UMA Engineering Ltd.
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February 5, 2007 Project No.: LFM (1.14)

Ms. Phyllis Beaulieu
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Ms. Beaulieu:

Re: Water Use License Application for FOX-4, Cape Hooper DEW Line Site

UMA Engineering Ltd. is submitting the enclosed Water Use Licence Application for the continuation of the landfill monitoring program at the former FOX-4, Cape Hooper DEW Line Site. The project was previously screened and approved by the NWB (1BR-FOX0406). The application is being submitted on behalf of Defence Construction Canada and the Department of National Defence.

If you have any questions or comments, please do not hesitate to contact the undersigned at 403-270-9220.

Sincerely,

UMA Engineering Ltd.

Eva Schulz, P.Ag.
Environmental Scientist
eschulz@umagroup.com

Encl: Water Use License Application

c.c. Nahed Farah, DCC

Effective June 16, 2006

P.O. BOX 119
GJOA HAVEN, NU X0B 1J0
TEL: (867) 360-6338
FAX: (867) 360-6369

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NUNAVUT IMALIRIYIN KATIMAYINGI
NUNAVUT WATER BOARD
OFFICE DES EAUX DU NUNAVUT

WATER LICENCE
APPLICATION FORM

Application for: (check one)

☐ **New** ☒ **Renewal** ☐ **Amendment** ☐ **Assignment** ☐ **Cancellation**

LICENCE NO:
(for NWB use only)

1. NAME AND MAILING ADDRESS OF APPLICANT/LICENSEE

Nahed Farah, P.Eng
Associate Project Manager
Defence Construction Canada Ltd.
Constitution Square, Suite 1720
350 Albert Street
Ottawa, Ontario K1A 0K3

Phone: 613-998-7917
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e-mail: Nahed.Farah@dcc-cdc.gc.ca

as administered by:
Eva Schulz, P.Ag., Environmental Scientist
2540 Kensington Road NW
UMA Engineering Ltd.
Calgary, Alberta T2N 3S3

Phone: 403-270-9220
Fax: 403-270-0399
e-mail: Eva.Schulz@uma.aecom.com

2. ADDRESS OF CORPORATE OFFICE IN CANADA (if applicable)

_____

Phone: _____
Fax: _____
e-mail: _____

3. LOCATION OF UNDERTAKING (describe and attach a topographical map, indicating the main components of the Undertaking)

Latitude: (68°26' " N) Longitude: (66°44' " W)
NTS Map Sheet No. 27B Scale: 1:50,000

4. DESCRIPTION OF UNDERTAKING (attach plans and drawings)

The purpose of the project is to collect sufficient information to assess the performance of the landfills from a geotechnical and environmental perspective. The landfill monitoring plan specifies the requirements for visual inspection, and chemical and thermal monitoring of landfills.

5. TYPE OF PRIMARY UNDERTAKING (A supplementary questionnaire **must** be submitted with the application for undertakings listed in **"bold"**)

☐ **Industrial**
☐ **Mining and Milling**(includes exploration/drilling)
☐ **Municipal** (includes camps/lodges)
☐ Power
☐ Agricultural
☐ **Conservation**
☐ Recreational
☒ **Miscellaneous** (describe below):

Landfill monitoring, including the collection of soil and groundwater samples.

See Schedule II of *Northwest Territories Waters Regulations* for Description of Undertakings

6. WATER USE

☐ To obtain water
☐ To cross a watercourse
☐ To modify the bed or bank of a watercourse
☐ Flood control
☐ To divert a watercourse
☐ To alter the flow of , or store, water

☒ Other (describe): To obtain groundwater samples.

7. QUANTITY OF WATER INVOLVED (cubic metres per day including both quantity to be used and quality to be returned to source)

Water use ☒ $100m^3$/day or less
☐ Greater than $100m^3$/day; if greater, indicate quantities to be used for each purpose (camp, drilling, etc.)

Water returned to source
0 m^3/day

8. WASTE (for each type of waste describe: composition, quantity (cubic metres per day), methods of treatment and disposal, etc.)

☒ Sewage
☐ Solid Waste
☐ Hazardous
☐ Bulky Items/Scrap Metal
☐ Waste oil
☒ Greywater
☐ Sludges
☐ Other describe):

Sewage from the camp will be deposited in a pit-toilet. Once the work at the site is completed, the pits will be backfilled with granular material stockpiles from excavation of the pits. Greywater will be deposited into a sump and buried at the end of the program.

9. OTHER PERSONS OR PROPERTIES AFFECTED BY THIS UNDERTAKING (give name, mailing address and location; attach if necessary)

Land Use Permit

DIAND	☒ Yes	☐ No	If no, date expected _____
Regional Inuit Association	☐ Yes	☒ No	If no, date expected _____
Commissioner	☐ Yes	☒ No	If no, date expected _____

10. PREDICTED ENVIRONMENTAL IMPACTS OF UNDERTAKING AND PROPOSED MITIGATION MEASURES (direct, indirect, cumulative impacts, etc.)

NIRB Screening ☒ Yes ☐ No If no, date expected _____

11. INUIT WATER RIGHTS

Will the project or activity substantially affect the quality, quantity, or flow of water flowing through Inuit Owned Lands and the rights of Inuit under Article 20 of the Nunavut Land Claims Agreement?

N/A

If yes, has the applicant entered into an agreement with the Designated Inuit organization to pay compensation for any loss or damage that may be caused by the alteration. If no compensation agreement has been made, how will compensation be determined?

N/A

12. CONTRACTORS AND SUB-CONTRACTORS (name, address and functions)

The contract for the next phase of this work has not yet been tendered or awarded. Therefore, the names, addresses and functions of the contractors and sub-contractors are not available at this time.

13. STUDIES UNDERTAKEN TO DATE (list and attach copies of studies, reports, research, etc.)
A full environmental clean up of the site was completed in 1999. No further studies have been completed.

14. THE FOLLOWING DOCUMENTS MUST BE INCLUDED WITH THE APPLICATION FOR THE REGULATORY PROCESS TO BEGIN

Supplementary Questionnaire (where applicable: see section 5) ☐ Yes ☒ No If no, date expected _____

Inuktitut and/or Inuinnaqtun/English Summary of Project ☒ Yes ☐ No If no, date expected _____

Application fee of $30.00 (Payee Receiver General for Canada) ☐ Yes ☒ No If no, date expected _____

Water Use fee of $30.00 (unless otherwise indicated in Section 9 of the *NWT Waters Regulations;* Payee Receiver General for Canada)

☐ Yes ☒ No If no, date expected _____

15. PROPOSED TIME SCHEDULE (unless otherwise indicated, the NWB will consider the application for a five (5) year term)

☐ one year or less (or) ☒ Multi Year

Start Date: July 1, 2007 Completion Date: September 30, 2023

Eva Schulz	Environmental Scientist		February 5, 2007
Name (Print)	**Title (Print)**	**Signature**	**Date**

For Nunavut Water Board office use only

APPLICATION FEE **Amount: $_____** **Pay ID No.: _____**

WATER USE DEPOSIT **Amount: $_____** **Pay ID No.: _____**

Post-Construction Monitoring Program

INTRODUCTION

The following summary is being provided for the post-construction landfill monitoring program as described in the DND-NTI Environmental Cooperation Agreement for the former FOX-4, Cape Hooper DEW Line site. Information on both the development and review process for the program, as well as the specific components of the program are included.

