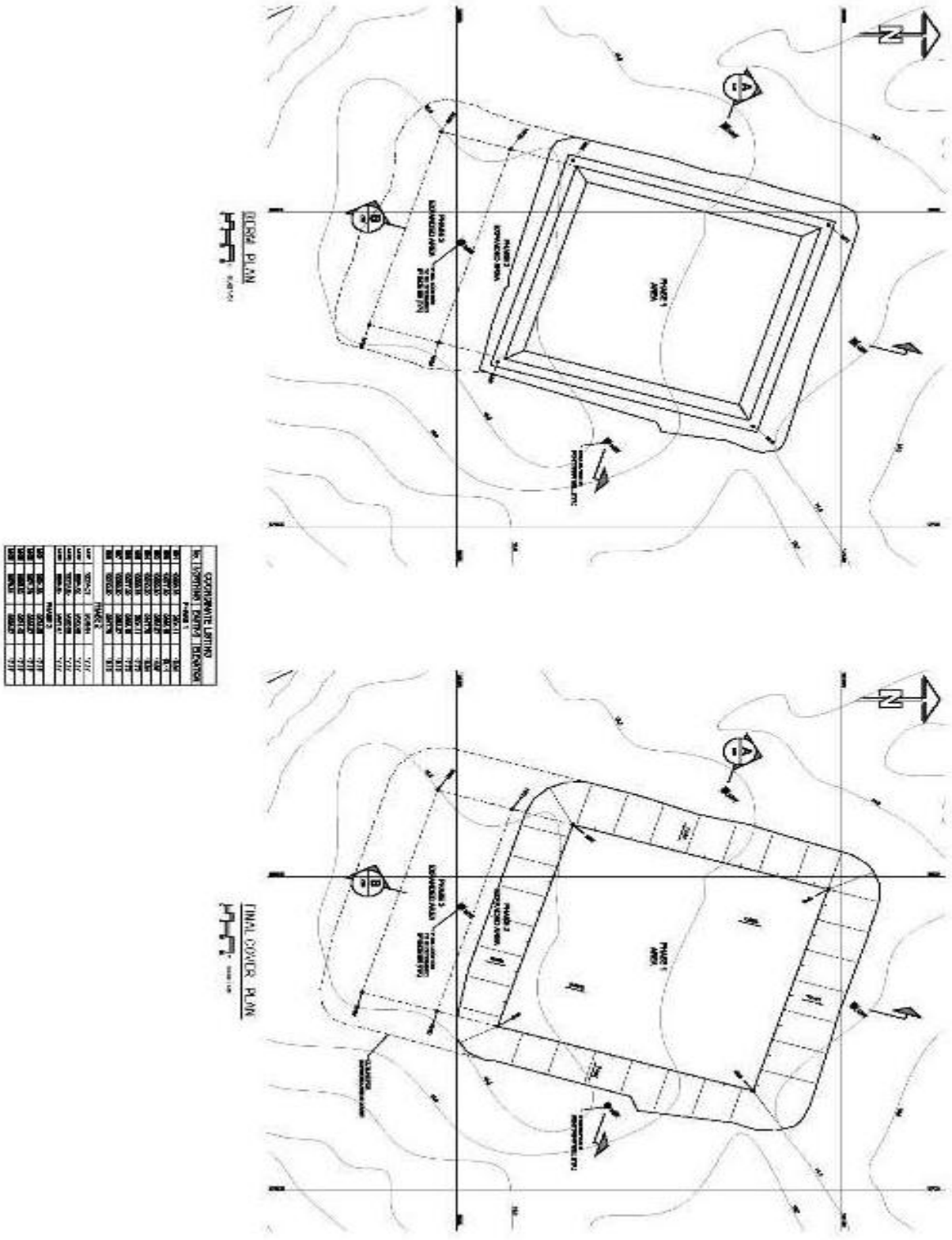
Appendix A: Cape Christian Site Layout

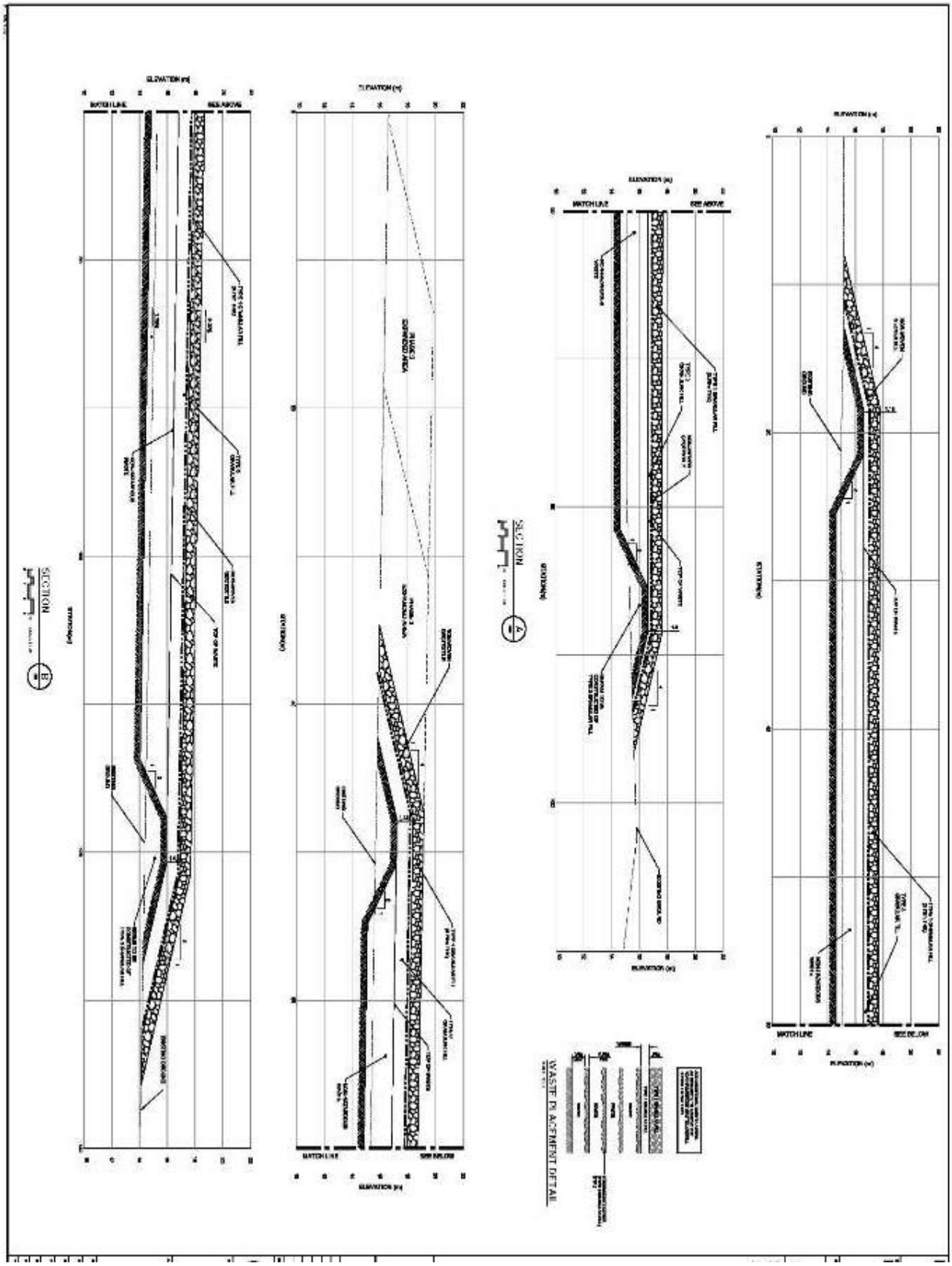

CAMPSITE #1
BORROW SOURCE #3
TO BORROW SOURCE #7
FUEL TANKS
MAIN STATION BUILDING
FRESH WATER RESEVOIR
HAZMAT BUILDING
EQUIPMENT DUMP
GARAGE
CAMPSITE #2
DISASTER HUT
BORROW SOURCE #4
FUEL TANK
AIR TEMINAL BUILDING
DRAINAGE COURSE
TO CLYDE RIVER
BORROW SOURCE #6
SOUTH BEACH BARREL CACHE
BLA #2

