



Submitted via efile Electronic Document Submission

September 30, 2021

Secretary of the CER
Canada Energy Regulator
Suite 210, 517 10th Avenue SW
Calgary, Alberta, T2R 0A8

To Whom It May Concern –

Re: Application for Amendment to Norman Wells Operations (NWO) Operations Authorization (OA) 1210-001 for Construction and Operation of a Waste Management Facility (WMF)

Enclosed please find Imperial's application for an amendment application to Operations Authorization (OA) 1210-001 to construct and operate a Waste Management Facility (WMF) associated with the Imperial Oil (Imperial) Norman Wells Operation (NWO). A WMF is an integral part of the approved Interim Closure and Reclamation (ICRP) Plan for the NWO, and as such, supports continued progressive reclamation efforts that Imperial is undertaking during the period leading up to closure and the broader Conservation and Reclamation (C&R) scope post-closure.

The application form has been developed based on Imperial's review of the CER's guidance for the development of OA applications, the outcomes of Imperial's discussions with the CER during the summer and fall of 2020 and ongoing project development, permitting and approvals activity related to the WMF. It also follows the outline in the pre-application memo which was submitted to the CER in June 2021. The CER file for this project is OF-EP-GEN-PA-1047.

If you have any questions or concerns, please contact Colson Foster at (587) 476-3502 or email colson.foster@esso.ca.

Yours truly,

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Application to Amend Canadian Energy Regulator Operations Authorization OA-1210-001 to Incorporate a Waste Management Facility

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September 2021
CE04944

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

1.1.1 Purpose of Document

Canadian Energy Regulator (CER) has advised that an Operations Authorization (OA) pursuant to the Canada *Oil and Gas Operations Act* will be required for the Waste Management Facility (WMF) that has been proposed as an integral component of the Interim Closure and Reclamation Plan (ICRP) for Imperial's Norman Wells Operations (NWO). The WMF will be used for the long term and secure containment of non-treatable soils and wastes generated by closure and reclamation activities on the NWO. Development of the WMF has been initiated in advance of the broader Closure and Reclamation (C&R) Plan because it is required to support the progressive reclamation efforts that Imperial is currently undertaking and will continue to progress during the period leading up to closure.

This document forms Imperial's application for an amendment to the existing NWO OA-1210-001 (NEB 2014) to incorporate construction and operation of the WMF. The form of this application has been developed on the basis of Imperial's review of the CER's guidance for the development of OA applications, the outcomes of Imperial's discussions with the CER during the summer and fall of 2020 and ongoing Project development, permitting and approvals activity related to the WMF. It also follows the outline in the pre-application memo which was submitted to the CER in June 2021.

1.1.2 Amendment Scope

The OA amendment describes the construction of both proposed phases of the WMF (i.e., near term (Phase 1) and final build-out (Phase 2)) and all ancillary infrastructure (e.g., monitoring systems, access roads, drainage structures). Movement of impacted soils and waste materials on the NWO into the WMF structure is also described. Elements of the broader C&R Plan scope beyond those directly associated with WMF construction are not included.

Given the degree of alignment between the current OA scope and the proposed WMF construction activity, Imperial has developed the OA amendment application adopting much of the current OA content. The amendment application focuses on the application of current management systems to the particular features of the WMF scope and describes any supplements to current OA content needed to fully address that scope.

1.2 Project Scope

This document includes a detailed Project description that outlines:

- how the WMF concept was selected within the context of the broader ICRP for the NWO;
- the WMF's capacity and key design elements and capabilities;
- the scope and methods proposed for removing and relocating the soils and waste materials that will be directed to the WMF;
- plans for monitoring, operating and maintaining the WMF during and after construction;

- the current design development status of the WMF and future plans for advancing the facility's design; and
- execution concepts for both phases of WMF development.

1.2.1 Waste Management Facility Concept Selection

A comprehensive consideration of alternatives for managing the inventory of non-treatable materials at the NWO determined that on-site disposition via a secure, earth base containment structure (i.e., the WMF) is the most effective method of meeting the Project objectives. The following sections describe the key elements of the WMF structure.

1.2.2 Waste Management Facility Design Volumes

- There are a range of potential material volumes that could ultimately be directed to the WMF. To accommodate this uncertainty in material volumes, the WMF scope describes an initial phase (Phase 1) and two potential outcomes for the second phase (Phase 2) to describe a minimum and maximum potential footprint. It is anticipated that the final Phase 2 footprint will fall somewhere between these two limits. These WMF configurations are summarized as follows: Phase 1 WMF Development: this first phase of WMF development is planned for the near term (i.e., prior to closure) and involves consolidation of the Mainland Sump (MLS) area materials within the WMF along with that proportion of accessible Mainland area soils needed to dry and condition the sump materials.
- Phase 2 WMF Development: this second phase of WMF development is planned following closure of the Operations.
 - Phase 2 Minimum WMF Build-Out: This representation of a possible final WMF reflects the minimum material volume that could ultimately be directed to the facility (i.e., minimum anticipated WMF facility footprint).
 - Phase 2 Maximum WMF Build-Out: this representation of the second phase of WMF development would also occur following closure of the Operations and reflects conservative estimates of potential material volumes (i.e., maximum anticipated WMF facility footprint).

These scenarios have been selected to describe the development of the WMF over the near term (Phase 1) and to demonstrate the bounds of minimum and maximum size of the anticipated configurations second phase of the WMF following closure (Phase 2).

1.2.3 Containment Concepts

The WMF will incorporate containment features similar to those used in contemporary secure landfills (i.e., geosynthetically based liner and cover systems; leachate collection, management and disposal capabilities).

1.2.3.1 Base Containment

The base containment sits between the ground and the stored material (i.e., the bottom of the WMF) and is designed both to separate potential impacted material from the environment and to collect any liquids (i.e., leachate). The typical base containment detail for the WMF is comprised of the following design elements (from the stored material down):

- Geotextile: limits the migration of fines from the impacted soils into the underlying drainage system;
- Drain rock: the drainage layer that collects leachate from the overlying impacted soil;
- Geotextile: limits the loss of fines from the drain rock into the underlying sand cushion;
- Sand cushion: this hydraulically transmissive layer provides physical protection to the underlying geosynthetics from the larger particle sizes and potentially angular drain rock;
- Composite layer: the primary contaminant barrier comprised of a High Density Polyethylene (HDPE) geomembrane overlying a Geosynthetic Clay Layer (GCL);
- Lower geomembrane: the lowest element of the base liner is a secondary HDPE geomembrane which mitigates concerns about local groundwaters impinging on the base containment; and
- Geotextile: this lower geotextile would provide cushioning for the overlying geosynthetics.

1.2.3.2 Cover System

Stored material is also covered by an engineered cover system to prevent precipitation from contacting the stored material and to limit the volumes of leachate contained in the structure. The typical WMF cover system detail is comprised of the following elements (from the stored material up):

- Geotextile: this initial layer contacts the impacted soil, provides cushioning for the overlying geosynthetics and would facilitate gas venting for any methane or other vapours generated by the soil;
- GCL: this GCL is a component of the cover's composite barrier that is designed to limit the potential for leachate generation;
- Geomembrane: the Linear Low Density Polyethylene (LLDPE) material that forms the upper component of the cover system's composite barrier layer;
- Geosynthetic drainage layer: this combination of a geonet and upper geotextile (to limit fines ingress) provides the drainage that will limit the buildup of hydrostatic pressures in the overlying cover soils (and, hence, maintain their stability); and
- Cover soil: this layer of local overburden, preferentially selected to increase fines and organic contents, will be placed to retain the surface moisture needed to sustain a vegetative cover.

1.2.4 Leachate Treatment Designs

Leachate treatment capability for the WMF will be a design contingency (i.e., developed if and when required). Actual leachate volumes are subject to considerable variability and an observational approach to leachate management has, therefore, been adopted to allow for a fit-for-purpose treatment system design if this is required. During early stages of the WMF operation, Operations will use the leachate storage available in the WMF facility and existing downhole injection facilities to manage leachate. As volumes are monitored, a leachate treatment system will be designed if and when required to be fit-for-purpose (and right-sized for treatment volumes) based on what is needed. This approach is important because it is possible that while volumes will be significant enough to warrant system development, they may be too low to justify or support continuous operation of the smallest, technically viable system throughput capacity.

The Project, and the Operations, are well positioned to support an observationally driven approach to defining leachate management requirements because the WMF facility itself will offer significant leachate storage, which in turn, will provide time for responding to observed conditions, and because of the availability of the Operations' downhole disposal capacity in the interim.

1.2.5 Surface Water Management

Providing positive surface drainage for the WMF property (i.e., the area within the facility fence) will be important for maintaining the long-term performance and physical integrity of the WMF cover and its associated landforms. Cover systems and features will perform most effectively if water is drained and not allowed to accumulate in contact with barriers, or where freezing will exacerbate erosion potentials. The WMF drainage concept incorporates a perimeter drainage ditch at the toe of the WMF berm which directs surface water to a collection sump at the southwest corner of the facility. The sump will connect to a discharge pipeline running south through the main Operations property to discharge on the Mackenzie River escarpment. All of these surface water discharges will be managed in alignment with Sahtu Land and Water Board (SLWB) Water Licence requirements.

Following construction, surface water on and around the WMF site has no contact with impacted materials and is not anticipated to require treatment. During construction, water will be impounded and tested prior to release to either the injection well (if impacted) or the watershed (if not).

1.2.6 Source Material Removals

1.2.6.1 Impacted Soils

Impacted soils that cannot be treated will be moved to the WMF during remediation and reclamation. Soil movement to the WMF is planned to use conventional heavy civil earthmoving equipment that is commonly used on northern mining projects (e.g., CAT 336 excavators, CAT 770 Wiggle Wagons), and is likely to be owned by, or accessible to, potential contractors. Transfers to and from the natural and artificial islands will be undertaken during the winter via an ice road similar to those constructed and maintained by Imperial as a part of current facility Operations.

1.2.6.2 Dismantling and Demolition Wastes

Dismantling and demolition (D&D) activity is included in the proposed OA scope because removal and relocation of these materials is required to complete construction of the WMF.

1.2.6.3 Above Grade Structures and Infrastructure

The deconstruction of above grade structures and equipment will be executed according to sequencing and protocols defined by detailed plans developed at the time of closure. Individual plans will be structure or area specific. Detailed plans for the removal or recovery of marketable equipment and materials will also be facility specific and will be integrated appropriately within the general D&D execution framework.

1.2.6.4 Foundations

Most foundation elements (generally concrete slabs, pedestals, grade beams and/or footings, and steel pipe piles) will be removed to depths below final reclaimed surfaces. Specific depths will be established on an area specific basis in the detailed execution plans. It is anticipated that some foundation elements will be excavated and removed entirely (e.g., oiled concrete slabs), and directed to the WMF.

1.2.6.5 Dismantling and Demolition Material Quantities

Current estimates indicate that the maximum D&D material volumes inventory at the NWO represents a comparatively small proportion of total NWO closure waste quantities. (i.e., in the range of 30,000 m³). At this preliminary level of C&R planning, it was conservatively assumed that this entire D&D inventory would require management and disposition as waste. In fact, a proportion will likely have a net market value and will be recovered for reuse or recycling.

1.2.7 Monitoring, Operations and Maintenance

Imperial has developed a management plan (Imperial 2021a) that describes how the WMF will be monitored and maintained during construction and operation to meet the following objectives:

1. confirm the effectiveness of the containment system to prevent contact of impacted materials with the surrounding environment;
2. identify maintenance requirements to ensure the containment system is operating per the design standards;
3. identify any potential releases to the surrounding environment;
4. define the appropriate response in the event of a release; and
5. determine leachate management requirements.

The management plan addresses the key components or elements of WMF operations, specifically, surface water, groundwater, leachate, and cover performance.

1.2.8 Design Development Status

The current WMF design has been developed to a Concept Select phase of design development (i.e., Stage 2 as defined by Imperial's Project development process). The current WMF designs include concepts, general layouts, profiles, preliminary designs and details for key WMF components. A schedule

of development activities addressing the investigation, study and design activity that will be required to progress design development during Stage 3 (Optimization/Front End Engineering and Design (FEED)/Execution Planning) and early Stage 4 (Detailed Design and Procurement) has been developed.

1.3 Safety Plan

The WMF Safety Plan draws heavily from the current NWO OA Safety Plan (Imperial 2014) because the latter document provides a comprehensive description of the overarching safety management processes and systems that apply to all of Imperial's Operations at Norman Wells, including those with scope elements similar to the proposed WMF development.

This document includes a table (main text Table 5-1) which describes specifically how the current OA Safety Plan will be applied to WMF development and operations. This table outlines the key hazards and/or safety issues that will be relevant for the WMF development. The current understanding of these hazards and issues has been derived from the key planning and design development documents supporting the current preliminary WMF design, specifically, the ICRP (Imperial 2016) and the WMF Facility Design Basis (FDB; Wood 2021). This description of safety hazards will be defined with more resolution as the WMF design development progresses and as Imperial integrates the OA WMF Safety Plan requirements with contracting safety plans during the procurement and construction management phases of the Project. The hazard identification processes in Imperial's standing safety management processes will be central to this process of integrating safety objectives, processes, and activities within the detailed Project Execution Plan.

1.4 Environmental Protection Plan

The Environmental Protection Plan (EPP) requirements of the CER OA have been addressed by incorporating the WMF into the existing environmentally focused operating plans for the NWO and via an Environmental Management Plan (EMP) developed specifically for the WMF (Imperial 2021a). The overarching NWO EPP outlines the environmental management and protection practices actively in place at Imperial. The Operations EPP clarifies the actions and responsibilities of employees and contractors to meet the intent of Imperial's Environmental Policy and manage Imperial's Environmental Aspects. Activities at the WMF will be governed by the management systems, procedures and protocols defined in this overarching plan.

The purpose of the facility specific EPP that has been incorporated into the WMF EMP is to provide additional detail about protection measures that apply particularly to the WMF. Many of the mitigation measures are design considerations intended to reduce the impact of the facility on the surrounding environment. Additional measures are also included to reduce environmental effects during construction. Monitoring, as described in the WMF EMP, will extend beyond facility commissioning and provide verification that the facility provides isolation of stored materials.

The environmental components or hazards impacted and/or created by the WMF have been identified and described in the NWO's ICRP (Imperial 2016), which also outlines the relationship between the WMF concept and the NWO's environmental objectives for closure. Additional definition of environmental issues/hazards is provided in the FDB for the WMF (Wood 2021), which also describes the WMF design concept and the bases for selection of key WMF design elements.

Table 6-1 describes more specifically how the CER's EPP requirements are addressed by the various NWO operating plans, the WMF EMP, the ICRP and the WMF design development documents.

1.5 Operations Overview (Waste Management Facility Construction Execution Plan)

Execution planning for the WMF will be progressed upon regulatory approval for the WMF. Broadly speaking, Phase 1 of the WMF (i.e., the pre-closure phase) is currently planned for construction over two years. In the first year, materials within the Phase 1 footprint would be excavated, prepared for final placement and stockpiled, and the base containment system constructed. Source area removals in the Mainland operating area will be initiated, along with waste placement Operations into the WMF. In the second year, the balance of stockpiled materials will be placed, waste materials outside the WMF footprint excavated and placed in conjunction with the remaining Phase 1 Mainland source area removals, and Phase 1 WMF cover and surface landforms constructed.

The initiation of Phase 2 WMF construction (i.e., the post closure phase) will be defined by the ultimate closure date for the NWO. Phase 2 activity will extend over a number of seasons and will be influenced by the execution schedules for other C&R activity at Norman Wells (particularly the well abandonment execution schedule).

1.6 Community Engagement

Community engagement has been an integral component of WMF development to date and will continue throughout both the construction and operational phases of the Project.

1.7 Concordance Table

Table C-1 identifies where specific CER OA requirements have been addressed in this amendment application document.

Table C-1: Concordance Table

Section	COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
Management System			
5 (1)	The applicant for an authorization shall develop an effective management system that integrates operations and technical systems with the management of financial and human resources to ensure compliance with the Act and these Regulations.	OA Section 5.1 – Operations Integrity Management System (OIMS)	
(2)	The management system shall include:		
	a the policies on which the system is based;	OA Section 5.1 – Safety Policy	
	b the processes for setting goals for the improvement of safety, environmental protection, and waste prevention;	OA Section 5.5 – OIMS System 5-4 Personnel Safety Management System OAAA – Table 6-1 – WMF Environmental Protection Plan; entry 1 – Environmental Management Systems and Related Organizational Structures	
	c the processes for identifying hazards and for evaluating and managing the associated risks;	OA Section 5.5.3 – Hazard Identification and reporting OAAA – Table 5-1 – WMF Safety Plan, entry 2	
	d the processes for ensuring that personnel are trained and competent to perform their duties;	OA Section 5.1 – Operations Integrity Management System (OIMS)	
	e the processes for ensuring and maintaining the integrity of all facilities, structures, installations, support craft and equipment necessary to ensure safety, environmental protection and waste prevention;	OA Section 5.1 – Operations Integrity Management System (OIMS)	WMF EMP NOW EPP NOW WMP
	f the processes for the internal reporting and analysis of hazards, minor injuries, incidents and near misses and for taking corrective actions to prevent their recurrence;	OA Section 5.7.2 – Upstream Incident Management Manual	
g the documents describing all management system processes and the processes for making personnel aware of their roles and responsibilities with respect to them;	OA Section 5.7 – Safety Management Tools		

Section		COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
5 (2) (cont'd)	h	the processes for ensuring that all documents associated with the system are current, valid and have been approved by the appropriate level of authority;	OA Section 5.1 – Operations Integrity Management System (OIMS)	WMF EMP NWO EPP NWO WMP NWO GMP NWO QAQCM
	i	the processes for conducting periodic reviews or audits of the system and for taking corrective actions if reviews or audits identify areas of non-conformance with the system and opportunities for improvement;	OA Section 5.1 – Operations Integrity Management System (OIMS) OA Section 5.8 – Other Management Systems that Interface with Safety Management Systems	
	j	the arrangements for coordinating the management and operations of the proposed work or activity among the owner of the installation, the contractors, the operator and others, as applicable;	OA Section 5.1 – Operations Integrity Management System (OIMS) OA Section 5.8.2 – OIMS System 8-1 Contractor Selection and Management	
	k	the name and position of the person accountable for the establishment and maintenance of the system and of the person responsible for implementing it;	Jody Crawford Conventional Operations Superintendent Imperial Oil Resources Norman Wells, NWT Jody.A.Crawford@esso.ca Ph: 1-867-587-8014 Cell: 1-403-807-5634	
(3)		The management system documentation shall be controlled and set out in a logical and systematic fashion to allow for ease of understanding and efficient implementation.	Acknowledged	
(4)		The management system shall correspond to the size, nature and complexity of the operations and activities, hazards and risks associated with the operations.	Acknowledged	