BACKGROUND

The Department of National Defence (DND), in cooperation with Nunavut Tunngavik Incorporated (NTI), developed a landfill monitoring plan to address post closure monitoring requirements for the landfills at the DEW Line Sites. Defence Construction Canada (DCC) is managing the cleanup and monitoring programs on behalf of DND.

The objective of the landfill monitoring program is to collect sufficient information to assess the performance of the landfills from a geotechnical and environmental perspective. The landfill monitoring plan specifies the requirements for visual inspection, and chemical and thermal monitoring of landfills at the DEW Line sites under DND's jurisdiction.

PROGRAM COMPONENTS

The post-construction landfill monitoring program consists of four main components to measure the performance of the landfills, depending on the remediation plan for each landfill. These components are visual, soil, active layer water and thermal monitoring. Details on each of the monitoring components are provided below.

Visual Monitoring: The physical integrity of the landfill is inspected and reported using hand-drawn sketches. Documented observations include:

- Evidence of settlement, ponding, frost action, erosion, and lateral movement.
- Sloughing of berms/covering layers, thermal contraction cracks, etc.

Photographic records are to be provided to document the general condition of the landfill and to substantiate all recorded observations. The location of all photographic viewpoints will be referenced to existing monuments.

Soil and Active Layer Water Monitoring: The soil and active layer water monitoring program consists of baseline/background assessment and contaminant evaluation. Background conditions represent soil and water quality from an area not impacted by the landfill. Background (naturally occurring) values are obtained from samples collected from areas that were not directly influenced by activities at the DEW Line site, but are indicative of the prevailing geochemistry. These samples are taken hydraulically upgradient and at some distance from the landfill. Baseline conditions refer to existing soil and water quality at the landfill area, prior to any remediation and/or construction work being carried out. These samples are generally collected from areas both up and downgradient of the landfill.

Soil and active layer water samples (where required) are collected prior to construction/closure of a landfill, to represent background as well as baseline conditions. The results of subsequent landfill monitoring events are compared to these baseline and background values to evaluate any potential changes in environmental conditions.

In general, one monitoring well was installed upgradient and two to three wells were installed downgradient of the landfill during the construction phase. Using water elevation data from a minimum of three wells allows assessment of the hydraulic gradient and flow velocities. Review of analytical data from water samples collected from wells up and down gradient allows evaluation of potential impacts associated with the landfill. Soil samples are collected from the toe of the landfill, generally from the same locations as the monitoring wells. Contamination in soil samples at the toe of the landfill reflects chronic input from water that may have infiltrated the landfill, and is an important factor of contaminated leachate.

Prior to collection of samples from a monitoring well, the well is purged and allowed to reach equilibrium. Physical measurements are collected prior to and after purging and are referenced to the top of the monitoring well pipe. The measured physical parameters include:

- Water elevation;
- Total depth of water;
- Presence of hydrocarbons;
- Hydrocarbon layer thickness (if appropriate);
- Colour, odour;
- pH;
- Conductivity; and
- Temperature.

Thermal Monitoring: Geothermal analyses were carried out as part of the design to predict the length of time required for permafrost aggradation through landfills requiring leachate containment, including the Tier II Soil Disposal Facility. These analyses also provided information on the long and short term thermal regime in the ground, and the depth of the active layer in the cover material.

A thermal monitoring system provides measurement of sub-surface ground temperatures, which allows comparison to and verification of the predicted ground temperatures. The thermal monitoring system consists of installation of thermistor strings, with thermistor beads at selected intervals to provide ground temperature profiles at various locations within the landfill. The thermistor strings are attached to automated data-loggers that allow for remote data collection. In general, a minimum of three thermistors are installed at each landfill where permafrost aggradation through the landfill contents is an integral part of the design.

FREQUENCY

The landfill monitoring program consists of three phases, as described in detail below.

Phase I: Phase I involves monitoring of conditions to confirm that equilibrium is achieved. The frequency of monitoring events during Phase I monitoring is dependent on the closure or

remediation design at specific landfills. The Helipad Landfills – East and West, Station Area Landfill, Lower Site Landfill and the Tier II soils disposal facility have been monitored on an annual basis for the last four years and are in the last year of Phase I monitoring. The five-year term was selected on the basis that ground-temperature thermal regimes at these specific landfills will require three to five years to reach equilibrium.

The Barrel Dump. Airstrip Landfill and Tanner Bay Landfill were regraded, and the Phase I monitoring was carried out over a reduced frequency in the first, third and fifth years following construction.

An evaluation of all Phase I data will be carried out at the end of five years to confirm that thermal and chemical equilibrium had been achieved, and that no stability issues had been identified. The landfill monitoring events are carried out by independent contractors, who successfully win the competitive tender.

Phase II: Phase II monitoring is the verification of equilibrium conditions established in Phase I. The monitoring frequency in Phase II is downgraded from Phase I and will be carried out according to the following schedule, year 7, year 10, year 15 and year 25. Year 25 marks the end of Phase II monitoring. FOX-4 is currently in Phase II monitoring.

Phase III: Phase III involves the monitoring for long-term issues such as liner integrity, permafrost stability, and significant storm events. At the end of the Phase II program, 25 years after construction, a re-evaluation of the landfill monitoring program will be carried out prior to initiating any Phase III program. The scope of the Phase III monitoring program is not included here, but is anticipated to be based on a 10 year monitoring interval.

REVIEW AND EVALUATION PROCESS

An Environmental Working Group (EWG) was established to provide a technical report and to support to the DLCU Steering Committee. This working group is comprised of qualified engineering and environmental scientists with expertise in environmental remediation and clean up in northern climates. The EWG has four designated representatives, two from each of the Owner (DND) and the Inuit (through the NTI), respectively.

During the monitoring program, the EWG reviews the results of the monitoring program in accordance with the methodology as described previously. The results of the review and any recommendations regarding changes to the monitoring plan and/or remediation requirements are reported to the DND/NTI Steering Committee.

The requirement for further monitoring after 25 years is evaluated. Monitoring may be terminated if the performance of the landfill was satisfactory over the period of monitoring from an environmental, geotechnical and thermal perspective, as appropriate. The assessment of satisfactory performance is carried out jointly by the NTI and DND.

UMA | AECOM

Defence Construction Canada

Landfill Monitoring Program - Updated

FOX-4, Cape Hooper

Prepared by:
UMA Engineering Ltd.
2540 Kensington Road NW
Calgary, AB T2N 3S3

Project Number: 0171-135-01-08

January 2007

Disclaimer

The attached Report (the "Report") has been prepared by UMA Engineering Ltd. ("UMA") for the benefit of Defence Construction Canada ("Client") in accordance with the agreement between UMA and Client for the services described in the Report (the "Agreement"), and is subject to the budgetary, time and other constraints and limitations set forth in the Agreement.

