



UNCLASSIFIED



DYE-M LANDFARM DESIGN AND MANAGEMENT PLAN

Contract # W8485-100224/001/NX

Document Number
PLN-EHS-18, Rev 3, 5-Oct-2021

Prepared for
North Warning System & Assoc. Projects
Aerospace Equipment Program Directorate
455 Blvd de la Carrière
11th Floor
Gatineau, Québec
K1A 0K2

Prepared by



400 Cooper Street
Suite 3000
Ottawa, ON, K2P 2H8

Warning: Information Subject to Export Control Laws — This document (and/or software, if applicable) may contain export-restricted data whose export/transfer/disclosure is restricted by U.S. and Canadian law. Dissemination to non U.S. persons whether in United States or abroad requires an export license or other authorizations from the United States and Canadian Governments.

UNCONTROLLED WHEN PRINTED



CHANGE HISTORY

This sheet is a record of each issue of this document. When the revised document is issued, the previous issue is automatically superseded.

Revision	Date	Author	Pages Changed	Reason for Change
1	17-Oct-2018	W. Wyman	All	New Document
2	7-Dec-2020	J. Berube	All	Updated with new Raytheon logo
3	5-Oct-2021	A. Leslie	All	Updates throughout for consistency with other plans. Updated CCME criteria and wastewater discharge criteria.

UNCONTROLLED WHEN PRINTED



TABLE OF CONTENTS

Change History	2
Table of Contents	3
List of Tables.....	3
1.0 Introduction	4
1.1 Overview.....	4
2.0 General Information	4
2.1 Climate	4
2.2 Geology	4
2.3 Surficial Deposits	4
3.0 Location and Construction of Facilities	5
3.1 Location	5
3.2 Construction	5
4.0 Landfarm Management.....	5
4.1 General.....	5
4.2 Health and Safety	5
4.3 Operation	6
4.4 Environmental Control	6
4.5 Landfarm Closure	6
5.0 References.....	7
Annex A: DYE-M Site Plan and Proposed Landfarm Location	8
Annex B: CCME Criteria	9
Annex D: Wastewater Discharge Criteria	10

LIST OF TABLES

Table 1: CCME - Canadian Soil Quality Guidelines	9
Table 2: Wastewater Discharge Criteria	10



1.0 INTRODUCTION

1.1 Overview

The North Warning System Office (NWSO) occasionally has a requirement to remediate spills on-site. Given the effort involved, landfarming impacted soil will only be considered where it is the best option for remediating a spill (e.g. treating the soil from a large spill instead of shipping it off-site for treatment). This is a general plan for the construction and operation of a landfarm for hydrocarbon-impacted soil at DYE-M, Cape Dyer. JET-A1 fuel is the main fuel used on the North Warning System (NWS) so it is the most common hydrocarbon contaminant in soil.

During any field season requiring an active landfarm at DYE-M-M the NWSO, or the NWS operations and maintenance contractor, intends on having a contract in place to allow for the excavation of all contaminated soils; preparation of a engineered landfarm to receive and remediate contaminated soil; conduct confirmatory soil sampling to ensure all contamination is removed according to the CCME commercial standard for coarse-grained soil; back-fill and grade excavated areas; and, till contaminated soil until remediated to the CCME commercial standard for coarse-grained soil (Annex B). Confirmatory sampling will be conducted during tilling to ensure the remediation target is met or exceeded; and at which time the landfarm will be decommissioned.

2.0 GENERAL INFORMATION

The terrain is rugged and boulder strewn with very little soil, consisting of mostly silt. Vegetation on the upper site is sparse, consisting of grass, wildflowers, mosses, and lichen. Vegetation at the lower site is more abundant consisting of wildflowers, creeping willows, and sedges. Several small ice fields exist within five miles of the site.

2.1 Climate

The total mean annual rain and snowfall are 98.4 mm and 566.2 cm, respectively with a total average annual precipitation of 602 mm. Generally September to November, receive the most precipitation. The mean annual temperature is -11°C, with the warmest month being July and the coldest months being January to March.

2.2 Geology

The mountainous terrain and the sheer cliffs, some over 610 m high, along the coastline are the most prominent features of the site.

The terrain at DYE-M varies from:

- a narrow coastal region along the southwest;
- to broad glacial U-shaped valleys and sub-rounded hills in the interior; and
- to boulder covered volcanic and metamorphic uplands.

2.3 Surficial Deposits

The drift is generally coarse textured consisting mostly of cobble, gravel, and sand with variable silt and clay content. Boulders are generally rare in the valley floor tills but become increasingly more common at higher elevations. Bedrock within the area is confined largely to the area of the main site facilities. It consists mostly of granite metasediments and volcanic rock.