Section	COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
Application for Authorization			
6	The application for authorization shall be accompanied by:		
	a a description of the scope of the proposed activities;	OAAA Section 4 - Scope	
	b an execution plan and schedule for undertaking those activities;	OAAA Section 7 – Operations Overview	
	c a safety plan that meets the requirements of Section 8;	OAAA Section 5 – Safety Plan	
	d an environmental protection plan that meets the requirements of Section 9;	OAAA Section 6 – Environmental Protection Plan	
	e information on any proposed flaring or venting of gas, including the rationale and the estimated rate, quantity and period of the flaring or venting;	Not Applicable (NA)	
	f information on any proposed burning of oil, including the rationale and the estimated quantity of oil proposed to be burned;	NA	
	g in the case of a drilling installation, a description of the drilling and well control equipment;	NA	
	h in the case of a production installation, a description of the processing facilities and control system;	NA	
	i in the case of a production project, a field data acquisition program that allows sufficient pool pressure measurements, fluid samples, cased hole logs and formation flow tests for a comprehensive assessment of the performance of development wells, pool depletion schemes and the field;	NA	
	j contingency plans, including emergency response procedures, to mitigate the effects of any reasonably foreseeable event that might compromise safety or environmental protection, which shall: i) provide for coordination measures with any relevant municipal, provincial, territorial, or federal emergency response plan, and ii) in an offshore area where oil is reasonably expected to be encountered, identify the scope and frequency of the field practice exercise of oil spill countermeasures; and	OA Section 5.7.2 – Upstream Incident Management Manual	WMF EMP NWO GMP NWO QAQCM
	k a description of the decommissioning and abandonment of the site, including methods for restoration of the site after its abandonment.	OAAA Section 3.2.2.2 - Interim Closure and Reclamation Plan (ICRP)	
7	Production Installations – not applicable	NA	

Section		COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
Safety Plan				
8		A description of the arrangements for monitoring compliance with the plan and for measuring performance in relation to its objectives.	OAAA – Table 5-1 - WMF Safety Plan, entry 4 – Monitoring Safety Compliance	
	a	a summary of and references to the management system that demonstrate how it will be applied to the proposed work or activity and how the duties set out in these Regulations with regard to safety will be fulfilled;	OA Section 5.3 – Safety Management	
	b	a summary of the studies undertaken to identify hazards and to evaluate safety risks related to the proposed work or activity;	OAAA Section 5.1 – Safety Plan	
	c	a description of the hazards that were identified and the results of the risk evaluation;	OAAA – Table 5-1 - WMF Safety Plan, entry 2 - Safety Hazards and Associate Mitigations	
	d	summary of the measures to avoid, prevent, reduce, and manage safety risks;	OAAA – Table 5-1 - WMF Safety Plan, entry 2 - Safety Hazards and Associate Mitigations	
	e	a list of all structures, facilities, equipment and systems critical to safety and a summary of the system in place for their inspection, testing and maintenance;	OA Section 5.7 – Safety Management Tools	
	f	<ul style="list-style-type: none"> a description of the organizational structure for the proposed work or activity and the command structure on the installation, which clearly explains their relationship to each other, and the contact information and position of the person accountable for the safety plan and of the person responsible for implementing it; 	OA Section 5.5.1 – Safety Organization OA Section 5.5.6 – Responsible and Accountable resources	
	g	if the possibility of pack sea ice, drifting icebergs or land-fast sea ice exists at the drill or production site, the measures to address the protection of the installation, including systems for ice detection, surveillance, data collection, reporting, forecasting and, if appropriate, ice avoidance or deflection; and	NA	
	h	a description of the arrangements for monitoring compliance with the plan and for measuring performance in relation to its objectives.	OAAA – Table 5-1 - WMF Safety Plan, entry 4 – Monitoring Safety Compliance	

Section	COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
Environmental Protection Plan			
9	The environmental protection plan shall set out the procedures, practices, resources and monitoring necessary to manage hazards to and protect the environment from the proposed work or activity and shall include:	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 1 - Environmental Management Systems and Related Organizational Structures	
	a a summary of and references to the management system that demonstrate how it will be applied to the proposed work or activity and how the duties set out in these Regulations with regard to environmental protection will be fulfilled;	OAAA Section 6 – Environmental Protection Plan	WMF EMP NWO EPP NWO WMP NWO GMP NWO QAQCM
	b a summary of the studies undertaken to identify environmental hazards and to evaluate environmental risks relating to the proposed work or activity;	OAAA Section 6 – Environmental Protection Plan – Introductory Discussion	
	c a description of the hazards that were identified and the results of the risk evaluation;	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 6 -Environmental Impacts/Hazards and Associated Mitigative Measures	
	d a summary of the measures to avoid, prevent, reduce and manage environmental risks;	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 6 -Environmental Impacts/Hazards and Associated Mitigative Measures	WMF EMP NWO GMP NWO QAQCM
	e a list of all structures, facilities, equipment and systems critical to environmental protection and a summary of the system in place for their inspection, testing and maintenance;	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 6 -Environmental Impacts/Hazards and Associated Mitigative Measures	WMF EMP NWO GMP NWO QAQCM
	f a description of the organizational structure for the proposed work or activity and the command structure on the installation, which clearly explains: i) their relationship to each other, and ii) the contact information and position of the person accountable for the environmental protection plan and the person responsible for implementing it;	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 1 - Environmental Management Systems and Related Organizational Structures Jody Crawford Conventional Operations Superintendent Imperial Oil Resources Norman Wells, NWT Jody.A.Crawford@esso.ca	
	g the procedures for the selection, evaluation and use of chemical substances including process chemicals and drilling fluid ingredients;	NA	

Section		COGDPR Requirement	Relevant Section in OA or OAAA Document:	Relevant Section(s) of Documents Invoked by OA or OAAA
9 (cont'd)	h	a description of equipment and procedures for the treatment, handling, and disposal of waste material;	OAAA Section 6 – Environmental Protection Plan	WMF EMP NWO ICRP
	i	a description of all discharge streams and limits for any discharge into the natural environment including any waste material;	OAAA Section 6 – Environmental Protection Plan	WMF EMP NWO WMP NWO GMP NWO QAQCM
	j	a description of the system for monitoring compliance with the discharge limits identified in paragraph (i), including the sampling and analytical program to determine if those discharges are within the specified limits; and	OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 4 – Compliance Monitoring	WMF EMP NWO GMP NWO QAQCM
	k	a description of the arrangements for monitoring compliance with the plan and for measuring performance in relation to its objectives.	WMF-EMP OAAA – Table 6-1 - WMF Environmental Protection Plan; entry 4 Compliance Monitoring	WMF EMP NWO GMP NWO QAQCM
Safety and Environmental Protection				
19		The operator shall take all reasonable precautions to ensure safety and environmental protection, including ensuring that	Acknowledged	
	j	the inventory of all equipment identified in the safety plan and the environmental protection plan is updated after the completion of any significant modification or repair to any major component of the equipment;	Acknowledged	
20	(1)	No person shall tamper with, activate without cause, or misuse any safety or environmental protection equipment.	Acknowledged	
21	(1)	No person shall smoke on an installation except in those areas set aside by the operator for that use.		

Document References Legend:

- OA Operations Authorization (NEB 2014)
- OAAA Operations Authorization Amendment Application (this document)
- WMF EMP Waste Management Facility Environmental Management Plan (Imperial 2021a)
- NWO EPP Norman Wells Operations Environmental Protection Plan (Imperial 2021b)
- NWO GMP Norman Wells Operations Groundwater Management Plan (Imperial 2021f)
- NWO QAQCM Norman Wells Operations Quality Assurance and Quality Control Manual (Imperial 2021c)
- NWO WMP Norman Wells Operations Waste Management Plan (Imperial 2021d)
- NWO ICRP Norman Wells Operations Interim Closure and Reclamation Plan (Imperial 2016)

2.0 GLOSSARY AND ACRONYMS

2.1 Terms and Definitions

Term	Definition
Abandonment	To close, or cease to maintain a facility, with the intent that the facility is unlikely to be reinstated into service within the foreseeable future.
Application	Imperial Oil's 2014 submission for an Operations Authorization approval from the National Energy Board (NEB).
Artificial Islands	The physical structure of the constructed islands, including sand core, slope and scour protection, drilling equipment and supplies, storage facilities, well head equipment, and temporary or permanent buildings.
Barrel	A measurement of crude oil volume. A barrel contains 42 US gallons or 159 litres (0.159 m ³).
Biodegradation	A microbiologically mediated process (e.g., due to the action of bacteria, yeasts and fungi) that alters the structure of a substance by breaking it down into smaller components.
Borrow Pit	A pit created to provide earthen materials that can be used for fill at another location.
Breakup	The period from the time the ice first starts to move in the Mackenzie River at Norman Wells in the spring, to the time when the river is free of pack ice at Norman Wells.
Central Processing Facility	IOR's plant where oil, gas, and produced water are collected from the oilfield and separated, with plant cooling being accomplished using Mackenzie River water. All buildings, structures, storage, equipment and surface improvements included in the Central Processing Facility, not including field flowlines, production facilities or wells.
Criteria	Numerical standards that are established for the concentrations of chemical substances in soil, groundwater, surface water, and sediments that relate to the suitability of a site for specific land uses and land use categories. Criteria are also often referred to as guidelines.
Crown	The Crown is a corporation sole that, in the Commonwealth realms and any of its provincial or state sub-divisions, represents the legal embodiment of executive, legislative, or judicial governance. For example, the Government of Canada.
Crude Oil	Naturally occurring, unrefined petroleum product composed of hydrocarbon deposits.
Decommission	The act of taking a processing plant or facility out of service and isolating equipment to prepare for routine maintenance work, suspension, or abandonment.
Demolition	To tear down completely (e.g., a building).
Dismantling	To take apart or remove, either equipment or a process.
Drilling Sump	An excavated area with soil walls and base that is used to contain waste drilling fluids and solids.
Emergency Response	Post event action taken to minimize the consequences of an emergency.
Emergency Response Plan	A thorough description of procedures to be followed by all parties in the event of an accidental release of material or other emergencies, such as fire, bomb threat, etc.
Field	The Field refers to those areas of Imperial Oil's NWO that are outside the boundary of the Central Processing Facility but inside the Proven Area such as wells, pads, and pipelines.
Groundwater	Water that occurs in the subsurface pores of sedimentary rocks.

Term	Definition
Groundwater Monitoring	The process of monitoring subsurface water quality, water level, or both, through a well.
Hydrocarbon	Any organic compound consisting primarily of carbon and hydrogen.
ICRP	A description of closure and reclamation plans for the NWO development pursuant to the requirements of the SLWB Water Licence.
Impacted Materials	Materials that have introduced substances, most commonly hydrocarbons.
Management System	A system for ensuring that objectives are achieved. Key elements typically include scope and objectives, processes and procedures, resources responsible for implementing and executing the system, a verification and measurement method to determine if desired results are being achieved, and a feedback mechanism to provide a basis for further improvement.
Mitigation	Measures to control, reduce, prevent, eliminate, or avoid an adverse environmental impact.
Monitoring Well	A well that is used to monitor groundwater quality and levels.
Natural Islands	Islands formed by natural processes including Bear, Goose, and Frenchy's Islands.
Natural Seeps	An area where liquid or gaseous hydrocarbons naturally come to the surface.
Norman Wells Operations	Imperial Oil's facilities at Norman Wells used for the extraction and processing of oil, natural gas and associated produced water.
Operations	Norman Wells Operations.
Operations Authorization	An authorization issued by the Canadian Energy Regulator (CER; formerly the National Energy Board (NEB)) pursuant to the requirements of the Canadian Oil and Gas Drilling and Production Regulations.
Operations Authorization Amendment Application	An application to the CER to amend an existing OA to address activity supplemental to the scope of the original OA.
Petroleum	A liquid mixture of hydrocarbons present beneath the earth's surface that is extracted and refined to produce fuels and other products.
Petroleum Hydrocarbon	The mixture of hydrocarbons normally found in petroleum. The mixture includes hundreds of chemical compounds.
Proven Area	The area described in Schedule "A" to the Proven Area Agreement dated July 21, 1944 between Imperial Oil Limited and His Majesty in Right of Canada, as amended and renewed from time to time. The Proven Area is where Imperial Oil conducts activities relating to its NWO. It measures 7,939 acres (32 km ²) in size and covers all of Goose Island, most of Bear and Frenchy's Islands, the six artificial islands and portions of the Mainland.
Reclamation	The process of returning a disturbed site to its natural state or one for other productive uses that prevents or minimizes any adverse effects on the environment or threats to human health and safety.
Regulators	The government departments or agencies that issue permits (licences) or authorizations likely to be applied for in response of a proposed project or existing operation.
Remediation	The management of a contaminated site to prevent, minimize, or mitigate damage to human health or the environment. Remediation may include both direct physical actions (e.g., removal, destruction, and containment of impacted materials) and institutional controls (e.g., zoning designations or orders).
Risk	The possibility of injury, loss, or environmental incident created by a hazard. The significance of the risk is determined by the probability of an unwanted incident and the severity of its consequences.

Term	Definition
Runoff	The part of water from rain and snow that flows overland to streams, ponds or other surface water bodies and that does not infiltrate into the ground or evaporate.
SLWB Registry	An online library of documents filed with the SLWB located at www.slwb.com. Documents are filed by company name and licence number.
Stakeholders	Individuals, groups, or organizations that have an interest or concern in something. Often, they can affect or be affected by the actions of others. Includes industry, federal agencies, the territorial government, Aboriginal governments and organizations, communities, and other interested parties.
Surface Water	Water on the earth's surface, including fresh and salt water.
Surface Water Runoff Facilities	The Refinery Impound Basin, LT 11 (or historic Battery 3) Impound Basin, Refinery Water Flood Basin, CPF Impound Basin, Miscellaneous Mainland Impound Areas, Miscellaneous Bear Island Impound Areas, Miscellaneous Goose Island Impound Areas, bunkers, and associated ditches or excavations provided for the collection, storage, and discharge of surface runoff waters from the Imperial Oil Resources NWT Limited lease.
Surveillance Network Program	A series or network of devices or sampling points designed to test environmental conditions for comparison against baseline data obtained from a point or area designed as a control. This is a method of tracking and identifying the spread of deleterious substances in the environment.
The River	The Mackenzie River.
Waste Management Plan	A document that outlines IOR processes for handling waste at its NWO.
Waters	An inland water, whether in a liquid or frozen state, on or below the surface of the land in the Northwest Territories.
Water Licence	Imperial Oil's Type "A" Water Licence from the Sahtu Land and Water Board, first issued August 30, 2004. Licence Number S03L-001 as amended.
Water Quality	A description of the chemical, physical, or biological properties of water relative to a specific use or value, e.g., an environment for aquatic life or as a source for drinking water.
WMF	A secure containment facility designed for the long-term storage of impacted soils and dismantling, and demolition wastes on the NWO.

2.2 Acronyms, Symbols and Units

Acronym, Symbol or Unit	Definition
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CCME	Canadian Council of Ministers of the Environment
CER	Canadian Energy Regulator
C&R	Closure and Reclamation
D&D	Dismantling and Demolition
EMP	Environmental Management Plan
EPP	Environmental Protection Plan
FDB	Facility Design Basis
FEED	Front End Engineering and Design
FEMA	Failure Modes and Effects Analysis
GCL	Geosynthetic Clay Layer
GMP	Groundwater Management Plan
HDPE	High Density Polyethylene
ICRP	Interim Closure and Reclamation Plan
IOR	Imperial Oil Resources NWT Limited
LLDPE	Linear Low Density Polyethylene
MLS	Mainland Sump
NEB	National Energy Board
NWO	Norman Wells Operations
NWT	Northwest Territories
OA	Operations Authorization
OAAA	Operations Authorization Amendment Application
OIMS	IOR's Operations Integrity Management System
PA	Proven Area
PHC F1	CCME Petroleum Hydrocarbon Fraction F1, covering the range from C ₆ to C ₁₀
PHC F2	CCME Petroleum Hydrocarbon Fraction F2, covering the range from C ₁₀ to C ₁₆
QA/QC	Quality assurance/quality control; procedures and controls designed to monitor the conduct, data quality and integrity of a study
QAQCM	Quality Assurance and Quality Control Manual
SLWB	Sahtu Land and Water Board
SP	Safety Plan
SSHE	Safety, Security, Health and Environment
WMF	Waste Management Facility
WMP	Waste Management Plan

3.0 INTRODUCTION

3.1 Site Background

Imperial Oil Limited's (Imperial's) NWO are located within the municipal boundary of the Town of Norman Wells in Canada's Northwest Territories (NWT). The Operations produce approximately 2,100 m³ (12,000 bbl) of oil per day via 307 active injection and production wells distributed over the Mainland and a series of natural and artificial islands in the Mackenzie River. The general arrangement of the NWO is shown on Figure 3-1.

3.2 Regulatory Instruments

3.2.1 Canadian Energy Regulator (formerly Natural Energy Board)

NWO has been in operation since the 1920s and underwent a major expansion in the early 1980s. The major expansion required Development Plan Approval and Production Operations Approval under the Canada Oil and Gas production Regulations. Below is a brief history of the approvals under Canada Oil and Gas production Regulations obtained for the NWO:

- 27 October 1980 – Imperial received a tentative Development Plan Approval (DIAND-#1-80) under Section 6 of the *Canada Oil and Gas Production Regulations* (September 1980 draft) from Indian and Northern Affairs.
- 18 October 1983 – The Canada Oil and Gas Lands Administration issued an interim Production Operations Approval, which applied to the mainland and natural island portion of the Norman Wells expansion project to permit the start-up of the processing facilities.
- 10 May 1985 – Imperial received final Production Operations Approval for the Norman Wells Expansion Project, which superseded the Conditional Production Operations Approval issued on 27 February 1985.
- 19 December 2014 – Imperial received OA-1210-001 for the NWO pursuant to an application under the Canada Oil and Gas Drilling and Production Regulations dated 31 July 2014.

OA-1210-001 was issued for a period of 10 years and is the current CER operating authorization for the NWO (NEB 2014).

3.2.2 Sahtu Land and Water Board

3.2.2.1 Water Licence

One of the primary instruments regulating activities on the Operations is the Water Licence issued by the SLWB under the *Mackenzie Valley Resource Management Act*. The Water Licence defines:

- allowable water withdrawals and sources;
- the required qualities of waters returned to the environment;
- conditions applying to Operations, maintenance, waste management, contingency planning, and aquatic effects monitoring; and
- requirements for facility C&R.

The current version of the Water Licence (S13L1-007) was issued pursuant to a recommendation by the SLWB issued on 02 January 2015.