The information and data contained in the Report, including without limitation the results of any inspections, sampling, testing and analyses and any conclusions or recommendations of UMA (the "Information"), represent UMA's professional judgement in light of the knowledge and information available to it at the time of preparation of the Report. UMA has not updated the Report since the date that the Report was prepared. Further, UMA has relied upon the accuracy of the information provided to it by Client in order to prepare the Report and UMA has not independently verified the accuracy of such information, nor was it required to do so. Thus, UMA shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared which may affect the information contained therein, or for any inaccuracies contained in information that was provided to UMA by Client.

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1.0 Post Construction Monitoring Program

1.1 Introduction

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1.2 Background

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1.3 Program Components

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Thermal Monitoring: Geothermal analyses were carried out as part of the design to predict the length of time required for permafrost aggradation through landfills requiring leachate containment, including the Tier II Soil Disposal Facility. These analyses also provided information on the long and short term thermal regime in the ground, and the depth of the active layer in the cover material.

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1.4 Frequency

The landfill monitoring program consists of three phases, as described in detail below.

1.4.1 Phase I & Phase II

Phase I involved monitoring of conditions to confirm that equilibrium is achieved. The Phase I monitoring at FOX-4 was completed in 2003 and is currently in Phase II monitoring. The frequency of Phase II monitoring is typically downgraded from Phase I. At FOX-4, the Phase II monitoring is being carried out on the following schedule: 2005, 2006, 2007, 2008, 2013, and 2023. Monitoring in Year 23 marks the end of the Phase II monitoring.

1.4.2 Phase III

Phase III involves the monitoring for long term issues such as liner integrity, permafrost stability, and significant storm events. At the end of the Phase II program, 25 years after construction, a re-evaluation

of the landfill monitoring program will be carried out prior to initiating any Phase II program. The scope of the Phase III monitoring program is not included here, but is anticipated to be based on a 10 year monitoring interval.

1.5 Review and Evaluation Process

An Environmental Working Group (EWG) was established to provide a technical report and to support to the DLCU Steering Committee. This working group is comprised of qualified engineering and environmental scientists with expertise in environmental remediation and clean up in northern climates. The EWG has four designated representatives, two from each of the Owner (DND) and the Inuit (through the NTI), respectively.

During the monitoring program, the EWG reviews the results of the monitoring program in accordance with the methodology as described previously. The results of the review and any recommendations regarding changes to the monitoring plan and/or remediation requirements are reported to the DND/NTI Steering Committee.

The requirement for further monitoring after 25 years is evaluated. Monitoring may be terminated if the performance of the landfill was satisfactory over the period of monitoring from an environmental, geotechnical and thermal perspective, as appropriate. The assessment of satisfactory performance is carried out jointly by the NTI and DND.

2.0 Detailed Landfill Monitoring Requirements

The following sections provide a summary and the detailed monitoring requirement for each landfill at FOX-4.

2.1 Helipad Landfills – East and West

The Helipad Landfills are located at the upper site to the west of the Short Range Radar facilities. The long term monitoring of these landfills includes visual inspection to monitor for evidence of settlement or erosion, and periodic collection of soil and groundwater samples to monitor for the presence of leachate. Monitoring Wells Nos. 3 and 4 were installed upgradient of both landfills. Well Nos. 1, 2, and 6 were installed downgradient of Helipad Landfill – West. Only one monitoring well, Well No. 5, was installed downgradient of Helipad Landfill – East, due to access constraints. Table 1 provides the coordinates of the monitoring stations, while Table 2 provides the detailed monitoring requirements at the Helipad Landfills – East and West. See Figure FOX-4.2 for details.

Table 1: Monitoring Station Coordinates at the Helipad Landfills – East and West

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-1 (soil & groundwater)	9839.1	9997.6	382
MW-2 (soil groundwater)	9901.6	9977.5	379
MW-3 (soil & groundwater)	9878.9	10 074.0	398
MW-4 (soil & groundwater)	9930.8	10 040.0	397
MW-5 (soil & groundwater)	9958.9	10 059.0	390
MW-6 (soil & groundwater)	9917.3	10 008.5	390
F4-1 (soil)	9912	10 110	-
F4-17 (soil)	9837	10 013	-
F4-18 (soil)	9855	9980	-
F4-19 (soil)	9880	9972	-
F4-20 (soil)	9975	9942	-

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations. Monitoring well coordinates are as provided by the cleanup contractor's survey.

Table 2: Detailed Monitoring Requirements at the Helipad Landfills – East and West

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
MW-1 → MW-6	Groundwater	Once per year in years 2007, 2008, 2013 and 2023	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-1 → MW-6, F4-1, F4-17 → F4-20	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.2 Barrel Dump

The Barrel Dump is a small landfill located at the upper site, west of the SRR facilities, and the Helipad Landfills East and West. The long term monitoring of this landfill includes visual inspection to monitor for evidence of settlement or erosion, and periodic collection of soil samples to monitor for the presence of leachate. Approximate locations for the collection of soil samples are identified on Figure FOX-4.2. Table 3 provides the landfill monitoring station coordinates and Table 4 provides the details of the landfill monitoring requirements at the Barrel Dump.

Table 3: Monitoring Station Coordinates – Barrel Dump

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
F4-2 (soil)	9980	9960	-
F4-3 (soil)	9976	9942	-
F4-4 (soil)	9990	9942	-
F4-5 (soil)	9979	9934	-
F4-21 (soil)	9970	9966	-
F4-22 (soil)	9969	9948	-
F4-23 (soil)	9978	9923	-
F4-24 (soil)	9964	9962	-

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations. Monitoring station coordinates are as provided by the cleanup contractor's survey.

Table 4: Detailed Monitoring Requirements at the Barrel Dump

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
F4-2 → F4-5; F4-21 → F4-24	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.3 Station Area Landfill

The Station Area Landfill is a new landfill constructed for the disposal of demolition and site wastes generated during the cleanup. The long term monitoring plan consists of visual monitoring for signs of settlement, collection of soil and groundwater samples to evaluate the effectiveness of the leachate containment system. Table 5 provides the coordinates of the monitoring stations and Table 6 provides the detailed monitoring requirements at the Station Area Landfill. See Figure FOX-4.3 for details.

Table 5: Monitoring Station Coordinates at the Station Area Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-7 (soil & groundwater)	9692.0	10422.9	389
MW-8 (soil & groundwater)	9726.8	10297.7	383
MW-9 (soil & groundwater)	9736.8	10338.0	382

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations. Monitoring well coordinates are as provided by the cleanup contractor's survey.