Appendix B: Non-Hazardous Waste Landfill Location Map

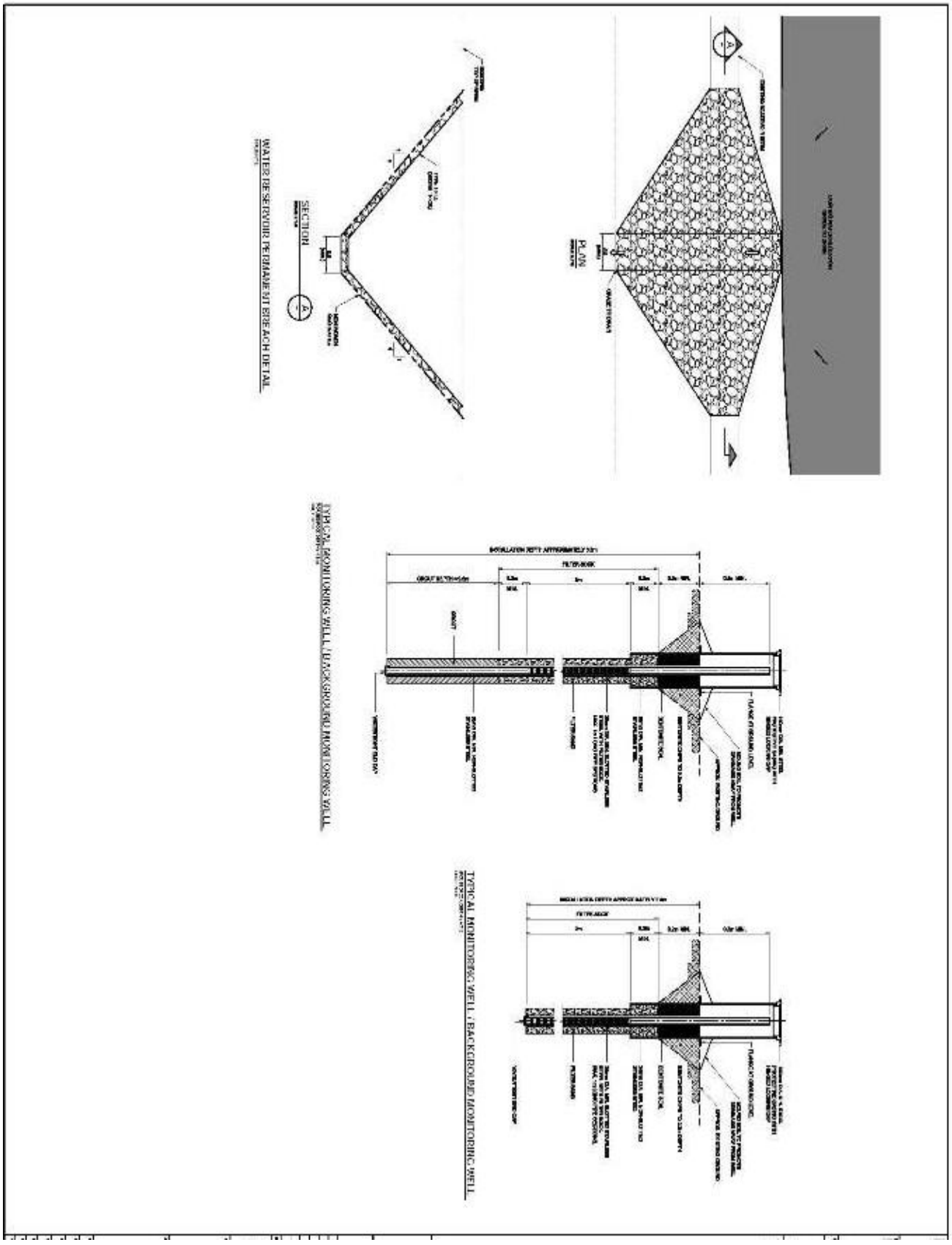


Appendix C: Non-Hazardous Waste Landfill As-Built Drawings





Appendix D: Monitoring Wells


WATER RESERVOIR PERIMETER BERM DETAIL
SECTION
PLAN
TYPICAL MONITORING WELL (BACKGROUND MONITORING WELL)
TYPICAL MONITORING WELL (BACKGROUND MONITORING WELL)

Appendix E: Visual Monitoring Checklist

Cape Christian
VISUAL MONITORING CHECKLIST

Date:	
Landfill:	

Visually assess the landfill for the following items & provide a photograph record

1. Erosion	Answer
a) Is erosion occurring on the surface or berms of the landfill?	
i) Are there preferred drainage channels?	
ii) Is there sloughing of material?	
b) What is the extent of the erosion? *(percentage of surface area)*	
i) Is it localized or continuous?	
c) Where is the erosion occurring? *(i.e. along the toe, on the surface, through the berms)*	
d) Explanation: *(i.e. evidence of significant surface water run-off, poor material)*	

2. Settlement	Answer
a) Is there differential settlement occurring on the surface?	
i) Are there low areas or depressions?	
ii) Are voids forming?	
b) What is the extent of the settlement? *(percentage of surface area)*	
i) Is it localized or continuous?	
ii) How deep is it?	
c) Where is the settlement occurring? *(i.e. near berms, near the centre of the facility)*	
d) Explanation: *(i.e. evidence of significant surface infiltration, water ponding, snow drifting)*	

3. Frost Action	Answer
a) Is there frost action/damage to the landfill?	
i) Is there exposed debris due to uplift?	
ii) Is there tension cracking along the berms?	
iii) Is there sorting of granular fill?	
b) What is the extent of the frost action? *(percentage of surface area)*	
i) Is it localized or continuous?	
c) Where is the heaving/cracking occurring? *(i.e. along the toe, on the surface, through the berms)*	
d) Explanation: *(i.e. poor material, poor compaction, high water/silt content in cover material)*	

4. Monitoring Instruments
a) What is the condition of the monitoring wells
5. Others - Confirm presence or absence, extent and description of the following
Animal Burrows: Vegetation: Staining: Vegetation Stress: Seepage Points: Exposed Debris: Other observed features:

6. Sketch

7. General Comments