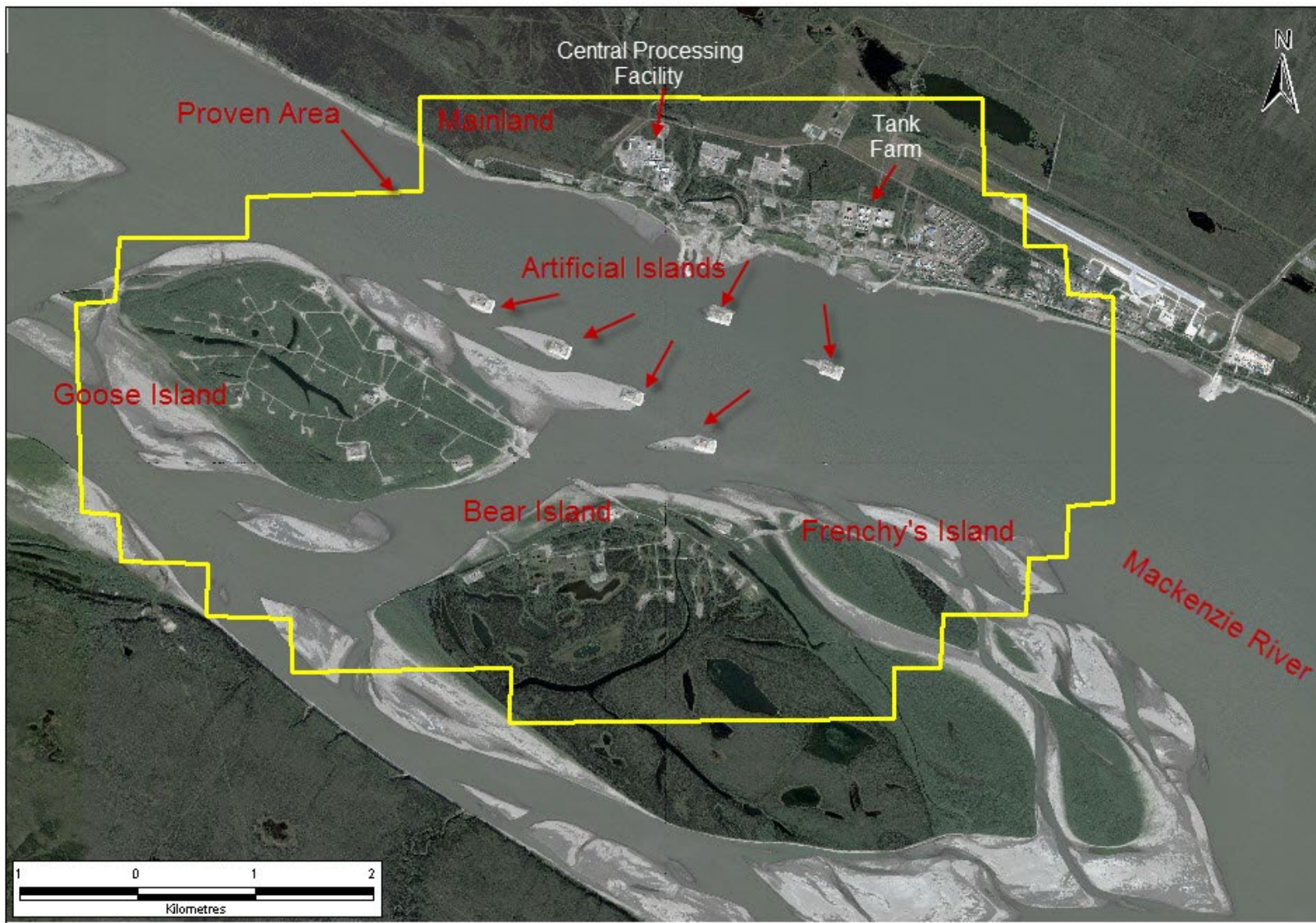


Image: Google Earth, November 2007. Proven Area boundary: interpreted from Beaufort-Mackenzie Mineral Development Area (BMMDA) web site (www.bmmda.nt.ca).

wood.

**NORMAN WELLS OPERATIONS
General Arrangement**

Date: November, 2020

Project No.: CEO4494

Figure: 3-1

3.2.2.2 **Interim Closure and Reclamation Plan**

The Water Licence required that Imperial prepare and maintain a C&R Plan for the Operations. The initial version of this C&R Plan was prepared by Imperial and submitted to the SLWB in October of 2016 (Imperial 2016). This plan was reviewed and accepted, with conditions, by the SLWB in January of 2017 (SLWB 2017). The plan is referenced as an ICRP Plan, recognizing that it will be reviewed and updated as needed in the period prior to Operations closure.

The ICRP includes the concept of an on-site WMF as an integral component of the ICRP. Development of the WMF was initiated in advance of the broader C&R Plan because it will be required to support the progressive reclamation efforts that Imperial will be undertaking during the period leading up to closure.

3.2.2.3 **Water License Amendment Application**

In September 2021, Imperial submitted to the SLWB, an application for amendment to the type A Water Licence S13L1-007 ("Licence") for the development of the WMF called for under the ICRP (Imperial 2021e). Imperial noted that it was seeking approval for the development of the WMF to provide long-term storage of impacted soil and dismantling/demolition debris produced during C&R of the Operation.

3.3 **Purpose of Document**

CER has advised that an OA pursuant to the *Canada Oil and Gas Operations Act* will be required for the proposed WMF. This document forms Imperial's application for an amendment to the existing NWO OA-1210-001 (NEB 2014) to incorporate construction and operation of the WMF. The form of this application has been developed on the basis of Imperial's review of the CER's guidance for the development of OA applications, the outcomes of Imperial's discussions with the CER during the summer and fall of 2020 and ongoing Project development, permitting and approvals activity related to the WMF. It also follows the outline in the pre-application memo which was submitted to the CER in June 2021..

3.4 **Amendment Scope**

The OA amendment describes the construction of both proposed phases of the WMF (i.e., near term (Phase 1) and final build-out (Phase 2)) and all ancillary infrastructure (e.g., monitoring systems, access roads, drainage structures). Movement of impacted soils and waste materials on the NWO into the WMF structure is also described. Elements of the broader C&R Plan scope beyond those directly associated with WMF construction are not included.

3.5 **Form of Amendment Application**

Construction of the WMF involves activities that were contemplated under the existing NWO OA (e.g., contaminated materials management, civil construction). Imperial understands that much of the current OA content is, therefore, applicable to the WMF scope and accordingly, those aspects will remain unchanged. Aspects of the amendment submission that vary from current approval conditions are understood to be:

- **Scale:** the WMF scope is a large-scale civil materials management effort; the current OA does not contemplate civil works of this scale; and
- **Geosynthetics:** the use of synthetic barriers and/or drainage systems feature prominently in the WMF design. These materials involve handling and construction activities not fully contemplated in the current OA.

The amendment application will describe how Imperial will apply the current management systems to the WMF scope and describe any supplements to current OA content that may be needed.

Given the degree of alignment between the current OA scope and the proposed WMF construction activity, Imperial has developed the OA amendment application adopting much of the current OA content. The amendment application focuses on the application of current management systems to the particular features of the WMF scope and describes any supplements to current OA content needed to fully address that scope.

Given the above, the amendment application follows the structure of the current NWO OA application documents (Imperial 2014). The application outline includes only Sections 1 through 7 of the current OA-1210-001 application document because Sections 8 through 11 (Field Data Program, Spill and Emergency Response Plans, Abandonment and Reclamation, and Flow System, Calculation and Allocation Procedures) do not apply to the WMF, or the scope is addressed via content in Sections 1 through 7 of the amendment application.

3.6 Supporting Documents

3.6.1 Norman Wells Operations Plans

A key feature of both the current NWO OA and this amendment application is a reliance on a suite of operating plans for the NWO that has been developed over the years by Imperial to support the Operations and to address regulatory and permitting obligations. Figure 3-2 shows the relationships between this amendment application document and these various operating plans. Brief scope descriptions for the key plans invoked under this application are as follows.

- NWO Environmental Protection Plan (EPP) (Imperial 2021b): outlines the various programs and measures that are in place to manage environmental components and their associated issues at the NWO. The EPP was updated in September 2021 to incorporate the proposed WMF development.
- NWO Quality Assurance and Quality Control Manual (QAQCM) (Imperial 2021c): outlines sampling, data development and interpretation, and response hierarchies for all surface water monitoring and management on the NWO. The QAQCM was updated in September 2021 to incorporate the proposed WMF development.
- NWO Waste Management Plan (WMP) (Imperial 2021d): supports regular NWO Operations as field guidance on protocols, equipment and disposition alternatives for the safe and effective management of wastes generated by, or encountered on, the Operations. The WMP was updated in September 2021 to incorporate the proposed WMF development.
- NWO Groundwater Management Plan (GMP) (Imperial 2021f): supports the NWO in a manner that ensures effective groundwater management while minimizing safety hazards and potential adverse environmental effects. The plan outlines the monitoring program framework, selection criteria for groundwater monitoring wells, and describes sampling methods, data evaluation protocols and reporting requirements. Monitoring is intended to provide early detection system of changes to groundwater in and around ongoing Operations. The plan was updated in September 2021 to incorporate the proposed WMF development.

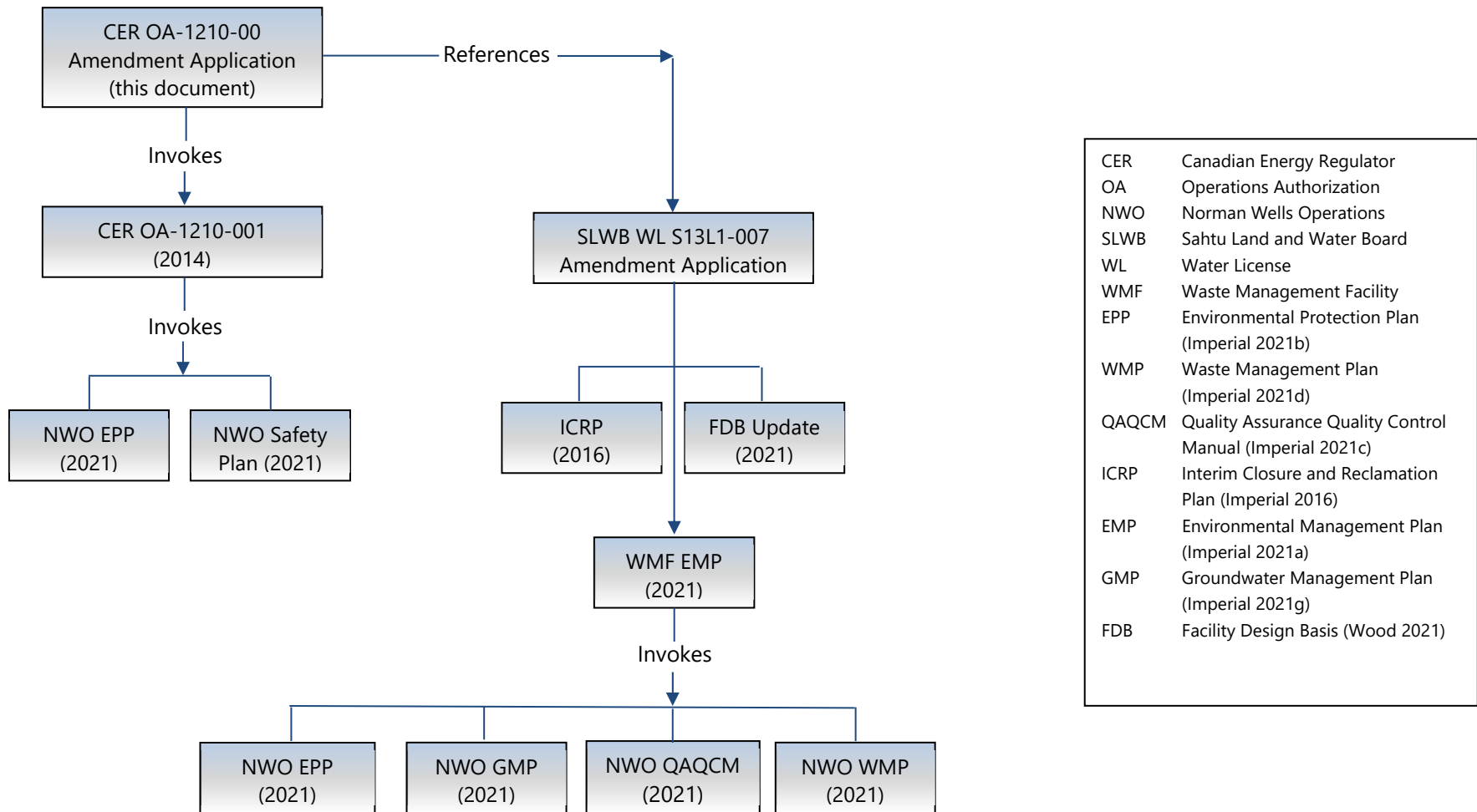


Figure 3-2: Relationship Structure – OA-1210-001 Amendment Application Supporting Documents

3.6.2 Studies and WMF Design Development Activity

The current NWO OA describes the various studies and monitoring outcomes that have supported progressive refinements in the NWO's operating plans. In addition, there are two key planning and design development documents that have relevance to the proposed WMF. The first is the ICRP for the NWO that introduced and rationalized the WMF concept (Imperial 2016), and the second is the FDB prepared for the structure (Wood 2021). These documents were developed pursuant to the requirements of the SLWB Water Licence or to support the current application for an amendment to the Water Licence to address WMF development (Imperial 2021e). Scope outlines for these two documents is as follows:

- NWO Interim Closure and Reclamation Plan (ICRP) (Imperial 2016): a requirement of the SLWB Water Licence for the NWO, the ICRP describes Imperial's plans for conducting all required C&R activity on the property before, during and after closure. Pursuant to SLWB Water Licence requirements, this interim plan will be finalized in the lead up to facility closure. The 2016 version of the ICRP introduced the WMF concept (referenced in the ICRP as the Long-Term Management Facility) as a key element of Imperial's C&R planning.
- NWO WMF Facility Design Basis (FDB) (Wood 2021): details the design bases and the rationales for key design development designs supporting the current preliminary design for the WMF. A September 2021 update of the FDB was prepared and submitted in support Imperial's application to the SLWB for an amendment to the Water Licence to incorporate development of the WMF.

3.7 Public Engagement

Based on feedback from the CER, in June of 2021, Imperial provided the CER with a Project description that included an *Introduction to the WMF Engagement Record* (Imperial 2021g). This document provides an overview of the specific engagement related to the WMF and how it aligns with the ongoing engagement completed for Imperial's Norman Wells activities. It also provides a summary of the key WMF issues raised and the status of those issues. The full Community Engagement Plan and Record of Engagement has been developed in line with the Mackenzie Valley Land and Water Board/SLWB requirements and will be part of the full submission to the SLWB. Imperial would expect that this may be a particular element of the WMF project development scope that would benefit from coordination between CER and the SLWB pursuant to the Memorandum of Understanding between the NEB (now CER) and the Mackenzie Valley Land and Water Board.

4.0 SCOPE

4.1 Introduction

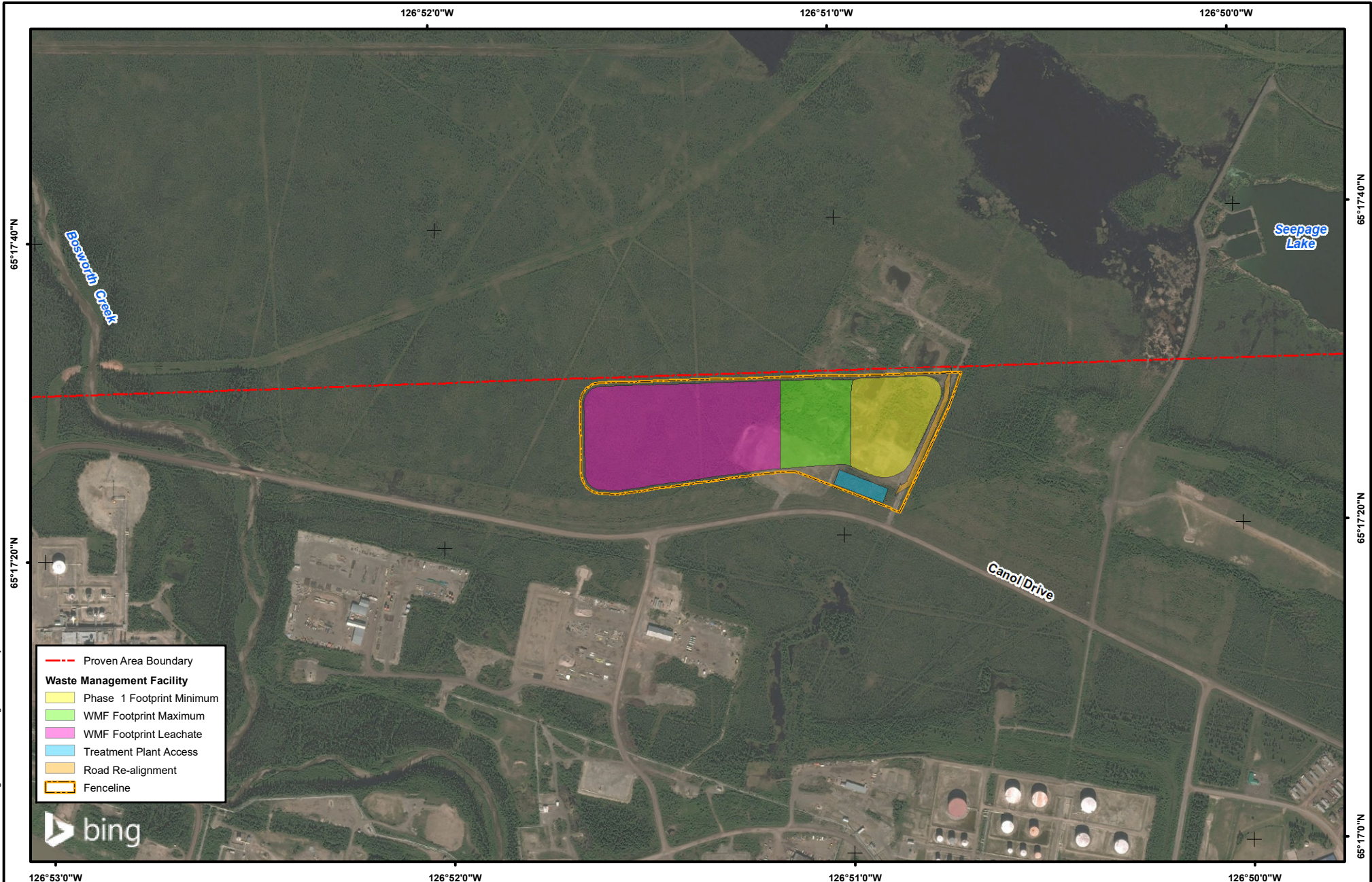
4.1.1 Background

This document describes the development, scope and key components of the WMF that forms an integral component of the ICRP for Imperial's NWO. The WMF will be used for the long term and secure containment of non-treatable soils and wastes generated by C&R activities on the NWO. Development of the WMF has been initiated in advance of the broader C&R Plan because it is required to support the progressive reclamation efforts that Imperial is currently undertaking and will continue to progress during the period leading up to closure.

- how the WMF concept was selected within the context of the broader ICRP for the NWO;
- the WMF's capacity and key design elements and capabilities;
- the scope and methods proposed for removing and relocating the soils and waste materials that will be directed to the WMF;
- plans for monitoring, operating and maintaining the WMF during and after construction;
- the current design development status of the WMF and future plans for advancing the facility's design; and
- execution concepts for both phases of WMF development.

The location of the proposed WMF within the NWO Proven Area (PA) boundary is shown on Figure 4-1.

This Project description has been derived from Imperial's design and permitting efforts for the WMF, principally those described by the ICRP for the NWO (Imperial 2016), the FDB prepared for the WMF (Wood 2021) and the application for a Water License amendment addressing the WMF submitted to the SLWB (Imperial 2021e).