Table 6: Detailed Monitoring Requirements at the Station Area Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
MW-7 → MW-9	Groundwater	Once per year in years 2007, 2008, 2013 and 2023	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-7 → MW-9	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.4 Lower Site Landfill (Non-Hazardous Waste Landfill)

The Lower Site Landfill and DCC Tier II Soil Disposal Area are located near the west end and north of the airstrip, in relatively close proximity to one another. The long term monitoring requirements for the Lower Site Landfill include visual inspection for evidence of settlement, or erosion, and groundwater and soil sampling and analyses. Table 7 provides the coordinates of the monitoring stations and Table 8 provides the detailed monitoring requirements at the Lower Site Landfill. See Figure FOX-4.3 for details.

Table 7: Monitoring Station Coordinates at the Lower Site Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-14 (soil & groundwater)	20096.0	20503.0	23.3
MW-15 (soil & groundwater)	20098.0	20396.0	20.3
MW-16 (soil & groundwater)	20159.4	20449.0	22.5

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations. Monitoring well coordinates are as provided by the cleanup contractor's survey.

Table 8: Detailed Monitoring Requirements at the Lower Site Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
MW-14 → MW-16	Groundwater	Once per year in years 2007, 2008, 2013 and 2023	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-14 → MW-16	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.5 Tier II Soil Disposal Facility

The DCC Tier II Soil Disposal Facility was constructed for the disposal of DCC Tier II contaminated soil excavated from the FOX-4 site. Long term monitoring of the Tier II soil disposal facility consists of visual monitoring for evidence of settlement, erosion, differential movement, collection of soil and groundwater samples from around the facility to monitor the effectiveness of the containment system, and monitoring of sub-surface ground temperatures in the berms and in the main body of the disposal facility. Table 9 provides the coordinates of the monitoring stations and Table 10 provides the detailed monitoring requirements at the Tier II Soil Disposal Facility. See Figure FOX-4.6 for details.

Table 9: Monitoring Station Coordinates at the Tier II Soil Disposal Facility

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
MW-10 (soil & groundwater)	20071.0	20374.8	19.6
MW-11 (soil & groundwater)	20027.3	20374.8	20.1
MW-12 (soil & groundwater)	20011.5	20444.4	20.0
MW-13 (soil & groundwater)	20030.8	20483.1	20.5
T1 (temperature)	20050.0	20388.0	-
T2 (temperature)	20062.0	20410.0	-
T3 (temperature)	20043.0	20417.0	-
T4 (temperature)	20071.0	20042.0	-
T5 (temperature)	20031.0	20453.0	-
T6 (temperature)	20048.0	20448.0	-

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations. Monitoring well and thermistor coordinates are as provided by the cleanup contractor's survey.

Table 10: Detailed Monitoring Requirements at the Tier II Soil Disposal Facility

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
MW-10 → MW-13	Groundwater	Once per year in years 2007, 2008, 2013 and 2023	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-10 → MW-13	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury
T1 → T6	Thermal	Once per year in years 2007, 2008, 2013 and 2023	Temperature

2.6 Airstrip Landfill

The Airstrip landfill is located at the lower site on high ground south of the east end of the Airstrip. The long term monitoring plan for this landfill includes visual inspection to monitor for evidence of settlement and/or erosion, and periodic collection of soil samples to monitor for the presence of leachate. Table 11

provides the coordinates of the monitoring stations and Table 12 provides the detailed monitoring requirements at the Tier II Soil Disposal Facility. See Figure FOX-4.5 for details.

Table 11: Monitoring Station Coordinates at the Airstrip Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
F4-8 (soil)	19515	21088	-
F4-9 (soil)	19632	21100	-
F4-10 (soil)	19592	21052	-
F4-25 (soil)	19 589	21 071	-

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations.

Table 12: Detailed Monitoring Requirements at the Airstrip Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
F4-8 → F4-10; F4-25	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.7 Tanner Bay Landfill

The Tanner Bay landfill is located at the original beach landing area for the site, along Tanner Bay. The long term monitoring plan for this landfill includes visual inspection to monitor for evidence of settlement and/or erosion, and periodic collection of soil samples to monitor for the presence of leachate. Table 13 provides the coordinates of the monitoring stations and Table 14 provides the detailed monitoring requirements at the Tanner Bay. See Figure FOX-4.6 for details.

Table 13: Monitoring Station Coordinates at the Tanner Bay Landfill

Landfill Monitoring Station	Coordinates		Elevation (masl)
	North (m)	East (m)	
F4-11 (soil)	830	920	-
F4-12 (soil)	845	960	-
F4-13 (soil)	852	930	-

NOTE: Coordinates are referenced to a local site grid and are approximate only for the soil sampling locations.

Table 14: Detailed Monitoring Requirements at the Tanner Bay Landfill

Location	Sample Type	Frequency	Parameters
Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 2007, 2008, 2013 and 2023	N/A
F4-11 → F4-13	Soil	Once per year in years 2007, 2008, 2013 and 2023	PCBs
			TPH as F1 (C_6-C_{10})
			TPH as F2 (C_{10}-C_{16})
			TPH as F3 (C_{16} - C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

Appendix A

Figures

Site Plan
Figure FOX-4.1 – Overall Site Plan
Figure FOX-4.2 – Station Area West
Figure FOX-4.3 – Station Area Landfill
Figure FOX-4.4 – DCC Tier II Soil Disposal Area and Lower Site Landfill
Figure FOX-4.5 – Airstrip Landfill
Figure FOX-4.6 – Tanner Bay Landfill

LANDS OUTSIDE OF THE BOUNDARIES ARE UNDER DIAND JURISDICTION

Monument

Custodian: DIAND

Road
Land Reservation to DND

PARCEL A

Custodian: DND

Radar Site
Transfer of Administration

PARCEL B

PARCEL E

PARCEL D

Custodian: DND

Water Lot
Transfer of Administration

Custodian: DND

Runway
Transfer of Administration

PARCEL C

RESERVED FOR DND

Custodian: DND

Beachhead
Transfer of Administration

Custodian : DIAND

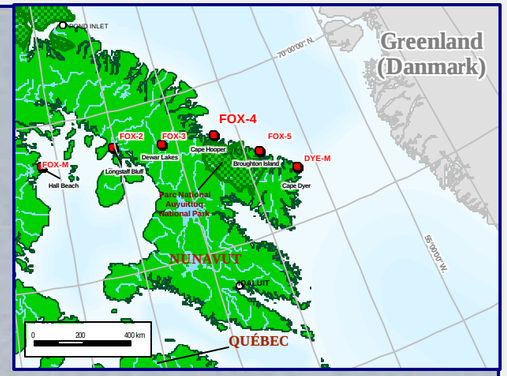
Reserve requested by DND 56/01/18
Established by DIAND 56/01/26

75 96000m. N.

75 92000m. N.

594000m. E.

586000m. E.



Version 2.0

FOX-4

CAPE HOOPER

FINAL

- Reserved for DND / Réservé pour le MDN
- Parcel A / Parcelle A
- Parcel B / Parcelle B
- Parcel C / Parcelle C
- Parcel D / Parcelle D
- Parcel E / Parcelle E
- National Park / Parc National

Background information : Topographic map 27 A (Scale: 1: 250 000). UTM Zone 19.
Produced by the Surveys and Mapping Branch
Department of Energy, Mines and Resources, Ottawa, 1980.