3.0 LOCATION AND CONSTRUCTION OF FACILITIES

3.1 Location

The proposed location for the construction of a landfarm facility at DYE-M was based on the location of the previous landfarm facility, which was constructed during the DEW Line Clean Up Project to remediate hydrocarbon-contaminated soil. Annex A contains a site map identifying the location of the landfarm. Originally, the selection of this site was chosen for the level area, which was present; also, the design of a landfarm took into account several other factors, including geotechnical suitability, which considers topography, soil conditions, natural drainage in the area, depth to bedrock or permafrost, groundwater, and adverse soil conditions that may affect permafrost and potential containment. Environmental considerations weighed heavily in the consideration for the location of the landfarm, these include the footprint of area required; the distance from ecologically sensitive areas, including marine and freshwater systems; the distance from water supplies; contaminated soil areas; geotechnical suitability; and the accessibility of the landfarm location during the remediation work.

3.2 Construction

During the construction of the landfarm facility berms will be created around the area that will contain the contaminated soil. The berms and the base of the facility will be heavily compacted to a level of 95% compaction; this will reduce the permeability of the granular fill. Once the facility has been prepared, the excavated hydrocarbon contaminated soil will be added and spread in a thin layer of 0.4 m thickness and treated to facilitate a reduction in hydrocarbon concentrations through biodegradation and volatilization.

Remediation of contaminated soil by landfarming typically involves the addition of nutrients and water to the soil, followed by tilling to aerate the soil and stimulate microbial activity.

4.0 LANDFARM MANAGEMENT

4.1 General

In the event that the landfarm is actively used, the focus will be safety and environmental responsibility.

Landfarming typically involves the following:

1. Preparation of a engineered landfarm to receive and remediate contaminated soil;
2. Excavation of all contaminated soils;
3. Soil sampling of excavated material to characterize contaminants of concern;
4. Soil sampling of the base and side walls of the excavation to ensure all contamination is removed;
5. Back-fill and grade excavated areas;
6. Till contaminated soil within the landfarm until remediated to the appropriate CCME soil guideline (see Annex B for details);
7. Soil sampling will be conducted to ensure the remediation target is met; and,
8. Decommissioning of the landfarm.

4.2 Health and Safety

Employees working in the landfarm will be trained prior to commencement of work so that they are aware of the health and safety risks and mitigation measures. The landfarm is not easily accessible to the public.

There are four primary exposure pathways to chemicals within the landfarm:

UNCONTROLLED WHEN PRINTED



- a. Inhalation;
- b. Ingestion;
- c. Skin contact; and
- d. Eye contact.

Because the landfarm is outside in open air, inhalation exposure can be mitigated. Ambient air concentrations of volatile organic compounds (VOCs) will be monitored periodically using a photoionizing detector (PID). In the case that PID readings are elevated respirators with combination filters will be worn.

Incidental ingestion, as well as skin and eye contact, will be prevented through appropriate worker training and personal protective equipment (PPE).

4.3 Operation

Prior to placing new material in the landfarm it will be characterized to ensure any contaminants of concern are appropriate for landfarming. Soil will then be placed into the landfarm cells in an even layer, ideally 30 to 75 cm thick.

After placing contaminated soil granular nutrients may be distributed over the surface. Moisture conditioning may be conducted, as required, by application of water spray to maintain optimum water content within the soil.

After application of nutrients, the full thickness of the soil may be tilled every five to ten days. During periods of heavy precipitation, tilling of the soil will be delayed until the soil is considered damp to a depth of 100 mm.

4.4 Environmental Control

Water runoff is captured within the landfarm due to the impervious liner and berms. In the event that water discharge is necessary water will be sampled and analyzed, prior to discharge, to ensure it meets the wastewater discharge criteria (see Table C-1 in Annex C).

The landfarm will be monitored weekly during summer months by the contractor to ensure proper operating conditions of soil moisture and aeration (i.e., moisture content around 5%, uncompacted soil). Soil samples will be routinely collected and analyzed at a CALA-accredited laboratory to ensure that concentrations of hydrocarbons are decreasing. Headspace vapour readings using a PID may aid in determining frequency of laboratory analysis.

Corrective maintenance to the landfarm facility will be noted during weekly inspections, and any repairs will be carried out promptly. The nature of the repairs required and when repairs were completed will be recorded in the weekly report.

Prior to exiting the landfarm, equipment will be cleaned off to ensure that contaminated soil is not spread outside the landfarm.

4.5 Landfarm Closure

Once the soil in the landfarm facility has been remediated to the CCME Canadian Soil Quality Standards, commercial coarse-grained soil, (CCME, 1999 r. 2018), (CCME, 2001 r. 2008) (see Annex B, Table B-1), and confirmatory testing of the soils verifies that the remediation objectives have been reached, the landfarm may be decommissioned.