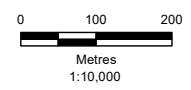


S:\GIS\Projects\CE\04839_NormanWells\ArcGIS\Fig4-1 Waste Management Facility.mxd ANALYST: Trevor Robertson 21-09-28 4:37:14 PM

Projection: NAD 1983 UTM Zone 9N
 QA/QC: KW JG
 Sources: Imperial Oil
 © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS



Waste Management Facility



January 2020

Figure 4-1

4.2 Waste Management Facility's Place in the Interim Closure and Reclamation Plan

4.2.1 Interim Closure and Reclamation Plan Design Principles

The selection of a WMF as a component of the ICRP started with, and was derived from, the basic planning principles that were established by Imperial to guide C&R activity for the NWO. Those principles that most directly influenced the selection of a WMF were as follows:

- Consolidation of Environmental Liabilities: Minimizing land use restrictions at a site as large and complex as the Norman Wells PA will require the consolidation of environmental liabilities. Land use restrictions related to disparate sources of impacted materials can be mitigated most cost effectively by consolidating them within dedicated management areas that limit the overall footprint of impact.
- Commitment to Long Term Management: The Norman Wells PA includes some impacted areas that, by their nature, will require long term in-situ management.
- Soil Treatment Philosophy: Impacted soils should be treated only if it can be reliably predicted that the material produced can be used without further monitoring, or without restrictions beyond those associated with the land use prescribed for the area in question.
- D&D Materials Disposition Philosophy: D&D materials will be included with the inventory of materials requiring disposition on-site unless those materials can be recycled or reused and when they have a market value sufficient to cover the costs of cleaning, preparation, handling and off-site disposition.
- Application of Proven Methods: C&R planning should apply concepts and methods that are known, or are judged likely, to be feasible at the Norman Wells PA.

4.2.2 Selection of the WMF Concept

The above Design Principles supported a consideration of alternatives for managing the inventory of non-treatable materials. This assessment led to the conclusion that on-site disposition via a WMF would be the most effective method of meeting the Project objectives. The central elements of the ICRP developed from this conclusion were as follows (excluding those components not directly related to the WMF):

- Impacted soils remaining on the PA at closure will be treated and reused on-site or consolidated into a single WMF.
- Impacted soils from areas remediated prior to closure as part of progressive reclamation efforts will be managed on-site via treatment and/or containment.
- The WMF will incorporate containment features similar to those used in contemporary secure landfills (i.e., geosynthetically based liner and cover systems; leachate collection, management and disposal capabilities).
- Following WMF completion, any leachate that accumulates within the structure will be treated or managed in ways consistent with the prescribed C&R project objectives.

- Impacted source areas will be remediated to Canadian Council of Ministers of the Environment (CCME) criteria (Industrial for the Mainland; Parkland for the balance of the PA) or site-specific, risk-based criteria.
- Following closure of the Operations, materials will be relocated to the WMF, and the source areas backfilled, over an execution schedule that will likely extend over a period of years to accommodate the associated wellbore abandonment scope. Impacted materials from the islands will be relocated to the Mainland via an ice road.
- Above grade facilities will be removed using conventional methods of decommissioning, dismantling and/or demolition. The disposition of D&D materials and wastes will be market driven. Materials or wastes with no net market value will be directed to the WMF.

4.3 Waste Management Facility Development Scope Limits

The WMF Project description addresses the work scope that will be proposed in Imperial's application for an amendment to OA-1210-001. Accordingly, this document describes the construction of both proposed phases of the WMF (i.e., near term (Phase 1) and final build-out (Phase 2)) and all ancillary infrastructure (e.g., monitoring systems, access roads, drainage structures). Movement of impacted soils and waste materials on the NWO into the WMF structure is also described. Elements of the broader C&R Plan scope beyond those directly associated with WMF construction are not included.

4.4 Waste Management Facility Description

4.4.1 Design Capacity

4.4.1.1 Volume Estimates

The ICRP volume estimates for materials potentially directed to the WMF were based largely on impacted soil volume estimates developed by Imperial and its consultants over the years. Current material volume estimates are summarized in Table 4-1 (from Advisian WorleyParsons 2017).

4.4.1.2 Volumes Directed to Treatment

The ICRP incorporates the concept of treating the proportion of soils for which proven and available technologies can reliably produce soils meeting CCME industrial criteria at costs that are competitive with disposal in the WMF. The understanding of treatable soil volumes will evolve and become more reliably defined as progressive reclamation operations continue in the years ahead. Table 4-1 identifies the proportion of soils described as potentially treatable by Imperial (via Advisian WorleyParsons 2017). This proportion has been defined largely as a function of the fraction of benzene, toluene, ethylbenzene, xylene (BTEX), F1 and F2 hydrocarbons described in site characterization data. This may or may not align with the soil volumes ultimately found to be treatable.

4.4.1.3 Closure Volume Uncertainty

Table 4-1 represents the current best estimates of impacted material volumes on the Operations. The proportion of this volume that might ultimately require consolidation in the WMF at closure will be influenced by a variety of issues or factors, specifically:

- Estimating Uncertainty: there are always limits to the characterization data that can reasonably be compiled for individual source areas, and the resulting uncertainty produces the estimating variance that is reflected in the Table 4-1 figures. Imperial is continually expanding the characterization dataset through its regular monitoring and operational activity, and this may, over time, reduce uncertainty in the volumes estimated for closure (i.e., support a lower estimating variance than is reflected in Table 4-1).
- Risk Assessment Outcomes: in the period leading up to closure, Imperial will continue to evaluate and assess the risks that select source areas could pose in the post closure landscape. These assessments may demonstrate that better environmental outcomes could be offered by containing and/or managing some materials in place, rather than via removal and consolidation in the WMF. Any judgements in this regard would be made considering the general closure principal that seeks to limit the areal footprint of source areas post closure (see Section 4.2.1). An example of a source area that Imperial will consider applying this review of the benefits and risks of in-place containment would be the Bear Island sumps.
- Treatment Performance Limits: as noted previously, there is uncertainty about the proportion of F1 and F2 hydrocarbon impacted materials listed in Table 4-1 that can be addressed in treatment Operations at Norman Wells. Imperial will be continuing evaluations of treatment performance limits in the period leading up to closure, and outcomes that would increase the treatable proportions of the inventory beyond the conservative representations in Table 4-1 are possible.
- Technology Developments: final closure of the Operations will not occur for some time and it is possible that advances in treatment technologies, characterization techniques and/or risk assessment methodologies and protocols will influence the considerations of estimating uncertainties, environmental risks and treatment performance limits described above. These developments will, in turn, influence material volume estimates and are more likely to reduce than increase predicted volumes, given the conservative nature of the Table 4-1 figures.
- Ongoing Operations: there is the potential for additional impacts to soil occurring during the remaining period of NWO. These incremental volumes will influence the total inventory ultimately reporting to the WMF.

Norman Wells WMF Phase 2 Design & Regulatory Development

CER OA Amendment Application

Table 4-1: Contaminated Material Volume Estimates



Waste Material	Fraction	Location/Component	Mass (tonnes)	Volume (m ³) ⁴
Impacted Soil ¹	Non Treatable	Artificial Islands	10,360	5,600
		Bear and Frenchy's Islands	316,350	171,000
		Goose Island	8,695	4,700
		Mainland Sumps	142,450	77,000
		Mainland	306,360	165,600
	Potentially Treatable (F1 + F2 Hydrocarbons)	Artificial Islands	3,700	2,000
		Bear and Frenchy's Islands	68,450	37,000
		Goose Island	10,915	5,900
		Mainland Sumps		-
		Mainland	534,465	288,900
Total Soil			1,401,745	757,700
Positive Estimating Variance (%) ⁵			25	
Assumed Minimum Treatable Fraction (%) ⁵			10	
Soil Volume				861,023
Soil Volume (Rounded)				860,000
Demolition Waste ²	All	Central Processing Facility	9,570	11,000
		Mainland Ancillary Buildings, Tanks and Equipment	6,438	7,400
		Flowlines ³	2,088	2,400
		Wells	6,786	7,800
		Goose Island Terminals	861	990
		Bear Island Terminals	957	1,100
Demolition Waste			26,700	30,690
Total Volume				891,713
Total Volume (Rounded)				890,000

¹ Source: Advision WorleyParsons Group. Project No.: 407074-00821-100 - 2016 / 2017 Update. Table 2: Estimated Soil Volumes (m3) Exceeding Regulatory Guidelines. Includes volumes exceeding CCME Parkland criteria on the Islands and CCME Industrial criteria on the Mainland. Volumes rounded to 2 significant digits by Amec Foster Wheeler.

² Source: Amec Foster Wheeler. Norman Wells Operations 2017 Liability Estimate (draft). May 25, 2017. Volumes rounded to 2 significant digits. Includes materials that may generate net market recycle value.

³ Flowline volume adjusted from Amec Foster Wheeler (2016) to account for removal of flowlines and disposition to LTMF.

⁴ Based on soil density of 1.85 tonnes/m³ and demolition waste density of .87 tonnes/m³.

⁵ See Section 2 and Table 3 of AmecFosterWheeler (2017a) for derivation and rationale for these factors.

4.4.1.4 Waste Management Facility Design Volumes

There are a range of potential material volumes that could ultimately be directed to the WMF. To accommodate this uncertainty in material volumes, the WMF scope describes an initial phase (Phase 1) and two potential outcomes for the second phase (Phase 2) to describe a minimum and maximum potential footprint. It is anticipated that the final Phase 2 footprint will fall somewhere between these two limits. These WMF configurations are summarized as follows:

- Phase 1 WMF Development: this first phase of WMF development is planned for the near term (i.e., prior to closure) and involves consolidation of the MLS area materials within the WMF along with that proportion of accessible Mainland area soils needed to dry and condition the sump materials.
- Phase 2 WMF Development: this second phase of WMF development is planned following closure of the Operations.
 - Phase 2 Minimum WMF Build-Out: This representation of a possible final WMF reflects the minimum material volume that could ultimately be directed to the facility (i.e., minimum anticipated WMF facility footprint).
 - Phase 2 Maximum WMF Build-Out: this representation of the second phase of WMF development would also occur following closure of the Operations and reflects conservative estimates of potential material volumes (i.e., maximum anticipated WMF facility footprint).

These scenarios have been selected to describe the development of the WMF over the near term (Phase 1) and to demonstrate the bounds of minimum and maximum size of the anticipated configurations second phase of the WMF following closure (Phase 2). These configurations are shown on Figure 4-1. Drawing CER2 shows the general arrangement of the Maximum WMF Build-Out scenario following NWO closure (note: the Minimum Build-Out configuration applies similar facility slopes and heights, along a comparatively short east-west axis).

4.4.2 Waste Management Facility Design

This section presents configurations for the WMF that reflect the range of material volume estimates described above. Configurations are provided for both the first, pre-closure phase of WMF development (i.e., Phase 1) and the final post closure build-out of the WMF (i.e., Phase 2).

4.4.2.1 General Arrangements and Sections

General arrangements and sections for the WMF are provided on Drawings CER1 through CER4. The first three drawings show the location, configuration and top elevations for the Phase 1, Phase 2 (Minimum) and Phase 2 (Maximum) configurations of the WMF. The last drawing shows sections or profiles at the north-south and east-west midpoints of the Phase 1 structure (similar sections and profiles apply for the Phase 2 configurations).

4.4.2.2 **Containment Concepts**

Base Containment

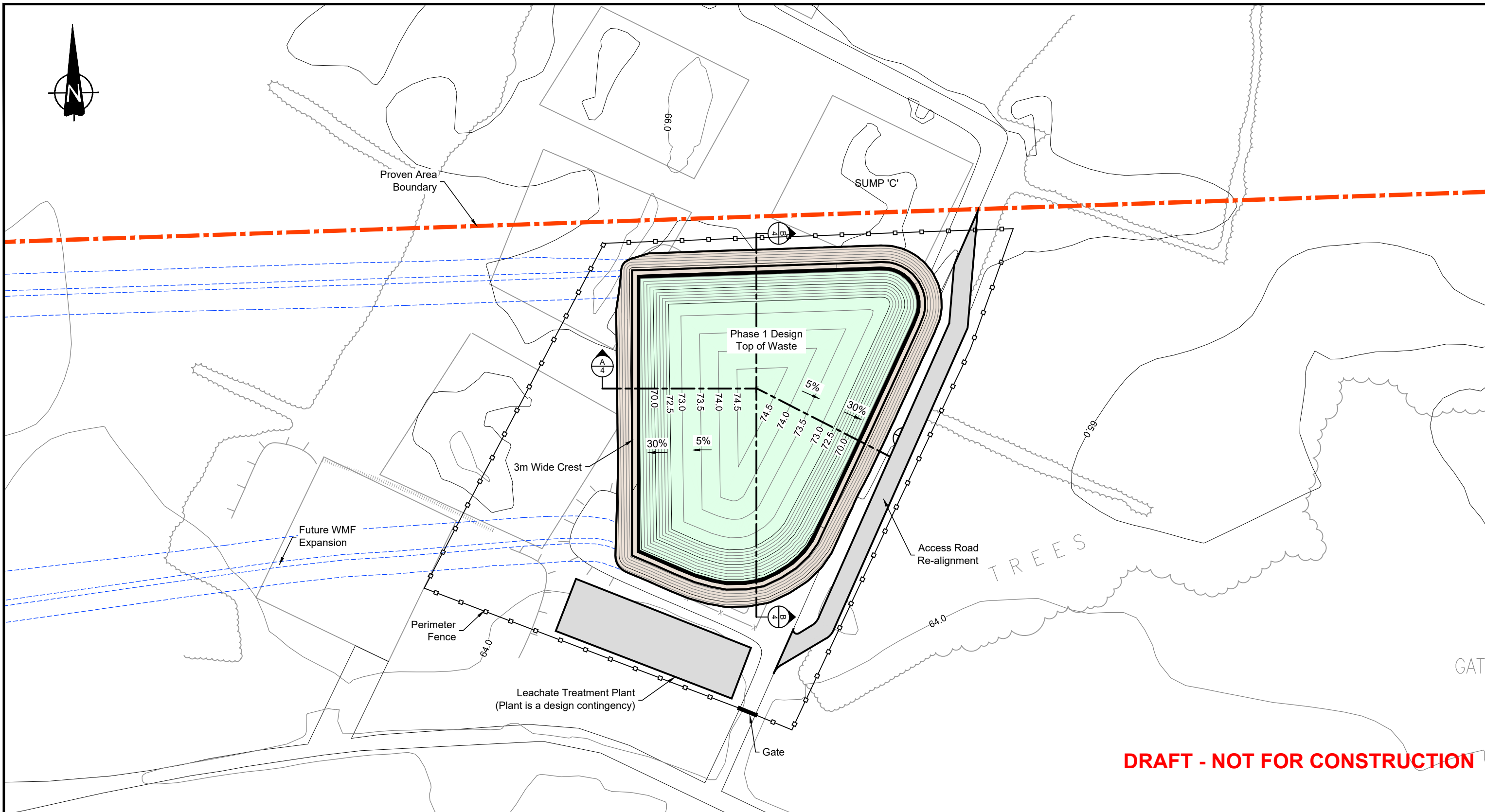
The typical base containment detail is comprised of the following elements (from the impacted soil down). See Drawing CER5:

- Geotextile: limits the migration of fines from the impacted soils into the underlying drainage system;
- Drain rock: the drainage layer that collects leachate from the overlying impacted soil;
- Geotextile: limits the loss of fines from the drain rock into the underlying sand cushion;
- Sand cushion: this hydraulically transmissive layer provides physical protection to the underlying geosynthetics from the larger particle sizes and potentially angular drain rock;
- Composite layer: the primary contaminant barrier comprised of a HDPE geomembrane overlying a GCL;
- Lower geomembrane: the lowest element of the base liner is a secondary HDPE geomembrane which mitigates concerns about local groundwaters impinging on the base containment; and
- Geotextile: this lower geotextile would provide cushioning for the overlying geosynthetics.

Cover System

The typical cover system detail is comprised of the following elements (from the impacted soil up, see Drawing CER5):

- Geotextile: this initial layer contacts the impacted soil, provides cushioning for the overlying geosynthetics and would facilitate gas venting for any methane or other vapours generated by the soil;
- GCL: this GCL is a component of the cover's composite barrier that is designed to limit the potential for leachate generation;
- Geomembrane: the LLDPE material that forms the upper component of the cover system's composite barrier layer;
- Geosynthetic drainage layer: this combination of a geonet and upper geotextile (to limit fines ingress) provides the drainage that will limit the buildup of hydrostatic pressures in the overlying cover soils (and, hence, maintain their stability); and
- Cover soil: this layer of local overburden, preferentially selected to increase fines and organic contents, will be placed to retain the surface moisture needed to sustain a vegetative cover.



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LEGEND

- Future WMF Expansion
- WMF Base and Berms
- Contaminated Soil

0m 20 40 60 80
1 : 2000

CLIENT:

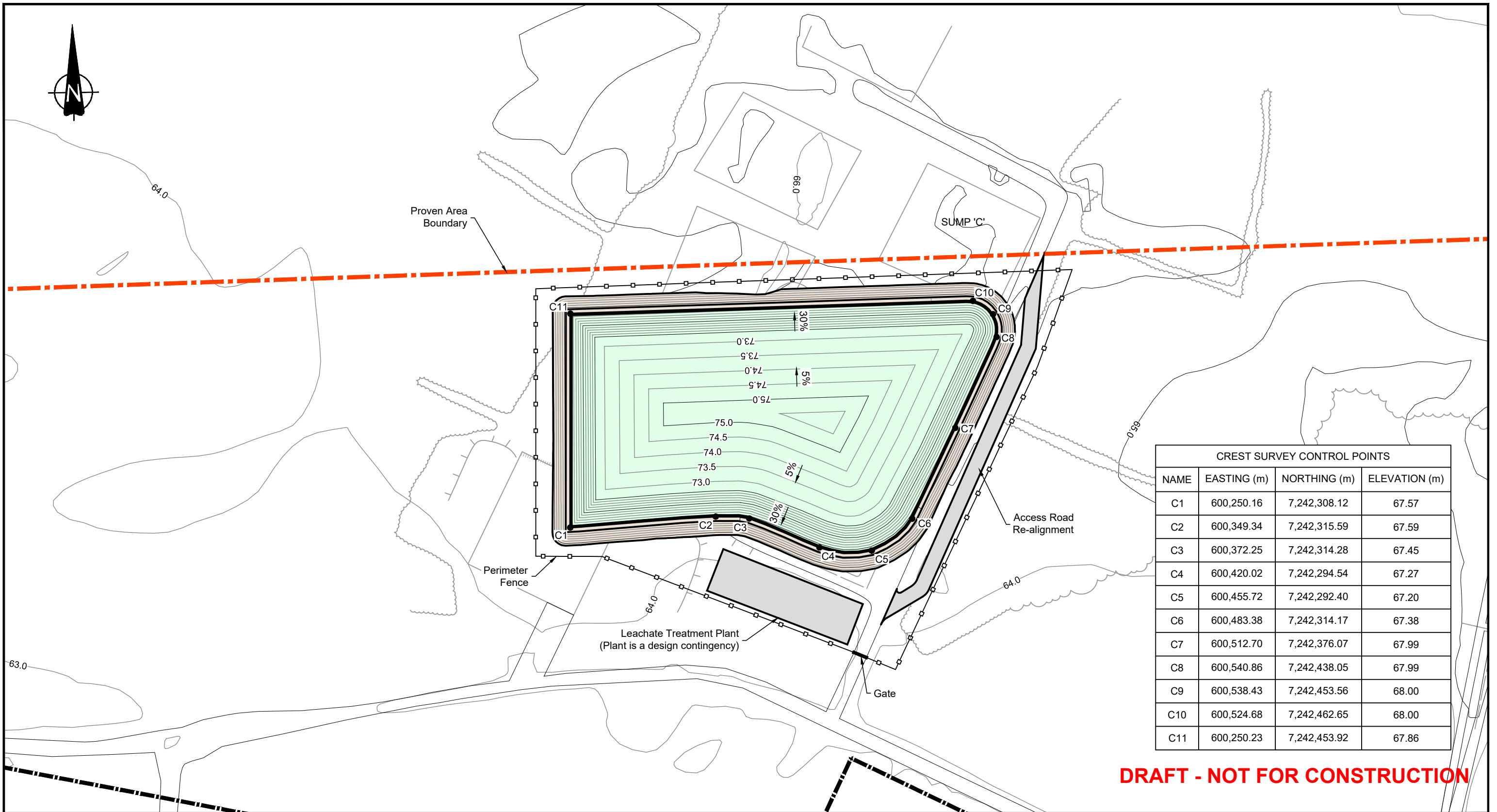
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wood.
Environment & Infrastructure Solutions
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PHONE 403-387-1639