Carte de base : carte topographique 27 A (Échelle 1 : 250 000). Zone UTM 19.
Publié par la Direction des levés et de la cartographie
Ministère de l'énergie, des mines et des resources, Ottawa, 1980.

N W E S

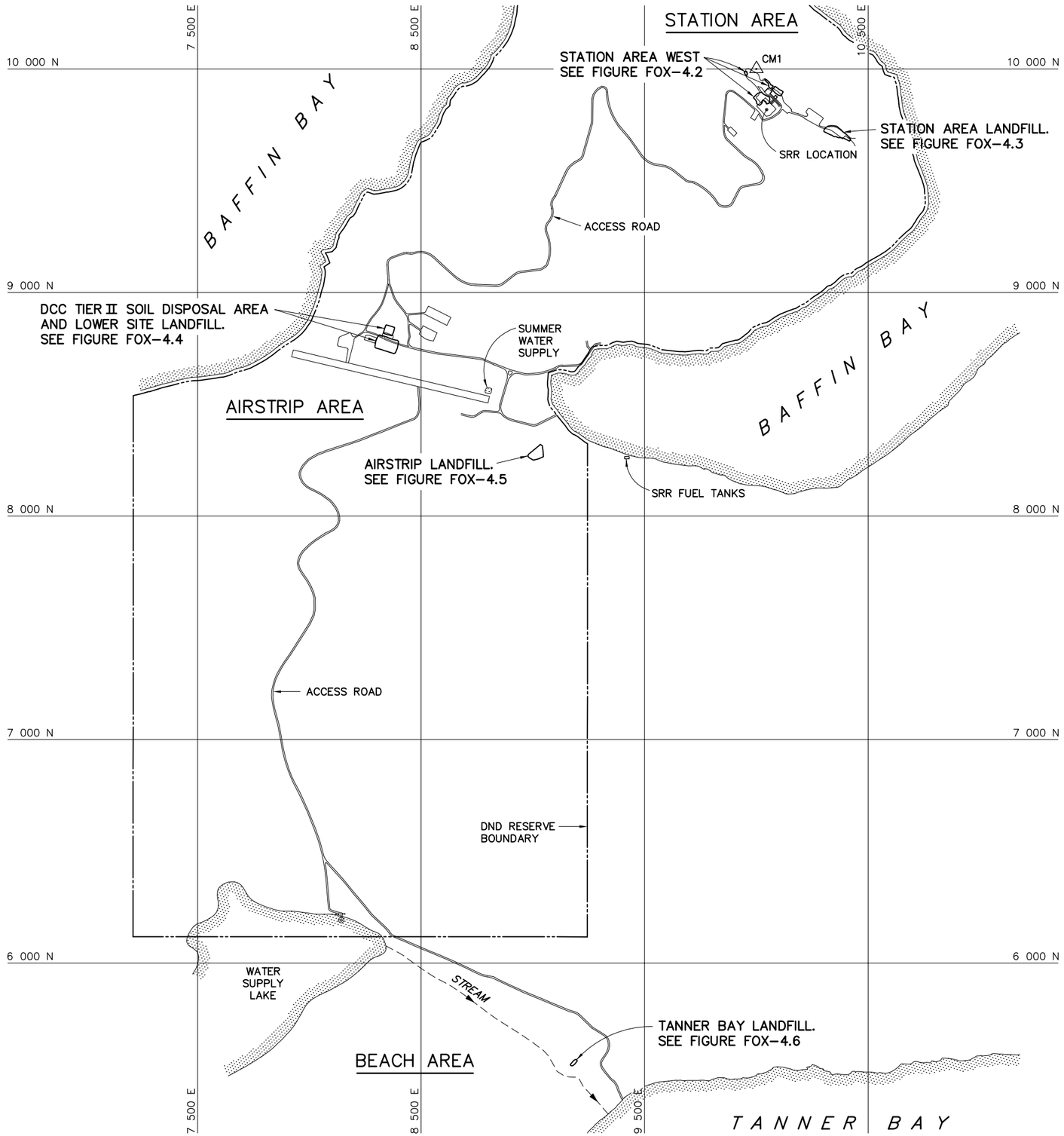
Scale / Échelle : 1 : 27 500

0 1 2 km

This map is to be used for presentation purposes only.
This map is not a legal survey document.

Cette carte devrait être utilisé à des fins de présentation seulement.
Cette carte n'est pas un document d'arpentage légal.

Produced by: Real Property Geomatics Services, Real Property Services Branch, PWGSC, March, 2003.
Produit par: Services géomatiques immobiliers, Service des biens immobiliers, TPSGC, mars 2003.



LEGEND:

CM1 △ SURVEY CONTROL MONUMENT

SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
CM1	10 000.000	10 000.000	397.575	FOX–4 BASELINE STA. 0+00
				(LEAD PLUG IN ROCK)

0 200 400 600m

200 100 1:20000

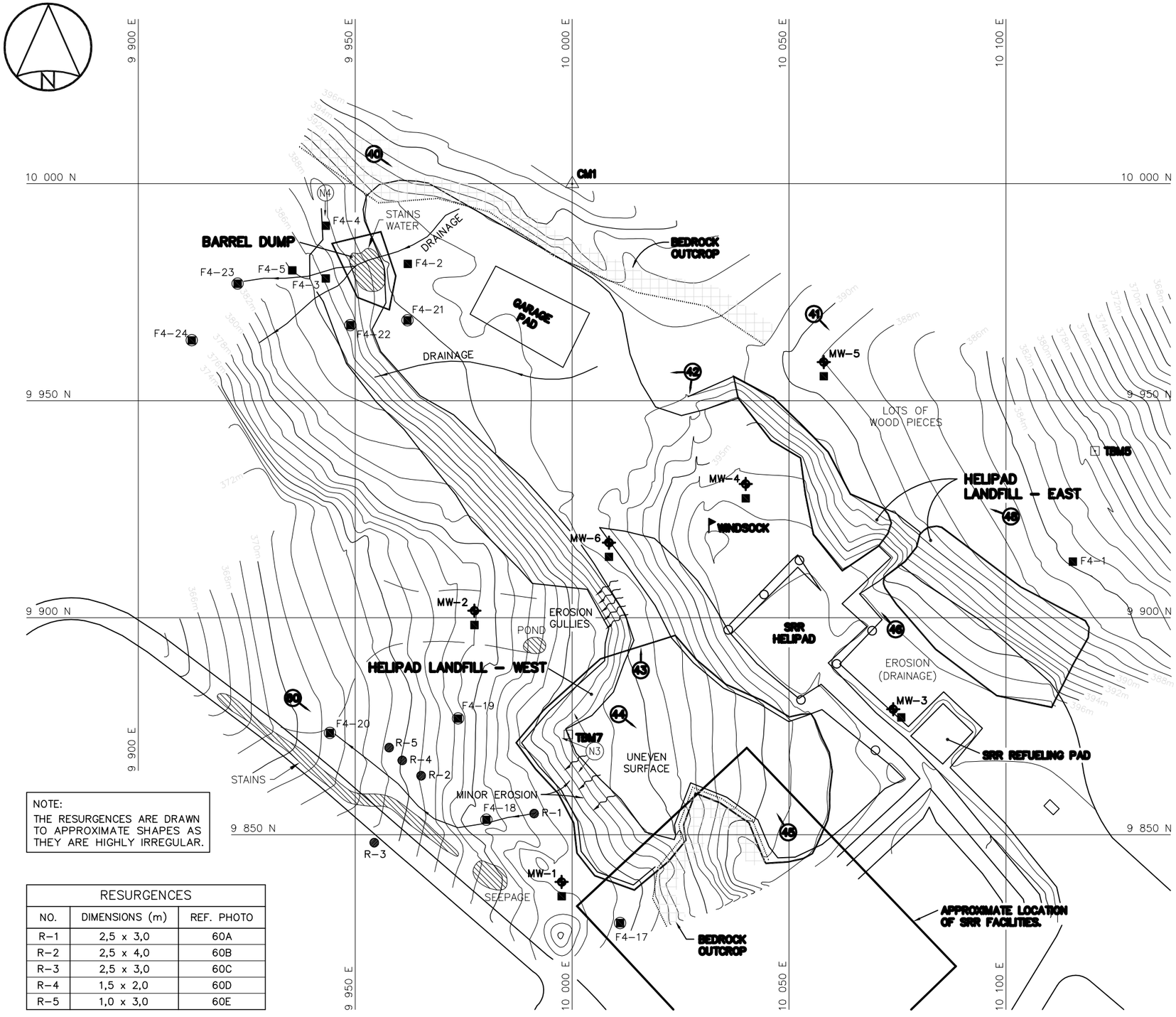
DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