Any wastewater will be sampled and analyzed to ensure that prior to discharge all wastewater conforms to Wastewater Discharge Criteria. Wastewater above the criteria will either be treated on site, or containerized for off-site disposal.

Remediated soil will be used as backfill in an area that is compatible with the selected guideline and land use type. If the landfarm is no longer required the perimeter berms will be regraded to prevent ponding within the former landfarm. Final grading will promote drainage away from the site and will match the surrounding terrain.

5.0 REFERENCES

- CCME. (1999 r. 2018). *Canadian Environmental Quality Guidelines*. Retrieved February 1st, 2021, from Canadian Council of Ministers of the Environment (CCME): <http://st-ts.ccme.ca/>
- CCME. (2001 r. 2008). *Canada Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil*. Canadian Council of Ministers of the Environment (CCME).
- CCME. (2008). *Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil Technical Supplement*. Canadian Council of Ministers of the Environment (CCME).
- Defence Construction Canada. (2017). *FOX-3 Landfarm Management Plan 2017*.
- ECCC. (2014). *1981-2010 Climate Normals and Averages*. Retrieved from Environment Canada and Climate Change (ECCC): https://climate.weather.gc.ca/climate_normals/index_e.html
- FCSAP. (2013). *Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils*. Federal Contaminated Sites Action Plan (FCSAP).
- GN. (1999 r. 2009). *Environmental Guideline for Contaminated Site Remediation*. Department of Environment, Government of Nunavut (GN).
- GSC. (2011). *Geological map of the Arctic (2159A)*. Geological Survey of Canada (GSC).
- INAC. (2008). *Abandoned Military Site Remediation Protocol: Volume I - Main Report*. Indian and Northern Affairs Canada (INAC), Northern Affairs Organization, Contaminated Sites Program.
- NRCAN. (1995). Canada Permafrost (MCR 4177). In *The National Atlas of Canada 5th Edition*. Natural Resources Canada (NRCAN).



ANNEX B. CCME CRITERIA

Table 1: CCME guidelines for coarse-grained soil (Canadian Soil Quality Guidelines (CCME, 1999 r. 2018) and Canada-Wide Standards for PHC in Soil (CCME, 2001 r. 2008))

Grouping	Parameter	Land Use: Commercial	Land Use: Industrial
Metals and Inorganics	Arsenic	12	12
	Barium	2000	2000
	Cadmium	22	22
	Chromium (total)	87	87
	Copper	91	91
	Cobalt	300	300
	Lead	260	600
	Mercury	24	50
	Nickel	89	89
	Zinc	410	410
PHCs	PHCs F1 (C6 to C10)	320	320
	PHCs F2 (C>10 to C16)	260	260
	PHCs F3 (C>16 to C34)	1700	2500
	PHCs F4 (C>34 to C50+)	3300	6600
VOCs	Benzene	0.03	0.03
	Toluene	0.37	0.37
	Ethylbenzene	0.082	0.082
	Xylene	11	11
Other	Phenol	3.8	3.8
	PCBs	33	33
<i>Grey Italic</i> – Indicates the industrial and commercial guidelines are the same Units: mg/kg			

Notes:

- Guideline values for PHCs are in reference to the Canada-Wide Standards for PHC in Soil (CCME, 2001 r. 2008). The other values are in reference to the Canadian Soil Quality Guidelines (CCME, 1999 r. 2018).
- Guideline values for PHCs refer to surface soils (between 0 and 3 mbgs) (CCME, 2008).
- Parameter groups recommended by FCSAP (2013) for spills of unleaded gasoline, leaded gasoline and/or aviation gasoline include: metals and inorganics, PHCs and VOCs. These parameters may be used for the initial screening to establish contaminants of concern. Additional parameters, such as the ones listed as "Other", may be used if other contaminants are suspected. If containments of concern are established confirmatory sample analysis may only include specific parameters.

**ANNEX C. WASTEWATER DISCHARGE CRITERIA****Table 2: Wastewater Discharge Criteria Nunavut Water Board licence No. 8BC-DYE1929, Part D.**

Parameter	Wastewater Discharge Criteria (µg/L)
pH	6 to 9 (units)
Oil and Grease	5000
Arsenic (total)	100
Cadmium (dissolved)	10
Chromium (dissolved)	100
Cobalt (dissolved)	50
Copper (dissolved)	200
Lead (dissolved)	50
Mercury (total)	0.6
Nickel (dissolved)	200
PCB (total)	1000
Phenols	20
Zinc (total)	500
Benzene	370
Toluene	2
Ethylbenzene	90