DWN BY:	MDDS
CHK'D BY:	BG
DATUM:	-
PROJECTION:	-
SCALE:	AS SHOWN

PROJECT:	NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN FDB UPDATE
TITLE:	WMF PHASE 1 TOP OF WASTE PLAN FOR 144,000 m ³ STORAGE CAPACITY

DATE:	AUG. 2021
PROJECT No.:	CE04944.1000
REV. No.:	A
DWG. No.:	CER1



CREST SURVEY CONTROL POINTS			
NAME	EASTING (m)	NORTHING (m)	ELEVATION (m)
C1	600,250.16	7,242,308.12	67.57
C2	600,349.34	7,242,315.59	67.59
C3	600,372.25	7,242,314.28	67.45
C4	600,420.02	7,242,294.54	67.27
C5	600,455.72	7,242,292.40	67.20
C6	600,483.38	7,242,314.17	67.38
C7	600,512.70	7,242,376.07	67.99
C8	600,540.86	7,242,438.05	67.99
C9	600,538.43	7,242,453.56	68.00
C10	600,524.68	7,242,462.65	68.00
C11	600,250.23	7,242,453.92	67.86

DRAFT - NOT FOR CONSTRUCTION

LEGEND

- - - Proven Area Boundary
- WMF Berms
- Waste Placed

0m 20 40 60 80 100
1 : 2500

CLIENT:

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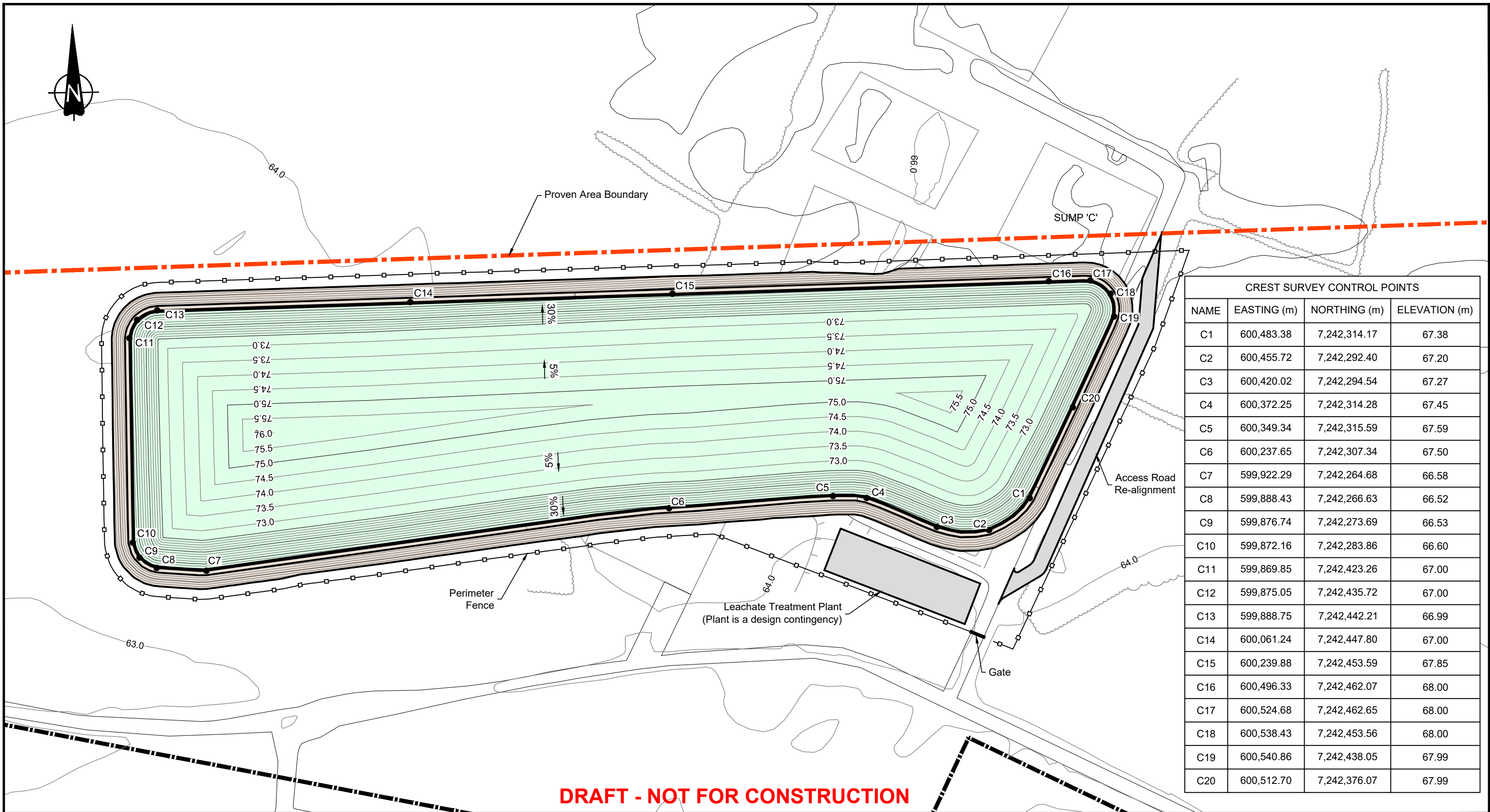
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DWN BY: MDDS
CHK'D BY: BG
DATUM: -
PROJECTION: -
SCALE: AS SHOWN

PROJECT: **NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN FDB UPDATE**

TITLE: **MINIMUM WMF FOOTPRINT BUILD-OUT STORAGE CAPACITY 325,000 m³**

DATE: AUG. 2021
PROJECT No.: CE04944.1000
REV. No.: A
DWG. No.: CER2



DRAFT - NOT FOR CONSTRUCTION

LEGEND

- Proven Area Boundary
- WMF Berms
- Waste Placed

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1 : 2500

CLIENT:
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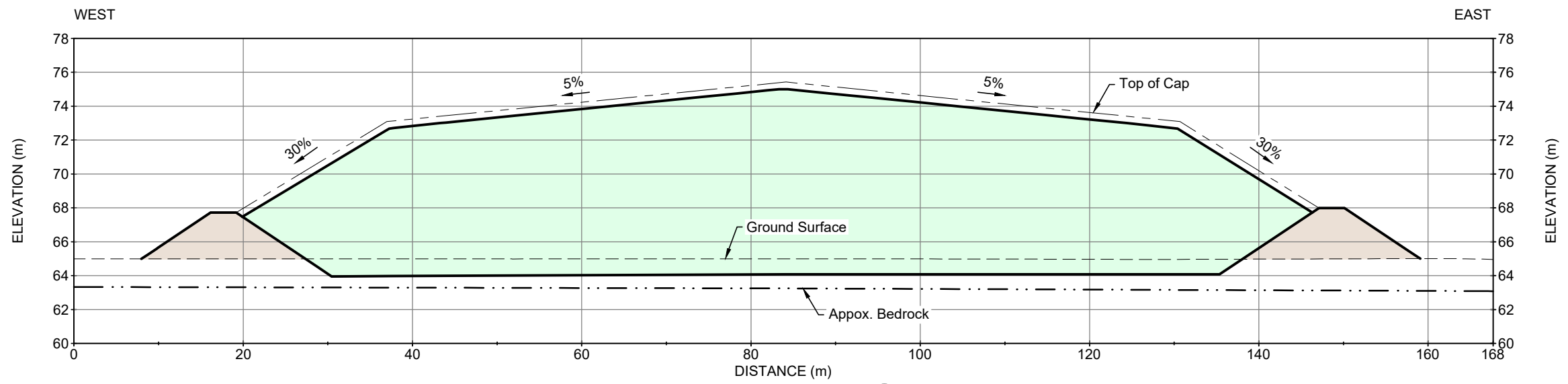
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PHONE 403-387-1639

DWN BY: MDDS
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SCALE: AS SHOWN

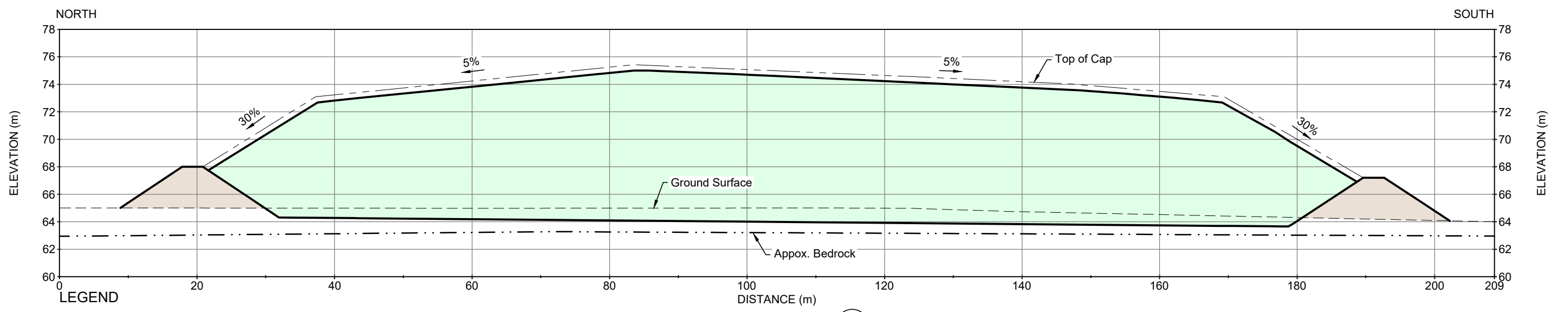
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TITLE: **MAXIMUM WMF FOOTPRINT BUILD-OUT STORAGE CAPACITY 900,000 m³**

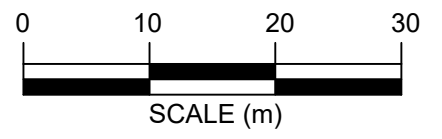
DATE: AUG. 2021
PROJECT No.: CE04944.1000
REV. No.: A
DWG. No.: CER3



CROSS SECTION **A**
2x Vertical Exaggeration



CROSS SECTION **B**
2x Vertical Exaggeration



LEGEND		
-----	Existing Ground	WMF Berms
- . - . - .	Approx. Bedrock	Impacted Soil
—————	Design	
-----	WMF Cap	

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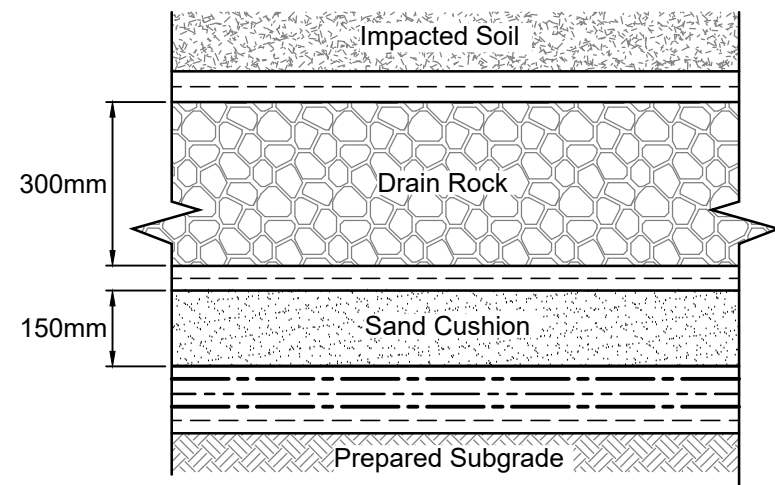
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PROJECTION:	-
SCALE:	AS SHOWN

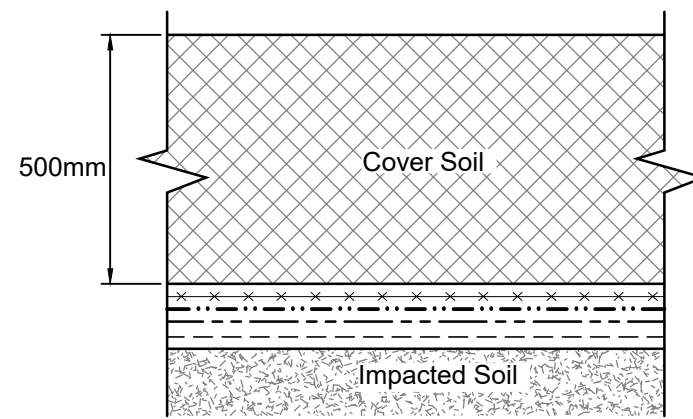
PROJECT: **NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN FDB UPDATE**

TITLE: **WMF PHASE 1 CROSS SECTIONS 'A' AND 'B'**

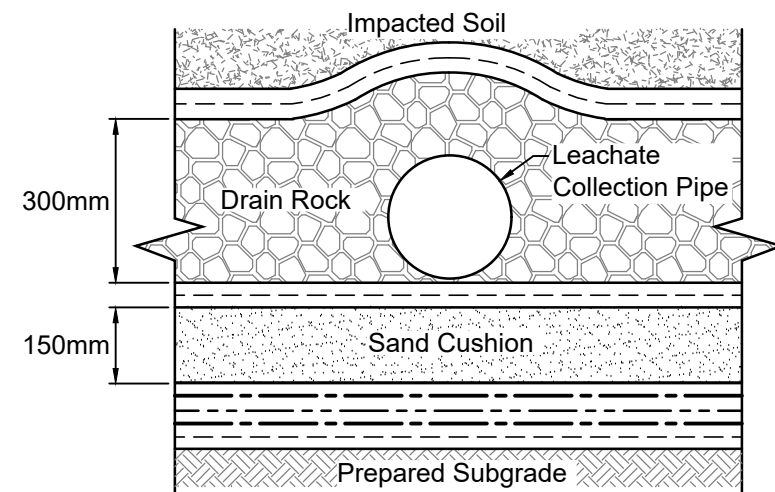
DATE:	AUG. 2021
PROJECT No.:	CE04944.1000
REV. No.:	A
DWG. No.:	CER4



1 TYPICAL SECTION ON BASE
NTS






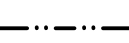
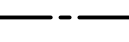
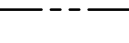
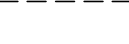



3 TYPICAL SECTION CAPPING
NTS



2 TYPICAL SECTION AT LEACHATE
COLLECTION PIPE ON BASE
NTS

LEGEND

-  Cover Soil
-  Drain Rock
-  Sand Cushion
-  Impacted Soil
-  Prepared Subgrade
-  LLDPE Geomembrane
-  HDPE Geomembrane
-  Geosynthetic Clay Liner
-  Geotextile
-  Geosynthetic Drainage Layer (Geonet with Geotextile)

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DATUM: -
PROJECTION: -
SCALE: AS SHOWN

PROJECT: **NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN FDB UPDATE**

TITLE: **WMF CONCEPT COVER AND LINER DETAILS**

DATE: AUG. 2021
PROJECT No.: CE04944.1000
REV. No.: A
DWG. No.: CER5

4.4.2.3 Borrow Material Sources

Sources of common, unimpacted fill will be required for the WMF perimeter berms, cover landforms and access roads and perimeter ditch berms. It is anticipated that these borrow volumes will be sourced from Mainland areas (i.e., within the PA boundary) adjacent to impacted material excavations.

4.4.3 Leachate Treatment Designs

Leachate treatment capability for the WMF will be a design contingency (i.e., developed if and when required). Actual leachate volumes are subject to considerable variability and an observational approach to leachate management has, therefore, been adopted to allow for a fit-for-purpose treatment system design if this is required. During early stages of the WMF operation, Operations will use the leachate storage available in the WMF facility and existing downhole injection facilities to manage leachate. As volumes are monitored, a leachate treatment system will be designed if and when required to be fit-for-purpose (and right-sized for treatment volumes) based on what is needed. This approach is important because it is possible that while volumes will be significant enough to warrant system development, they may be too low to justify or support continuous operation of the smallest, technically viable system throughput capacity.

The Project, and the Operations, are well positioned to support an observationally driven approach to defining leachate management requirements because the WMF facility itself will offer significant leachate storage which, in turn, will provide time for responding to observed conditions, and because of the availability of the Operations' downhole disposal capacity in the interim.

If a leachate treatment capability is ultimately found to be necessary, it would likely be developed in the area at the southeast corner of the WMF site shown on CER Drawings 1 through 3.

4.4.4 Surface Water Management

4.4.4.1 Scope

Providing positive surface drainage for the WMF property (i.e., the area within the facility fence) will be important for maintaining the long-term performance and physical integrity of the WMF cover and its associated landforms. Cover systems and features will perform most effectively if water is drained and not allowed to accumulate in contact with barriers, or where freezing will exacerbate erosion potentials. The WMF drainage concept incorporates a perimeter drainage ditch at the toe of the WMF berm which directs surface water to a collection sump at the southwest corner of the facility. The sump will connect to an HDPE discharge pipeline running south, through the main Operations property to discharge on the Mackenzie River escarpment. All of these surface water discharges will be managed in alignment with SLWB Water Licence requirements.

4.4.4.2 Site Features

The proposed WMF property is in a poorly drained area with little topographic relief. The elevation of Seepage Lake to the north is within a metre or two of ground level at the proposed interface with the WMF berm. Providing positive gravity drainage will require the conveyance of surface flows to the topographic relief offered by the Mackenzie River escarpment to the south.

4.4.4.3 Design Concepts

Drawing CER6 illustrates surface water management concepts for the various potential configurations of the WMF. The concept common to all calls for a perimeter drainage ditch at the toe of the WMF berm discharging to a collection sump at the southwest corner of the facility. The sump would be serviced by a pipeline that would run south, through the main Operations property to discharge on the Mackenzie River escarpment. Note that this sump and discharge line would also be required to service Phase 1 WMF development and would, therefore, be constructed as an early component of site development. Drawing CER6 includes a typical section for the perimeter ditch.