OVERALL SITE PLAN

FIGURE FOX-4.1

DGN NAME: F4–R001.DWG IC – 02/05/27



LEGEND:

- SURVEY CONTROL MONUMENT (CM1)
- TEMPORARY BENCHMARK (TBM5)
- MONITORING WELL LOCATION
- MONITORING SOIL SAMPLE LOCATION
- NEW MONITORING SOIL SAMPLE LOCATION
- RESURGENCE
- PHOTOGRAPHIC VIEW POINT (APPROXIMATE LOCATION)

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
5	9 938.442	10 120.491	388.170	CROSS CUT IN ROCK
7	9 873.107	9 999.103	388.170	NAIL

SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
CM1	10 000.000	10 000.000	397.575	FOX–4 BASELINE STA. 0+00

MONITORING WELLS		
NO.	COORDINATES	
	NORTHING	EASTING
MW–1	9 839.1	9 997.6
MW–2	9 901.6	9 977.5
MW–3	9 878..9	10 074.0
MW–4	9 930.8	10 040.0
MW–5	9 958.9	10 058.0
MW–6	9 917.3	10 008.5

NOTE:
THE RESURGENCES ARE DRAWN TO APPROXIMATE SHAPES AS THEY ARE HIGHLY IRREGULAR.

RESURGENCES		
NO.	DIMENSIONS (m)	REF. PHOTO
R–1	2,5 x 3,0	60A
R–2	2,5 x 4,0	60B
R–3	2,5 x 3,0	60C
R–4	1,5 x 2,0	60D
R–5	1,0 x 3,0	60E

0 10 20 30m
10 5 1:1000

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

STATION AREA WEST

FIGURE FOX-4.2

MONITORING WELLS		
NO.	COORDINATES	
	NORTHING	EASTING
MW-7	9 692.0	10 422.9
MW-8	9 726.2	10 297.7
MW-9	9 736.8	10 338.0

COORDINATE POINTS			
NO.	NORTHING	EASTING	ELEV.
101	9 721.3	10 358.1	386.3
102	9 704.3	10 390.6	386.0
103	9 691.0	10 385.5	386.8
104	9 696.5	10 347.8	386.3

LEGEND:

- TBM3 ⊡ TEMPORARY BENCHMARK
- ⌖ MONITORING WELL LOCATION
- 101→ COORDINATE POINT
- ■ MONITORING SOIL SAMPLE LOCATION
- PHOTOGRAPHIC VIEW POINT (APPROXIMATE LOCATION)

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
3	9 695.382	10 473.854	398.519	CROSS CUT IN ROCK
4	9 833.172	10 278.429	394.655	CROSS CUT IN ROCK

TBM4 ⊡

ZONE OF SETTLEMENT MANY SINKHOLES

POOLING AREA

STATION AREA LANDFILL

MW-9 ■

MW-8 ■

MW-7 ■

DITCH

FUEL SHEEN AND FUEL ODOUR DETECTED

WAREHOUSE FOUNDATION

LOTS OF SMALL SINKHOLES (TYPICAL FOR 3)

N1

N2

101

102

103

104

STAINED AREA (HYDROCARBON ODOUR GROUND IS BLACK)

IMPOSSIBLE TO LOCATE (2003)

TBM3 ⊡

UPPER SITE DUMP AREA

52 (03-08-11)