4.5 Source Material Removals

4.5.1 Impacted Soils

4.5.1.1 Locations

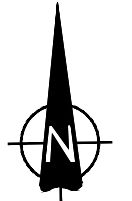
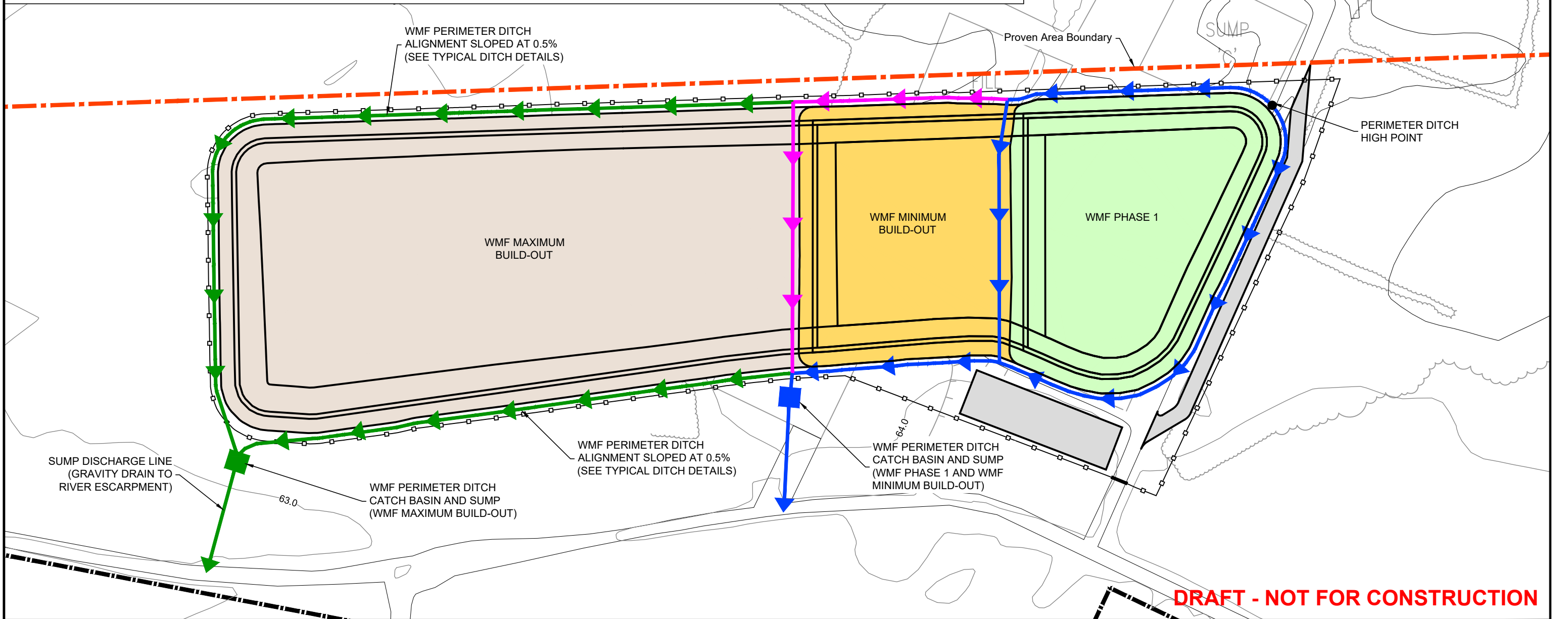
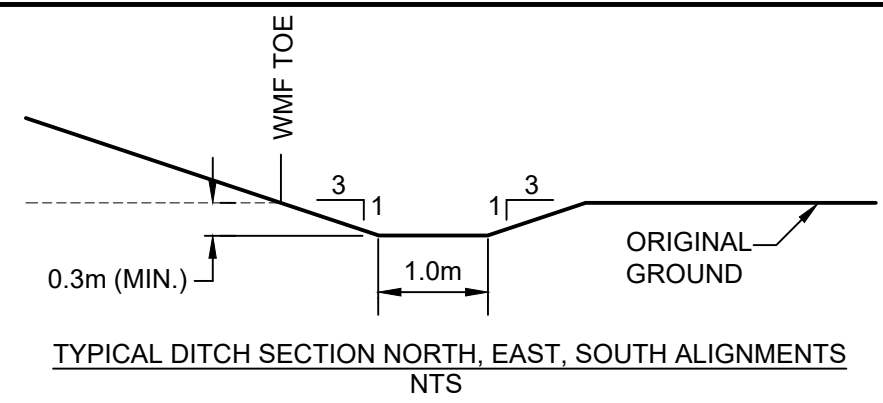
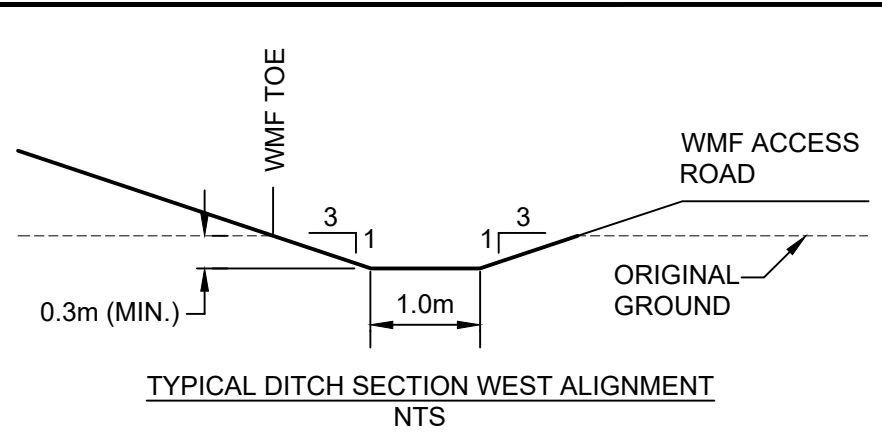
The distribution of the impacted material volumes described previously and summarized in Table CER1 is illustrated on Figure 4-2. The aerial extent of impacted soils is shown as circles of various diameters and colours with larger soil volumes represented by progressively larger circles and depth represented by colour. Red circles are indicative of relatively shallow impacts and represent the total source area volume as a circular perimeter extending to 2 m. Similarly, blue circles are indicative of relatively deep impacts and represent source area volumes within circular perimeters extending to 4 m. It is important to note that these figures are rough constructs developed to illustrate the general distribution of impacted materials and to support preliminary facility planning and siting. The actual distribution of impacted materials for any individual source can vary significantly from this representation.

4.5.2 Materials Management Methods

4.5.2.1 Excavation and Transport

Characterizations of impacted source materials and/or the site stratigraphy have not identified features or conditions that would suggest that specialized excavation and transport equipment will be needed to support the materials relocation scope. Relocations are anticipated to be executed using conventional heavy civil earthmoving equipment that is commonly used on northern mining projects (e.g., CAT 336 excavators, CAT 770 Wiggle Wagons), and is likely to be owned by, or accessible to, potential contractors.

Transfers to and from the natural and artificial islands will be undertaken during the winter via an ice road similar to those constructed and maintained by Imperial as a part of current facility Operations.



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LEGEND

- - - Proven Area Boundary
- WMF PHASE 1 DRAINAGE
- WMF MINIMUM BUILD-OUT DRAINAGE
- WMF MAXIMUM BUILD-OUT DRAINAGE

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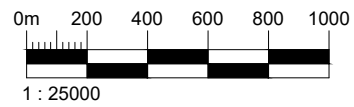
DWN BY:	MDDS
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DATUM:	-
PROJECTION:	-
SCALE:	AS SHOWN


PROJECT:	NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN FDB UPDATE
TITLE:	WMF SITE DRAINAGE CONCEPTS

DATE:	AUG. 2021
PROJECT No.:	CE04944.1000
REV. No.:	A
DWG. No.:	CER6



 Zone with 2m Depth
 Zone with 4m Depth



CLIENT: IMPERIAL OIL LIMITED 	DWN BY: MDDS CHK'D BY: BG DATUM: NAD 27 PROJECTION: ZONE 99 SCALE: AS SHOWN	PROJECT: NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN TITLE: QUANTITY DISTRIBUTION MAP NWO PA INDUSTRIAL ON THE MAINLAND PARKLAND ON THE ISLANDS	DATE: DEC. 2015 PROJECT No.: CC4058.300 REV. No.: A FIGURE No.: FIGURE 4-2

4.5.2.2 Sequencing

The sequencing of material relocations will be defined by the seasonal constraints associated with transfers to and from the islands, the likely capacity limitations of potential contractors and Imperial/stakeholder objectives for major Project completion milestones.

The current relocation concept assumes that the relatively small volumes of Goose Island soils will be staged via ice road to Bear Island and that the Bear and Goose Island inventories will also be transferred to the Mainland via an ice road. Winter source excavations on the islands would be managed to maximize the maintenance of an unfrozen cut face that could then be removed, transported and placed directly into the WMF before freezing. The first frozen cut on the islands and any other frozen proportions of the inventory (e.g., after shutdowns) would be directed to an interim Mainland stockpile for thawing and placement during the following summer season.

The concept also assumes that impacted materials from the natural islands (i.e., Bear and Goose) will be relocated to the Mainland over one winter season; an assumption that is judged as reasonable given Imperial's experience with ice road construction and seasonal capacity, and the comparatively small material volumes on the artificial islands.

4.5.3 Dismantling and Demolition Wastes

D&D activity is included in the proposed OA scope because removal and relocation of these materials is required to complete construction of the WMF.

4.5.3.1 Above Grade Structures and Infrastructure

The deconstruction of above grade structures and equipment will be executed according to sequencing and protocols defined by detailed plans developed at the time of closure. Individual plans will be structure or area specific, but will likely incorporate a series of general stages similar to the following:

- Task 1: will include the setup of worker decontamination systems, building/work area containment systems, removal of miscellaneous smaller equipment and debris, packaging/removal of any hazardous drums, external cleaning of pipes, equipment and vessels, and wrapping/packaging of pipes, equipment and vessels.
- Task 2: will include the removal of packaged piping, equipment and vessels to access all areas of the building/work area. Any wastes will be moved to a temporary Waste Staging Area.
- Task 3: will include the demolition of the building/work area with excavators, shears, torch crews and labourers. Non-hazardous waste will be classified and transported to a temporary Waste Staging Area and thereafter to recycling, salvage or to the WMF; packaged hazardous waste will also be classified and transported to the temporary Waste Staging Area prior to shipment off-site.
- Task 4: will involve final building/work area clean-up, packaging, classification, and transport of final waste streams to the temporary Waste Staging Area.

Detailed plans for the removal or recovery of marketable equipment and materials will also be facility specific and will be integrated appropriately within the general D&D execution framework outlined above.

4.5.3.2 Foundations

Non-impacted foundation elements (generally concrete slabs, pedestals, grade beams and/or footings, and steel pipe piles) will be cut and removed to depths ranging between 1.5 and 2.0 m below final reclaimed surfaces. Specific depths will be established on an area specific basis in the detailed execution plans.

Foundation elements with surfaces known to be impacted (e.g., oiled concrete slabs), or that cannot be confirmed to be non-impacted, will be excavated and removed entirely, and managed thereafter as impacted rubble (i.e., directed to the WMF).

4.5.3.3 Dismantling and Demolition Material Quantities

Table 4-1 provides the estimated tonnage associated with the buildings and equipment inventory at the Operations. At this preliminary level of C&R planning, it was conservatively assumed that this entire inventory would require management and disposition as waste. In fact, a proportion will likely have a net market value and will be recovered for reuse or recycling.

4.6 Monitoring, Operations and Maintenance

4.6.1 Waste Management Facility Environmental Management Plan

Imperial has developed a management plan (Imperial 2021a) that describes how the WMF will be monitored and maintained during construction and operation to meet the following objectives:

1. confirm the effectiveness of the containment system to prevent contact of impacted materials with the surrounding environment;
2. identify maintenance requirements to ensure the containment system is operating per the design standards;
3. identify any potential releases to the surrounding environment;
4. define the appropriate response in the event of a release; and
5. determine leachate management requirements.

The management plan addresses the key components or elements of WMF operations, specifically, surface water, groundwater, leachate, and cover performance.

4.6.2 Surface Water

After construction, surface water will be monitored to confirm the separation between precipitation and impacted materials in the WMF. Monitoring will also include inspections of drainage ditches and sampling and testing of surface waters (see Drawing CER6). Water samples will be tested using the protocols defined in the Imperial's QAQCM for the NWO (Imperial 2021c). The results of this monitoring will be included in the NWO's Annual Water Use Report.

Following construction, surface water on and around the WMF site has no contact with impacted materials and is not anticipated to require treatment. During construction, water will be impounded and tested prior to release to either the injection well (if impacted) or the watershed (if not).

4.6.3 Groundwater

Groundwater will be monitored by a series of wells (see Drawing CER7) installed around the edge of the WMF to ensure the containment system is functioning as intended and impacts are not leaching into the groundwater. Monitoring wells will target the groundwater table and the upper bedrock aquifer. Monitoring data will be collected in accordance with the sampling frequency and methodology outlined in the Imperial's Groundwater Monitoring Plan for the NWO (Imperial 2021f) and results will be included in the NWO's Annual Water Use Report.

4.6.4 Leachate Monitoring

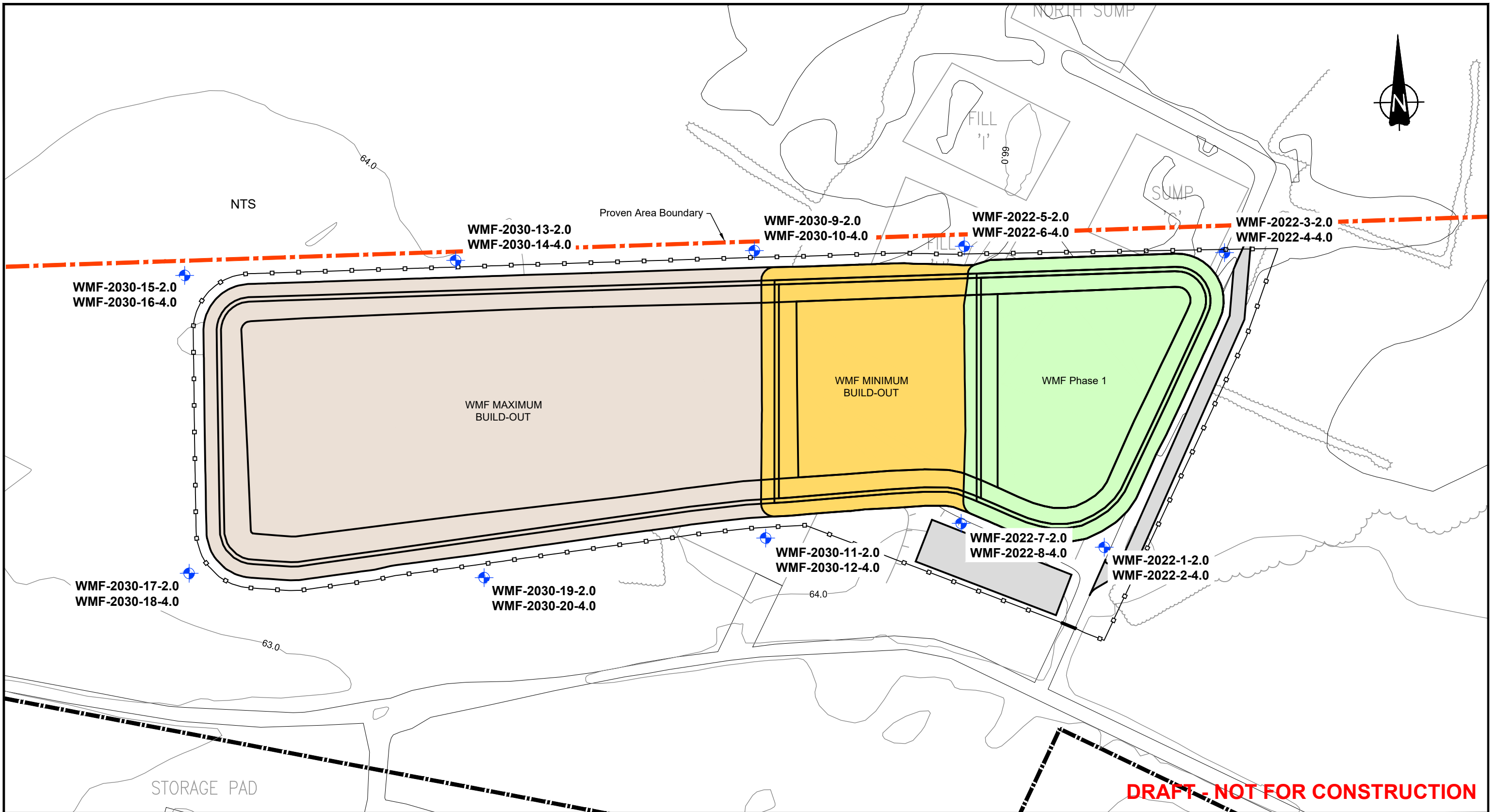
Leachate will be monitored to determine if a leachate treatment plant is needed and to validate the effectiveness of the cover and liner systems. The anticipated range of leachate volumes fall within the capacity of the existing on-site injection well, F-31X. Leachate volumes will be disposed of through the injection well until leachate volumes exceed the capacity of the well or the water quality of the leachate requires separate treatment, at which time a wastewater treatment facility will be installed to manage produced leachate. Leachate sampling will apply the water testing protocols prescribed in Imperial's Groundwater Monitoring Plan for the NWO (Imperial 2021f).

4.6.5 Cover

The cover will be monitored to confirm that it is not damaged and/or leaking and to assess the conditions of any cover vegetation. Inspections will identify issues and will be used to plan maintenance activities such as restoration of cover vegetation, repair of erosion, or repair of the cover itself. The results of inspections will be reported in the NWO's Annual Water Use Report.

4.6.6 Contingencies

The WMF EMP outlines appropriate responses to monitoring outcomes that indicate assessment, maintenance and/or mitigation is required to ensure the WMF continues to function as intended. Separate descriptions of the response hierarchies for the groundwater, surface water, leachate, and cover integrity components of WMF monitoring are provided.



DRAFT - NOT FOR CONSTRUCTION

LEGEND

- Proven Area Boundary
- Proposed WMF Monitoring Well (Water Table & Bedrock Completions)

CLIENT:

IMPERIAL OIL LIMITED

DWN BY:	MDDS
CHK'D BY:	BG
DATUM:	-
PROJECTION:	-
SCALE:	AS SHOWN

PROJECT:	NORMAN WELLS INTERIM CLOSURE AND RECLAMATION PLAN
TITLE:	WMF GROUNDWATER MONITORING LOCATIONS

DATE:	OCT. 2020
PROJECT No.:	CE4839.0020
REV. No.:	A
FIGURE No.:	CER7

4.7 Design Development Status

The current WMF design has been developed to Stage 2 as defined by Imperial's Project development process. Broadly, this stage is described as the Concept Select phase of design development. The current WMF designs provide concepts, general layouts and profiles, and preliminary designs and details for key WMF components. The following activities capture the investigation, study and design activity that will be required to progress design development during Stage 3 (Optimization/FEED/Execution Planning) and early Stage 4 (Detailed Design and Procurement).

- site investigations:
 - supplementary geotechnical investigation (Phase 2 footprint);
 - compilation of detailed topographic data;
- detailed source area removal planning;
- sump material mixing/drying protocols and schedules;
- detailed WMF liner and cover barrier assessments;
- cover landform assessment, selection and design;
- WMF containment system water balance and thermal modelling;
- detailed water management plans (during and post construction);
- final cover geotechnical stability assessments;
- detailed borrow area selections and operational and reclamation designs;
- final WMF design Failure Modes and Effects Analysis (FEMA Study);
- development of construction QA/QC Plans; and
- development of construction specifications and work packages.

5.0 SAFETY PLAN

The WMF Safety Plan will draw heavily from the current NWO OA Safety Plan because the latter document provides a comprehensive description of the overarching safety management processes and systems that apply to all of Imperial's Operations at Norman Wells, including those with scope elements similar to the proposed WMF development.

Table 5-1 describes more specifically how the current OA Safety Plan will be applied to WMF development and operations. The table outlines the key hazards and/or safety issues that will be relevant for the WMF development. The current understanding of these hazards and issues has been derived from the key planning and design development documents supporting the current preliminary WMF design, specifically, the ICRP (Imperial 2016) and the WMF FDB (Wood 2021). This description of safety hazards will be defined with more resolution as the WMF design development progresses and as Imperial integrates the OA WMF Safety Plan requirements with contracting safety plans during the procurement and construction management phases of the Project. The hazard identification processes in Imperial's standing safety management processes will be central to this process of integrating safety objectives, processes, and activities within the detailed Project Execution Plan.

Table 5-1: Waste Management Facility Safety Plan

CER Safety Plan Requirement	Related WMF Development and/or Operational Activity	Hazards and/or Other Safety Issues	Description Overview	Document References
1. Safety Management Systems and Related Organization Structures	All	All	<p>Construction, operation and maintenance of the WMF will be undertaken pursuant to the Safety Plan that forms part of the current NWO OA-1210-001. That plan describes Imperial's safety policy, outlines that Operations Integrity Management System (OIMS) that Imperial applies to execute safety policy and details the various technical and management tasks that are delivered under the OIMS structure to establish and sustain safe operations. Key excerpts from the Safety Plan follow.</p> <p><u>Operations Integrity Management System</u> The Imperial OIMS has been in place since 1992 and forms the overall framework for Imperial Operations. OIMS includes systems designed to ensure the establishment of processes and procedures necessary to comply with the laws, regulations and internal requirements related to Safety, Security, Health, and Environment (SSHE) and is aimed at reducing the SSHE risks inherent to the business activities.</p> <p>OIMS is embedded in day-to-day work processes to establish common expectations that every operating unit must fulfill to proactively manage risk. OIMS is implemented over the complete life cycle of a project – from exploration and development to production and reclamation – and ensures that management is accountable for results. It is expected that management comply with all OIMS requirements and conduct OIMS assessments of Operations annually.</p> <p><u>Elements of OIMS</u> OIMS provides a systematic, structured, and disciplined approach that is used across Imperial business and facilities and enables Imperial to measure progress and manage accountability in these areas. It also ensures appropriate public engagement with the communities in which Imperial operates.</p> <p>The Imperial Safety Management System addresses all aspects of occupational health and safety as well as off the job safety. Detailed procedures and processes relating to safety are included in the following OIMS documents:</p> <ul style="list-style-type: none"> • OIMS, System 5-4, "Personnel Safety" • OIMS, System 5-5, "Health Management" • OIMS, System 6-1, "Operating and Maintenance Procedures" • OIMS, System 6-4, "Work Management" • OIMS, System 8-1, "Contractor Selection and Management" 	NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014)
2. Safety Hazards and Associated Mitigations	All	All	<p>The current OA Safety Plan (SP) incorporates comprehensive processes for identifying and reporting hazards through all phases of project execution (construction, Operations, and maintenance. The SP notes that effective hazard identification and reporting includes, at a minimum, the following three components:</p> <ul style="list-style-type: none"> • reporting of specific hazards as they are identified; • regular review/inspection of the workplace for potential hazards; and • focused hazards hunts for specific issues (i.e., electrical, hand tools). <p>All levels of the organization are required to participate in the hazard identification program. There are numerous methods used to identify, report, and assess hazards. Scheduled methods are:</p> <ul style="list-style-type: none"> • Formal risk assessments (as required by OIMS System 2-1): <ul style="list-style-type: none"> – a formal risk assessment is more structured than any other hazard identification method; – formally scheduled and led by risk management specialists, these generally occur every 5-8 years or triggered by a screening level risk assessment; and – the OIMS Risk Assessment Matrix is used to plot probability and consequence for potential incidents. • Work site, loss-control inspections: <ul style="list-style-type: none"> – more regularly scheduled inspections used to identify faulty equipment or procedures or potential non-compliances; and – checklists are available for use by inspection teams. • Industrial hygiene surveys: <ul style="list-style-type: none"> – routine surveys by industrial hygienists focused on measurement of higher risk exposures. 	NWO OA-1210-001 Section 5.5.3 – Hazard Identification and Reporting Section 5.8.5 – Contractor Selection and Management (Imperial 2014)

CER Safety Plan Requirement	Related WMF Development and/or Operational Activity	Hazards and/or Other Safety Issues	Description Overview	Document References
2. Safety Hazards and Associated Mitigations (cont'd)	All (cont'd)	All (cont'd)	<p>Unscheduled (proactive) methods are those than can be completed by any worker any day and includes hazard identifications (HIDs); loss prevention observations and near-miss reporting. These proactive reports are discussed at morning meetings and reports that require follow-up action (i.e., HIDs) are logged into a proactive reports spreadsheet with risks accessed and assigned a person responsible for closure.</p> <p>Large portions of the WMF scope will be executed by contracted work forces. Imperial's OIMS includes a system for Contractor Selection and Management that provides a systematic approach for the selection of third-party suppliers of services (i.e., contractors) and subsequent management of interfaces to achieve continuous improvement in contractor Operations Integrity performance. The System covers requirements for requisition planning, evaluating, and selecting contractors, pre-mobilization planning, and interfaces for monitoring, evaluation, and feedback to the contractor. The System components are:</p> <ul style="list-style-type: none"> • contractors are qualified, evaluated and selected based on their ability to perform work in a safe, secure, and environmentally sound manner at the best total value; • a pre-mobilization process is in place to effectively communicate and develop interface plans; proactive actions are taken to address contractor supervisor and crew competency issues; • effective management of interfaces occurs between the Unit and contractors; and • contractor performance is monitored, feedback provided, and deficiencies corrected. 	
	WMF Construction	Civil Materials Movements	<p>WMF construction will be, to a large extent, a civil materials management program. Construction of earth containment berms will be followed by the excavation, transport, and placement of impacted soils from across the NWO PA. Some of the wetter materials in the inventory (e.g., drilling sump wastes) will require conditioning in mixing and drying processes that will again resemble civil materials handling exercises. While the scale of the civil operations will be large, there is nothing in the material characterizations and/or property characteristics that would suggest that specialized equipment and/or processes will be required. It is anticipated that the safety management systems and processes in the current OA SP will be appropriate and adequate for managing WMF construction activity. These civil processes are activities that have been routinely executed at the NWO, albeit typically at a smaller scale.</p>	<p>NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014) NWO ICRP Section 5.6 – Materials Management Plan (Imperial 2016)</p>
		Island to Mainland Transfers	<p>A portion of the impacted material inventory is on natural and artificial islands sites on the PA. These materials will be relocated to the WMF site via an ice bridge across the Mackenzie River. This unique relocation activity introduces some hazards that are not typically associated with materials management programs. However, Imperial has been sustaining ice bridge operations across the Mackenzie River for many years and has developed practices executed under the existing SP appropriate for sustaining safe operations. It is anticipated that the existing SP and Imperial's operational experience will be sufficient for executing the island transfers required to complete WMF construction.</p>	<p>NWO ICRP Section 5.6.3 – Materials Management Methods (Imperial 2016)</p>
		Geosynthetic Installations	<p>The base and cover designs for WMF make extensive use of geosynthetic materials (i.e., geotextiles, geomembranes, geonets and geosynthetic clay layers). Installation of these materials involves handling large, heavy rolls and materials over steep slopes, and introduces the associated safety hazards. Large scale handling of geosynthetics is not typically associated with activities on the NWO. However, the associated risks can be readily mitigated, particularly when using the specialist material suppliers and contractors that are typically employed for these installations. It is anticipated that the safety issues associated with geosynthetic installations can be effectively managed via application of the existing OA SP systems and protocols.</p>	<p>NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014) NWO FDB Section 6.0 – WMF Containment Designs (Wood 2021)</p>
		D&D Activity	<p>D&D activity is included in the proposed scope because removal and relocation of these materials will be required to complete the second, final phase of WMF construction (i.e., the phase undertaken at NWO closure). The scope of this activity is limited because of the relatively small proportion of the WMF inventory comprised of D&D wastes. Again, this kind of activity has been undertaken successfully at the NWO over the years under the auspices of the current OA Safety Plan, albeit at a smaller scale than will occur at closure. However, it is anticipated that the current SP systems and protocols will be appropriate for managing the safety components of D&D activity at NWO closure. Note that issues related to the identification and management of potentially dangerous and/or hazardous materials during D&D activity are also addressed under the EPP component of this amendment application (i.e., Table 6-1, entry #2).</p>	<p>NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014) NWO ICRP Section 5.5.5 – Building and Equipment (Imperial 2016)</p>

CER Safety Plan Requirement	Related WMF Development and/or Operational Activity	Hazards and/or Other Safety Issues	Description Overview	Document References
3. WMF Operations	Leachate Management	Leachate Monitoring	Leachate will be sampled via pipes installed within WMF berms that provide access to the leachate collection sump. Sampling techniques and processes will be similar to those outlined in the NWO GMP for groundwater monitoring. It is not anticipated that leachate monitoring would generate any safety risks incremental to the typical groundwater and surface water monitoring activities that are addressed by the current NWO SP.	NWO OA-1210-00 Section 5 – Safety Plan (Imperial 2014) NWO GMP Section 3.2 – Groundwater Sampling Program (Imperial 2021f)
		Leachate Transport and Disposal	It is anticipated that the WMF cover design will substantially limit, and potentially eliminate, leachate volumes requiring removal and disposal during WMF operations. Any volumes requiring removal will be transported via truck to the deep well injection facility that is a part of the current NWO. These handling and transport activities are within the scope of those currently addressed by the NWO OA SP. If leachate volumes and/or qualities encountered during WMF operations prove beyond the capabilities of injection facilities, alternate requirements and/or processes (up to and including the development of a stand-alone leachate treatment capability) are not anticipated to depart from the range of processes and safety hazards/risks contemplated by the current NWO OA.	NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014)
	Groundwater and Surface Water Management	All	Surface water management structures for the WMF will be gravity driven with no active operational requirement; neither will there be any requirement for active groundwater level management. Operational activities will be limited to monitoring the physical condition of drainage structures and water quality monitoring. The specific activities involved are described in the WMF EMP and the NWO GMP and QAQCM. The associated safety risks are within these contemplated by the current NWO OA SP.	NWO OA-1210-001 Section 5 – Safety Plan (Imperial 2014) WMF EMP – Surface Water Program Section and Groundwater Program Section (Imperial 2021a) NWO GMP Section 3.2 – Groundwater Sampling Program (Imperial 2021f) NWO QAQCM Section 5 – Surface Water Testing and Schedules (Imperial 2021c)
	WMF Maintenance	WMF Cover and Drainage Structure Repairs	WMF maintenance operations will focus on confirming the ongoing physical integrity and performance of the WMF cover and drainage structures. Where necessary, maintenance activity will likely involve the civil works needed to repair cover landforms, clear debris from drainage structures and mitigate erosion on structure slopes. In limited circumstances, repairs to cover geosynthetics may be required. All of these civil activities are similar to those associated with WMF construction, albeit at a much smaller scale. The associated safety risks will be mitigated and/or managed as described above in entries 1 and 2.	
4. Monitoring Safety Compliance	All	All	<p>Safety compliance monitoring is integrated throughout the various management tools and systems that comprise Imperial's Operational Integrity Management Systems (OIMS). Particular OIMS systems that integrate these compliance elements include:</p> <ul style="list-style-type: none"> • OIMS, System 6-4, "Work Management" • OIMS, System 5-5, "Health Management" • OIMS, System 6-1, "Operating and Maintenance Procedures" • OIMS, System 6-6, "Facility Integrity Management" • OIMS, System 8-1, "Contractor Selection and Management" <p>In addition, Imperial produces a full-length document annually called the Corporate Citizenship Report (available online at www.imperialoil.ca). This report identifies the economic, environmental, and social challenges, opportunities and issues of concern that Imperial engages in ongoing dialogue with stakeholders. The feedback received influences Imperial's business planning and promotes a greater understanding of corporate citizenship issues.</p> <p>Imperial focuses its corporate citizenship activities in six areas: safety, environmental performance, managing climate change risk, community relations, corporate governance, and economic development. Safety performance indicators have been developed to measure performance and are reported on in the report.</p> <p>Safety performance is reviewed monthly by all levels of Imperial management.</p>	NWO OA-1210-001 Section 5.6 – Safety Stewardship and Reporting, Section 5.7 – Safety Management Tools, and Section 5.8 – Other Management Systems that Interface with the Safety Management System (Imperial 2014)

6.0 ENVIRONMENTAL PROTECTION PLAN

The EPP requirements of the CER OA have been addressed by incorporating the WMF into the existing environmentally focused operating plans for the NWO and via an EMP developed specifically for the WMF (Imperial 2021a). The overarching NWO EPP outlines the environmental management and protection practices actively in place at Imperial. The Operations EPP clarifies the actions and responsibilities of employees and contractors to meet the intent of Imperial's Environmental Policy and manage Imperial's Environmental Aspects. Activities at the WMF will be governed by the management systems, procedures and protocols defined in this overarching plan.

The purpose of the facility specific EPP that has been incorporated into the WMF EMP is to provide additional detail about protection measures that apply particularly to the WMF. These measures are presented in the WMF EMP using tabular formats consistent with the SLWB's license application guidelines. These measures:

- reflect site and activity-specific conditions;
- align with applicable management plans submitted to the SLWB in association with Water Licence S13L1-007 and conditions (SLWB 2015);
- are consistent with the closure objectives and criteria established in the ICRP approved with conditions in January 2017 (SLWB 2017);
- meet applicable federal and territorial regulatory requirements and guidelines;
- consider engagement with affected community members, organizations, and parties;
- align with applicable land use planning information; and
- reflect consultation with land use regulators and government agencies.

Many of the mitigation measures are design considerations intended to reduce the impact of the facility on the surrounding environment. Additional measures are also included to reduce environmental effects during construction. Monitoring, as described in the WMF EMP, will extend beyond facility commissioning, and provide verification that the facility provides isolation of stored materials.

The environmental components or hazards impacted and/or created by the WMF have been identified and described in the NWO's ICRP (Imperial 2016), which also outlines the relationship between the WMF concept and the NWO's environmental objectives for closure. Additional definition of environmental issues/hazards is provided in the FDB for the WMF (Wood 2021), which also describes the WMF design concept and the bases for selection of key WMF design elements.

Table 6-1 describes more specifically how the CER's EPP requirements are addressed by the various NWO operating plans, the WMF EMP, the ICRP and the WMF design development documents.

Table 6-1: Waste Management Facility Environmental Protection Plan

CER EPP Requirement	Related WMF Development and/or Operational Activity	Impacted Environmental Component and/or Hazard	Description Overview	Document References
1. Environmental Management Systems and Related Organizational Structures	WMF Construction, Operations and Maintenance	All	<p><u>Operations Integrity Management System</u> Imperial's OIMS has been in effect since 1992 and forms the overall framework for Imperial's Operations. OIMS includes systems designed to ensure the establishment of processes and procedures necessary to comply with the laws, regulations and internal requirements related to SSHE.</p> <p>OIMS is embedded in day-to-day work processes to establish common expectations that every business unit must fulfil to proactively manage risk. OIMS is implemented over the complete life cycle of a project from exploration and development to production and reclamation. It provides a systematic, structured, and disciplined approach to identify and manage risk, measure progress, and ensure management accountability.</p> <p><u>Environmental Management System</u> The OIMS Framework contains principles and expectations that set the foundation for an Environmental Management System. The purpose of the Environmental Management System is to enable Imperial to conduct its business in a manner that is compatible with the balanced environmental and economic needs of the communities in which it operates. Under the umbrella of Imperial's Environmental Policy and regulatory standards, OIMS guides how Imperial manages environmental performance. OIMS includes the Environmental Management System framework which requires operations and development projects to identify how Operations interact with the environment ('environmental aspects') and how that interaction is managed through measurement, stewardship, risk assessment and risk mitigation.</p> <p><u>Environmental Responsibilities</u> Key roles and responsibilities related to environmental management at Norman Wells are outlined in the NWO EPP. All parties on-site are responsible for understanding and managing regulatory compliance. Bridging documentation identifies the key OIMS-related responsibilities and interfaces between Environmental & Property Solutions (E&PS) and NWO (SSHE coordinator and E&R Advisor). In addition, processes are in place to define on-site areas under the care and control of E&PS (versus NWO). Responsibility for implementation of the Environmental Aspects Protection and Mitigation Measures (described in Section 3 of the NWO EPP) depend on the care and control of specific on-site locations.</p>	<p>NWO EPP Section 2.3 – Operations Integrity Management System (OIMS) NWO EPP Section 2.4 – Environmental Management System NWO EPP Section 2.1 – Environmental Responsibilities (Imperial 2021b)</p>
2. Environmental Impacts/ Hazards and Associated Mitigative Measures	WMF Construction	Land, Vegetation and Wildlife Disturbance	<p>The Land and Vegetation Section of the NWO EPP lists the following measures proposed to mitigate the impacts of WMF development on the local landscape:</p> <ul style="list-style-type: none"> • implement erosion control measures as required during construction; • inspect the WMF for evidence of near surface soil erosion or displacement generated by precipitation running off the cover; • comply with municipal zoning requirements and siting offsets; • design the WMF as a landform compatible with surrounding land; and • revegetate the final WMF cap to be compatible with the reclamation plans for the overall site. <p>The EPP section of the WMF EMP includes a presentation of impacts and proposed mitigations for the abiotic components of the Project (i.e., Land, Water, Permafrost and Air). The discussion notes that the Project area lies within the boundaries of the Town of Norman Wells inside an area zoned as Heavy Industrial Lands. The footprint for first phase of development is owned by Imperial Oil and contains three existing brownfield sumps areas (mainland drilling sumps, well services sumps and northern sumps) that supported historical oil exploration activities. Effects on land have been reduced by selecting a site that is already impacted by previous industrial use and effects on water have been minimized by choosing a proposed site that is set back from the Mackenzie River, Bosworth Creek and other waterbodies. Table 4 of the WMF EMP outlines detailed mitigation measures for the Project's land component.</p> <p>The EPP section of the WMF EMP also includes a presentation of impacts and proposed mitigations for the biotic components of the Project (i.e., Vegetation, Wildlife and Aquatic Habitats). The discussion notes that the proposed WMF site consists of brownfield areas (existing sumps) surrounded by areas of undisturbed vegetation. Sumps are predominantly bare ground with some vegetation and small local patches of water. There are no known native rare plant species or identified traditional plant harvesting sites in the area. Similarly, there are no known threatened or endangered wildlife species or identified traditional hunting or trapping sites on the proposed WMF site. The Project is not expected to interact with the aquatic habitat. After construction, the cover of the WMF will be revegetated to be compatible with the reclamation plans for the overall site as part of cover stabilization. Table 5 of the WMF EMP outlines detailed mitigation measures for the Project's vegetation and wildlife components.</p>	<p>NWO EPP Section 3.2 – Land and Vegetation (Imperial 2021b)</p> <p>WMF EMP Table 4 - Potential Project Impacts and Proposed Mitigation Measures for Abiotic Components (Imperial 2021a)</p> <p>WMF EMP Table 5 - Potential Project Impacts and Proposed Mitigation Measures for Biotic Components (Imperial 2021a)</p>