10 300 E | 10 350 E | 10 400 E | 10 450 E | 10 500 E | 10 550 E

9 800 N | 9 750 N | 9 700 N | 9 650 N

0 10 20 30m

10 5 1:1000

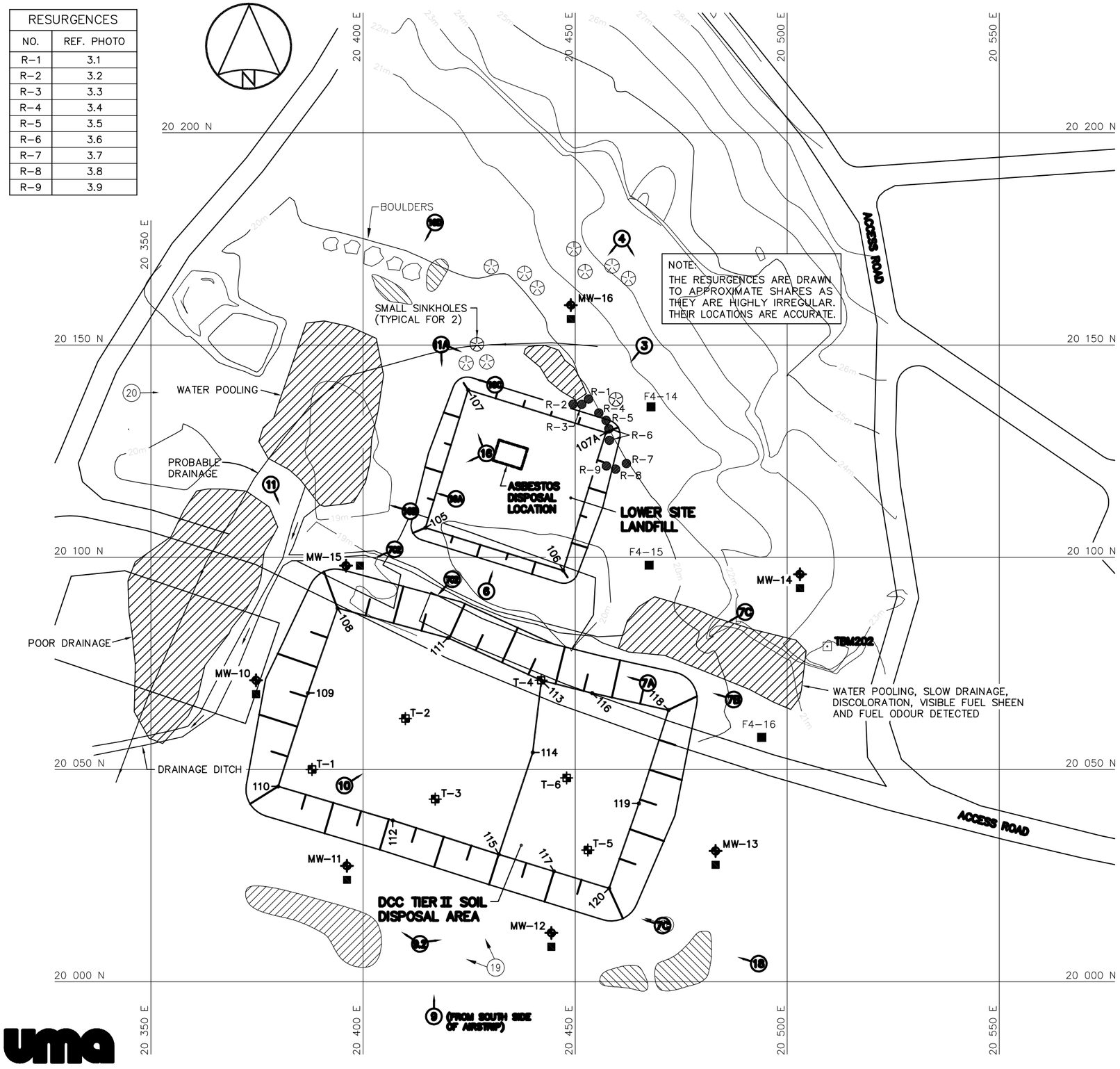
DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

STATION AREA LANDFILL

FIGURE FOX-4.3

RESURGENCES	
NO.	REF. PHOTO
R–1	3.1
R–2	3.2
R–3	3.3
R–4	3.4
R–5	3.5
R–6	3.6
R–7	3.7
R–8	3.8
R–9	3.9



LEGEND:

- TBM202 — TEMPORARY BENCHMARK
- MONITORING WELL LOCATION
- 105 — COORDINATE POINT
- VERTICAL THERMISTOR
- MONITORING SOIL SAMPLE LOCATION
- RESURGENCE
- PHOTOGRAPHIC VIEW POINT (APPROXIMATE LOCATION)

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEV.	DESCRIPTION
	NORTHING	EASTING		
202	20 079.007	20 509.423	24.110	19mm DIA. PIPE

MONITORING WELLS		
NO.	COORDINATES	
	NORTHING	EASTING
MW–10	20 071.0	20 374.8
MW–11	20 027.3	20 396.2
MW–12	20 011.5	20 444.4
MW–13	20 030.8	20 483.1
MW–14	20 096.0	20 503.0
MW–15	20 098.0	20 396.0
MW–16	20 159.4	20 449.0

VERTICAL THERMISTORS		
NO.	COORDINATES	
	NORTHING	EASTING
T–1	20 050.0	20 388.0
T–2	20 062.0	20 410.0
T–3	20 043.0	20 417.0
T–4	20 071.0	20 442.0
T–5	20 031.0	20 453.0
T–6	20 048.0	20 448.0

COORDINATE POINTS							
NO.	NORTHING	EASTING	ELEV.	NO.	NORTHING	EASTING	ELEV.
108	20 088.0	20 394.0	22.10	115	20 030.0	20 432.0	22.04
109	20 068.0	20 387.0	22.65	116	20 068.0	20 454.0	22.34
110	20 046.0	20 380.0	21.89	117	20 026.0	20 445.0	22.34
111	20 081.0	20 420.0	22.30	118	20 064.0	20 472.0	22.31
112	20 038.0	20 407.0	22.00	119	20 042.0	20 465.0	22.60
113	20 071.0	20 442.0	22.28	120	20 022.0	20 458.0	22.01
114	20 054.0	20 440.0	22.75				

COORDINATE POINTS			
NO.	NORTHING	EASTING	ELEV.
105	20 107	20 415	21.0
106	20 097	20 447	21.3
107	20 139	20 425	21.1
107A	20 129	20 457	21.6