CER EPP Requirement	Related WMF Development and/or Operational Activity	Impacted Environmental Component and/or Hazard	Description Overview	Document References
2. Environmental Impacts/ Hazards and Associated Mitigative Measures (cont'd)	WMF Construction (cont'd)	Groundwater Impacts	The Groundwater and Soil Section of the NWO EPP notes the following measures proposed to mitigate the groundwater impacts of WMF development: <ul style="list-style-type: none"> incorporate design features (e.g., cover and liner) to provide physical separation of impacted materials from local groundwater and surface water; and implement groundwater monitoring program to validate liner integrity. Groundwater monitoring will be initiated during WMF construction with characterization of local baseline conditions following placement of the WMF perimeter berms and prior to initial waste placements within the WMF. Thereafter, testing frequencies and methods will be per the requirements of the NWO's GMP (Imperial 2021f). Table 4 of the WMF EMP also describes the mitigation measures that will be applied to address impacts to the groundwater component of the Project.	NWO EPP Section 3.3 – Groundwater and Soil (Imperial 2021b) WMF EMP – Groundwater Program Section (Imperial 2021a) NWO GMP Section 3.2 – Groundwater Sampling Program (Imperial 2021f) WMF EMP Table 4 - Potential Project Impacts and Proposed Mitigation Measures for Abiotic Components (Imperial 2021a)
		Surface Water Impacts	The Surface Water Quality Section of the NWO EPP lists the following measures proposed to mitigate the surface water impacts of WMF development: <ul style="list-style-type: none"> incorporate a cover system as a physical barrier between impacted material and surface water; design a leachate management system capable of satisfying the Project's surface water quality objectives at the compliance boundary; design surface water management structures (e.g., drainage ditches, surface contours) to promote positive drainage and with capacity sufficient to accommodate storm events; and implement surface water monitoring program to ensure compliance with licence conditions. Table 4 of the WMF EMP also describes mitigation measures that will be applied to address impacts to the surface water component of the Project. In addition, the WMF EMP notes that during construction, the WMF will be categorized as a location where surface water impacts are anticipated and managed accordingly. Water accumulating in excavations will either be directed to the NWO's injection well or tested and confirmed compliant with specified criteria prior to release. Waters will be tested and managed pursuant to the NWO's QAQCM for surface water sampling, testing, and management (Imperial 2021c).	NWO EPP Section 3.4 – Surface Water Quality Management Monitoring (Imperial 2021b) WMF EMP – Surface Water Program Section (Imperial 2021a) NWO QAQCM Section 5 – Surface Water Testing and Schedules (Imperial 2021c) WMF EMP Table 4 - Potential Project Impacts and Proposed Mitigation Measures for Abiotic Components (Imperial 2021a)
	WMF Operations and Maintenance	Land, Vegetation and Wildlife Disturbance	The Land Vegetation Section of the NWO EPP notes that the WMF cover will incorporate landforms compatible with surrounding lands and will be developed with vegetative covers compatible with the reclamation plans for the overall site. The intent of these measures is to limit and mitigate the WMF's long term impacts on the local landscape, wildlife habitats and the health and vigour of local vegetation. In addition, the WMF EMP outlines the following physical inspections of the cover that will be undertaken as part of regular cover monitoring: <ul style="list-style-type: none"> any evidence of unanticipated differential settlements that have, or have the potential to, compromise cover integrity; any evidence of deep-seated soil movements impacting cover integrity; the performance of drainage structures that are incorporated into the cover landforms; the vigour and percent cover of any vegetation that is part of the final cover design; any evidence of shallow soil movements or displacements above cover barrier drainage systems; any evidence of near surface soil erosion or displacement generated by precipitation running off the cover; and the condition of any fencing around the cover, or any vents or surface infrastructure associated with the cover. The WMF EMP notes that cover inspections will identify any cover maintenance issues that may emerge from time to time and the resulting action to resolve the issue and ensure continued integrity of the cover system. Potential requirements may include: <ul style="list-style-type: none"> restoration of gaps in the cover vegetation; removal of invasive, deep rooting trees or shrubs that could damage the cover; repair of erosional rills or other soil displacements above the cover geosynthetics; and repair of damage to geosynthetic layers caused by unanticipated soil displacements. 	NWO EPP Section 3.2 – Land and Vegetation (Imperial 2021b) WMF EMP – Cover Integrity Section (Imperial 2021a)

CER EPP Requirement	Related WMF Development and/or Operational Activity	Impacted Environmental Component and/or Hazard	Description Overview	Document References
2. Environmental Impacts/ Hazards and Associated Mitigative Measures (cont'd)	WMF Operations and Maintenance (cont'd)	Groundwater Impacts	The Groundwater and Soil Section of the NWO EPP notes that a groundwater monitoring program will be implemented to validate WMF liner integrity. In addition, the WMF EMP describes a WMF specific groundwater monitoring program that will be applied to assess the containment performance of the facility via a series of wells installed around the perimeter. Monitoring of these wells will apply the protocols for defining indicator parameters, sampling and testing, data evaluation and parameter excursion response that are specified in the NWO's GMP.	NWO EPP Section 3.3 – Groundwater and Soil (Imperial 2021b) WMF EMP – Groundwater Program Section (Imperial 2021a) NWO GMP Section 3.2 – Groundwater Sampling Program (Imperial 2021f)
		Leachate Management	The WMF EMP notes that monitoring of leachate that accumulates in the WMF collection system will be undertaken to meet three objectives, specifically: <ul style="list-style-type: none"> • to assess whether future volumes and/or qualities of leachate are likely to exceed the accommodative capabilities of on-site infrastructure and thus require alternate means of disposal such as the development of a local treatment system; • to ensure the containment performance of the WMF is consistent with the objectives established for the facility; and • to collect volume and water quality data to support potential future design of leachate treatment capabilities. The following leachate monitoring requirements will be common to meeting these objectives: <ul style="list-style-type: none"> • starting after the initial placements of waste, monitoring of leachate levels in all collection sumps will be undertaken weekly; • once leachate accumulation rates have stabilized, or are declining, the level monitoring frequency will be reduced to that required to confirm that the maximum allowable liner head will not be exceeded, but in no case, less frequent than monthly; • prior to the stabilization of accumulation rates, leachate quality from each sump will be tested monthly; following stabilization, leachate quality will be tested in accordance with the groundwater sampling frequency specified in the GMP (twice annually in the current GMP); and • leachate samples will be tested for the indicator parameters and using the protocols specified in the GMP for category 1 wells. 	WMF EMP – Leachate Program Section (Imperial 2021a) NWO GMP Section 3.2 – Groundwater Sampling Program (Imperial 2021f)
		Surface Water Impacts	The Surface Water Quality Section of the NWO EPP notes that the WMF will incorporate a management system capable of satisfying the Project's surface water quality objectives at the compliance boundary, and that a surface water monitoring program will be implemented to ensure compliance of surface runoff with license conditions. <p>Following construction, surface water monitoring for the WMF will be rolled into the broader NWO surface water management program detailed in the NWO QAQCM.</p> The WMF design includes perimeter ditches that will transfer surface water (precipitation falling on the WMF or water from melting snow) to catch basins. Testing of catch basins will continue until a baseline is established verifying the performance of the cover membrane. Catch basin water will be treated and managed per the QAQCM as impacted waters until testing confirms the cover membrane successfully isolates contaminated materials from surface water. Thereafter, surface waters will be allowed to drain naturally to the surrounding environment. Lab sampling of catch basin waters will be conducted twice a year to confirm the integrity of the WMF containment system and will follow the sampling protocols outlined in the QAQCM.	NWO EPP Section 3.4 – Surface Water Quality Management and Monitoring (Imperial 2021b) WMF EMP – Surface Water Program Section (Imperial 2021a) NWO QAQCM Section 5 – Surface Water Testing and Schedules (Imperial 2021c)
	Waste Material Movements - Excavation of Impacted Soils	Land Disturbance	The bulk of the materials directed to the WMF will be impacted soils from areas throughout the PA, including areas on both the Mainland and Islands (natural and artificial). Relocating these soils will involve land disturbances via the excavations that are part of the relocation effort. The NWP EPP notes that the environmental impacts of these excavations will be mitigated, in part, by implementing erosion control measures as required during construction. Further mitigation will be provided via the backfilling, recontouring and surface reclamation plans that are part of the ICRP for the property. <p>In addition, Table 4 of the WMF EMP outlines mitigation measures for activities related to the excavation of impacted soils.</p>	NWO EPP Section 3.2 – Land and Vegetation (Imperial 2021b) NWO ICRP Section 5.6 – Materials Management Plan Section 5.0 – Permanent Closure and Reclamation (detailed in the individual component descriptions of C&R Scope and Activity) (Imperial 2016) WMF EMP Table 4 - Potential Project Impacts and Proposed Mitigation Measures for Abiotic Components (Imperial 2021a)

CER EPP Requirement	Related WMF Development and/or Operational Activity	Impacted Environmental Component and/or Hazard	Description Overview	Document References
2. Environmental Impacts/ Hazards and Associated Mitigative Measures (cont'd)	Waste Material Movements - Excavation of Impacted Soils (cont'd)	Groundwater Impacts	Soil excavation operations are not expected to have material impacts on local groundwater qualities over any significant timeframes. Following excavation, source area groundwater qualities can be expected to improve with time. In any event, groundwater impacts would be assessed via the surveillance network that is part of the NWO GMP.	NWO GMP Section 3.0 – Groundwater Surveillance Network Program (Imperial 2021f)
		Surface Water Impacts	Open-source area excavations will be categorized as locations where surface water impacts are anticipated and managed accordingly. Waters accumulating in excavations will either be directed to NWO's injection well or tested and confirmed compliant with specified criteria prior to release. Waters will be tested and managed pursuant to the NWO's QAQCM for surface water sampling, testing, and management.	NWO QAQCM Section 5 – Surface Water Testing and Schedules (Imperial 2021c)
	Removal and Management of D&D Wastes	D&D Waste Characterization and Disposition	The NWO maintains a Waste Management Plan (WMP) (Imperial 2021d) that provides the guidance needed to ensure waste materials generated by or encountered during Operations are safely and properly managed. The operational guidance in this document will be carried through the decommissioning and dismantling activities at closure that will generate D&D wastes. The WMP outlines Imperial's waste management processes and defines procedures for characterizing wastes and for their subsequent handling and disposition. Tables addressing requirements for specific waste types are provided, including Construction and Demolition Material and other materials likely to be encountered during decommissioning and dismantling activity. The WMP incorporates the WMF as an on-site disposition alternative and identifies those anticipated waste streams that can be directed to the WMF.	NWO WMP Section 3 – Waste Management Approach Section 4 – Waste Classification and Appendix B – Waste Information Table NWO ICRP Section 5.5.5 – Building and Equipment (Imperial 2021d)
		Hazardous D&D Materials Characterization and Management	Imperial's application of the WMP results in the regular disposition of any hazardous materials generated during Operations to facilities in southern Canada. This regular identification and management of hazardous materials encountered during Operations means that volumes remaining at closure are likely to be limited. However, at closure, the characterization protocols in the WMP will be applied to identify any residual hazardous materials. Any such materials, or items containing those materials, will be directed to appropriate facilities in southern Canada (i.e., hazardous materials and/or residuals will not be directed to the WMF).	NWO WMP Section 3 – Waste Management Approach Section 4 – Waste Classification and Appendix B – Waste Information Table NWO ICRP Section 5.5.5 – Building and Equipment (Imperial 2021d)
3. Waste Treatment, Handling and Disposition	WMF Operations and Maintenance	<ul style="list-style-type: none"> • Land, Vegetation and Wildlife Disturbance • Surface Water Impacts • Groundwater Impacts • Leachate Management • D&D Materials/ Management and Disposition 	Waste materials characterization and management is integrated within the WMF Operations and Maintenance activity described in the table entry 2. Reference to particular WMF operational activities under this entry can be made to identify specific waste materials management protocols and measures proposed for the WMF.	Per activities included above under table entry 2
4. Compliance Monitoring	WMF Operations and Maintenance	<ul style="list-style-type: none"> • Surface Water Impacts • Groundwater Management 	Compliance monitoring is integrated within the WMF Operations and Maintenance activity described in table entry 2. Reference to particular WMF operational activities under this entry can be made to identify specific compliance monitoring protocols and measures proposed for the WMF.	Per activities included above under table entry 2

7.0 OPERATIONS OVERVIEW (WMF CONSTRUCTION EXECUTION PLAN)

7.1 Phase 1 Execution Plan

7.1.1 Overview

This section provides a summary description of the key activities that will be associated with construction of the first WMF phase, and the execution sequence of those activities. Execution planning will be influenced by the outcomes of the future design development activity described in Section 4.7. The content of this section should be viewed as broadly indicative of the activities and sequences involved and recognizing that changes will result from the outcomes of future Project development activity.

Key activities, and timelines for constructing Phase 1 of the WMF, are shown on Figure 7-1. This plan assumes execution over two construction seasons. In the first year, waste drying/conditioning areas would be prepared, materials within the Phase 1 footprint excavated and stockpiled, the WMF base containment system constructed, waste drying/conditioning protocols refined, and source area removals in the Mainland operating area initiated, along with waste placement operations into the WMF. The second construction season would see the balance of stockpiled materials placed, waste materials outside the WMF footprint excavated, conditioned, and placed in conjunction with the remaining Phase 1 Mainland source area removals, and construction of the Phase 1 WMF cover and surface landforms.

7.1.2 Task Descriptions

Additional details/comments on the activities listed on Figure 7-1 are as follows:

- Temporary Facilities and Controls: installation or development of all the Project infrastructure needed to execute Phase 1. This would include:
 - site access roads and security fencing;
 - the water management system (i.e., facilities for collecting, storing and transporting surface waters from active work areas to the Operation's disposal well);
 - site office trailer(s); and
 - any on-site laboratory facilities (for geotechnics and/or geosynthetics; detailed execution planning will establish if these facilities are best developed at the work site or in existing facilities that may be available on the Operations).
- Site Preparation: stripping the WMF footprint and drying/conditioning areas in the MLS area.
- Borrow Area Development: developing site access, security and drainage for areas providing the clean overburden materials that will be used to construct the Phase 1 containment berms.
- Footprint Excavation and Stockpiling: the excavation of sump wastes and surrounding overburden within the Phase 1 footprint and direction of these materials to the appropriate drying/conditioning stockpile (note: it is anticipated that stockpiles will be categorized by the nature and/or moisture content of the materials contained).

- Berm Construction: constructing the containment berms around the Phase 1 perimeter with clean overburden materials sourced from borrow areas.
- Lower Barrier Construction: installing and/or constructing the various layers of geosynthetics and granular materials that will comprise the WMF base liner and leachate collection system.
- Drying/Conditioning Operations (Step 1): drying, mixing and conditioning of wastes within designated stockpiles to provide materials that will exhibit adequate strength when placed in the WMF. It is anticipated that this first step of drying/conditioning operations will be used to refine the mixing ratios and conditioning protocols that will apply to subsequent operations, and to facilitate and maximize more efficient direct placement and conditioning within the WMF (i.e., minimizing the double handling associated with the use of drying/conditioning in stockpiles).
- Source Area Excavations (Step 1): the excavation of comparatively dry, impacted materials from accessible Mainland source areas that will occur concurrently with drying/conditioning operations. These materials will be required to manage and optimize moisture contents in the conditioned materials destined for the WMF.
- Source Area Backfilling and Reclamation: completing whatever grading, backfilling and/or surface restoration of Mainland source areas is required to provide lands compatible with the final closure objectives.
- Materials Placement Operations (Step 1): the initial movements of dried and conditioned materials from stockpiles into the completed Phase 1 base containment structure.
- Sump Material Excavations Outside the Phase 1 Footprint: the excavation of sump materials outside the Phase 1 footprint and direction to stockpiles, or directly into the WMF for drying and conditioning with Mainland source area materials.
- Source Area Excavations (Step 2): the continuation of source area removal operations to support drying and conditioning requirements in stockpiles and for waste materials placed directly into Phase 1 of the WMF.
- Drying/Conditioning Operations (Step 2): the continued drying, mixing and conditioning operations in stockpiles and within the Phase 1 WMF run concurrently with the balance of Phase 1 material placement operations.
- Cover Barrier Construction: installing and/or constructing the various layers of geosynthetic materials that comprise the WMF cover system.
- Cover Landform Construction: constructing the integrated system of swales, berms, mounds, benches and/or plantings that will comprise the final WMF cover landforms.
- Surface Drainage System: construction of the perimeter ditching that will manage surface waters in and around the Phase 1 WMF site and integration of that drainage system with existing systems and patterns of drainage on the Operations.
- Phase 1 Demobilization: the decommissioning and removal of all Temporary Facilities and Controls that will not be required following Phase 1 construction operations (note: this would not include the connections to the Operations disposal well system that may be required to manage any WMF leachates generated following construction of Phase 1).

8.0 REFERENCES

- Advisian WorleyParsons. 2017. *Estimated Soil Volumes Exceeding Regulatory Guidelines*. Table 2 of Project No. 407074-00821-100-2016/2017 Updates. Submitted to Imperial Oil Limited.
- Imperial Oil Resources NWT Limited (Imperial). 2014. *Authorization Application for the Norman Wells Field*. Submitted under cover of correspondence to the Natural Energy Board dated 31 July 2014.
- Imperial Oil Resources NWT Limited (Imperial). 2016. *Norman Wells Operations, Interim Closure and Reclamation Plan*. Submitted to the Sahtu Land and Water Board pursuant to Water Licence S13L1-007.
- Imperial Oil Resources NWT Limited (Imperial). 2021a. *Norman Wells Operations, Waste Management Facility Environmental Management Plan. Appendix A-4 of the Application to Amend Water Licence S13L1-007 to include a Waste Management Facility*. Submitted to the Sahtu Land and Water Board. September 2021.
- Imperial Oil Resources NWT Limited (Imperial). 2021b. *Norman Wells Operations, Environmental Protection Plan*. Submitted to the Sahtu Land and Water Board pursuant to an application to amend Water License S13L-007.
- Imperial Oil Resources NWT Limited (Imperial). 2021c. *Norman Wells Operations, Quality Assurance and Quality Control Manual*. Submitted to the Sahtu Land and Water Board pursuant to an application to amend Water License S13L-007.
- Imperial Oil Resources NWT Limited (Imperial). 2021d. *Norman Wells Operations, Waste Management Plan*. Submitted to the Sahtu Land and Water Board pursuant to an application to amend Water License S13L-007.
- Imperial Oil Resources NWT Limited (Imperial). 2021e. *Application to Amend Water Licence S13L1-007 to include a Waste Management Facility*. Submitted under cover of correspondence to the Sahtu Land and Water Board.
- Imperial Oil Resources NWT Limited (Imperial). 2021f. *Norman Wells Operations, Groundwater Management Plan*. Submitted to the Sahtu Land and Water Board pursuant to an application to amend Water License S13L-007.
- Imperial Oil Resources NWT Limited (Imperial). 2021g. *Application for Amendment to Norman Wells Operations (NWO) Operations Authorization (OA) 1210-001 for Construction and Operation of a Waste Management Facility (WMF)*; a Project description and record of engagement submitted to the CER in advance of the formal OA application. June 2021.
- National Energy Board (NEB). 2014. *Operations Authorization OA-1210-001 Issued in Accordance with Subsection 7(2) of the Canada Oil and Gas Drilling and Production Regulations*. Issued via correspondence to Imperial Oil Resources re: "Imperial Oil Resources NWT Limited Operations Authorization Application dated 31 July 2014 for the Norman Wells Field" dated 19 December 2014.

Sahtu Land and Water Board (SLWB). 2015. Correspondence to Imperial Re: *Ministerial Approval Required for Issuance of Imperial Oil Resources NWT Limited's Type A Water Licence for the Norman Wells Operations (S13L1-007)*. 2 January 2015.

Sahtu Land and Water Board (SLWB). 2017. Correspondence to Imperial Re: *Board Decision on Approval of the Interim Closure and Reclamation Plan, pursuant to Water License S13L1-007*. 05 January 2017.

Wood Environment & Infrastructure Solutions (Wood). 2021. *Stage 2 WMF Design Development Facility Design Basis Update, Norman Wells NWT*. Submitted to Imperial Oil Limited, September 2021.