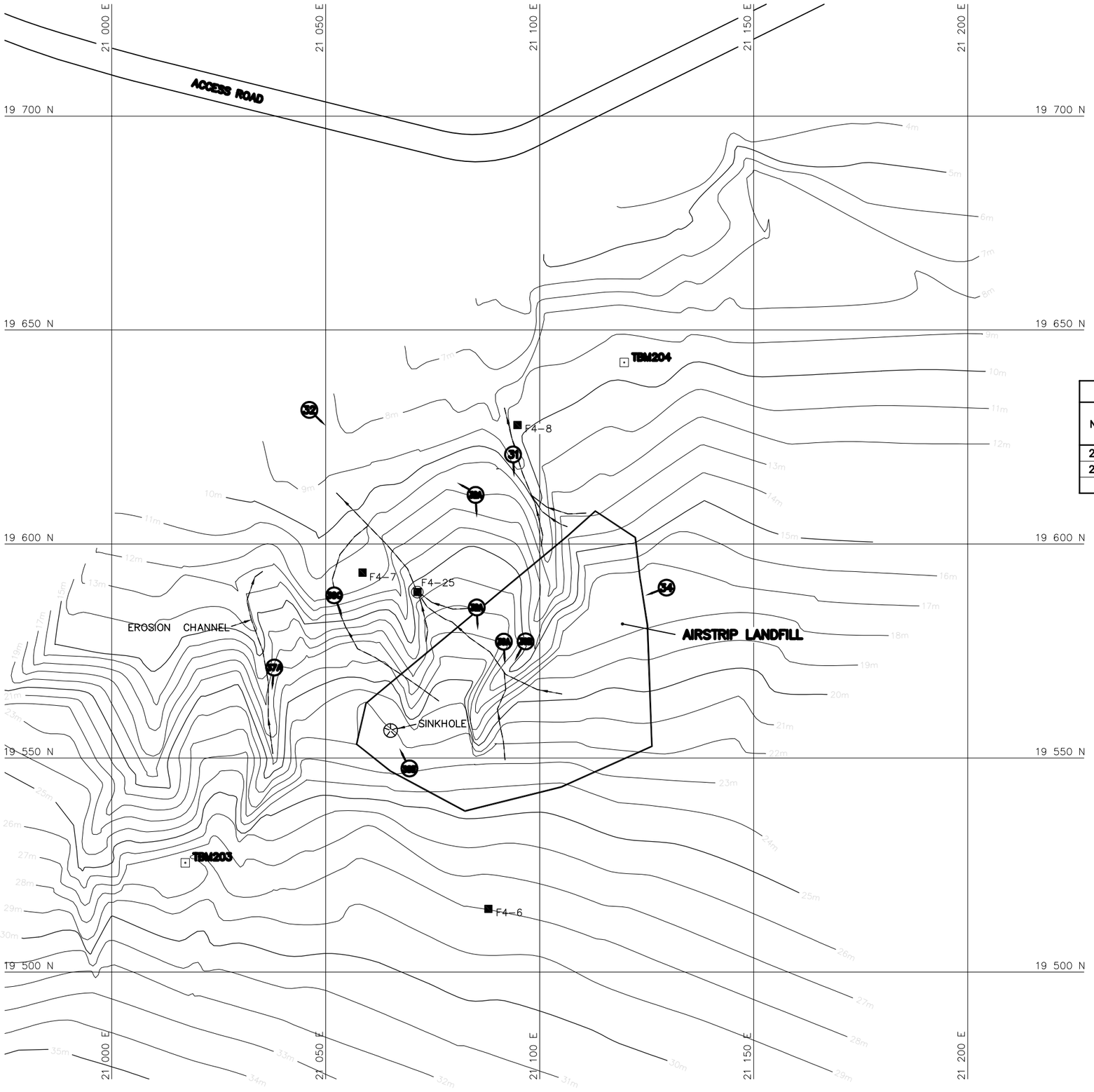
0 10 20 30m
10 5 1:1000

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

DCC TIER II SOIL DISPOSAL AREA AND LOWER SITE LANDFILL

FIGURE FOX-4.4



LEGEND:

- TBM203 ⊡ TEMPORARY BENCHMARK
- ■ MONITORING SOIL SAMPLE LOCATION
- ◙ NEW MONITORING SOIL SAMPLE LOCATION
- PHOTOGRAPHIC VIEW POINT (APPROXIMATE LOCATION)

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
203	19 525.545	21 017.155	28.241	19mm DIA. PIPE/STONE CAIRN
204	19 642.453	21 119.708	10.019	19mm DIA. PIPE/STONE CAIRN

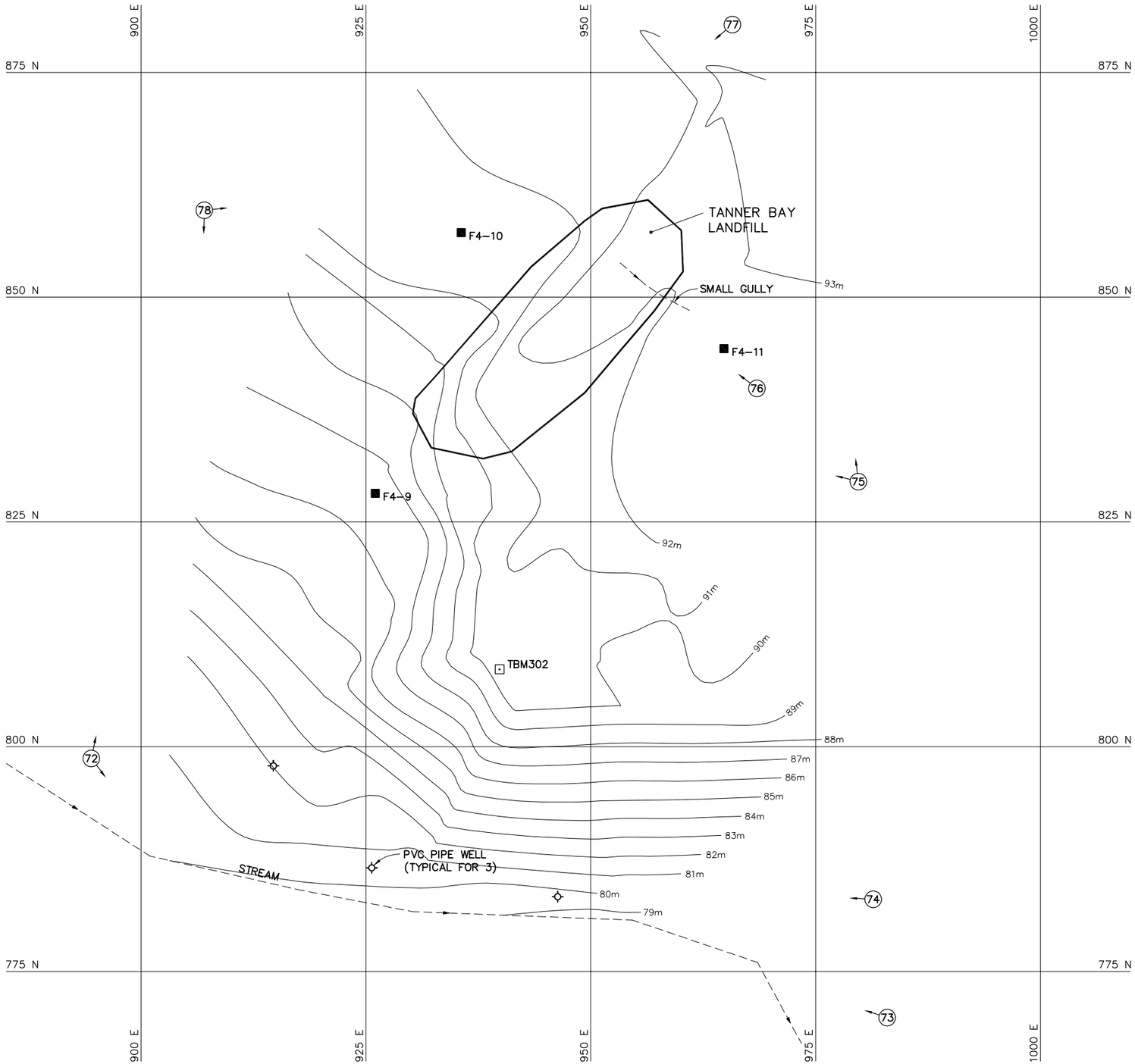
0 10 20 30m
10 5 1:1000

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

AIRSTRIP LANDFILL

FIGURE FOX-4.5



LEGEND:

- TBM302 ⊡ TEMPORARY BENCHMARK
- ■ MONITORING SOIL SAMPLE LOCATION
- PHOTOGRAPHIC VIEW POINT (APPROXIMATE LOCATION)

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEV.	DESCRIPTION
	NORTHING	EASTING		
302	808.603	939.857	90.944	19mm DIA. PIPE/STONE CAIRN

0 5 10 15m
5 2.5 1:500

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

FOX-4 - CAPE HOOPER

TANNER BAY LANDFILL

FIGURE FOX-4.6

DGS NAME: F4-R006.DWG IC - 02/05/28