



Imperial Norman Wells Waste Management Plan

August 2026

Imperial Oil Resources NWT Limited

Bag 5000, 1001 Canol Drive,

Norman Wells, Northwest Territories

X0E 0V0, Canada

Switch Board: (867) 587-3100



Plain Language Summary

The Waste Management Plan (WMP) explains how waste will be managed at the Norman Wells Facility as the site transitions from oil production to decommissioning, care and maintenance, environmental assessment, monitoring, and progressive reclamation following the end of production in August 2026. The plan applies to facilities located on the mainland and the natural and artificial islands that make up the Norman Wells Operation. It provides employees and contractors with clear requirements for handling, storing, transporting, treating, and disposing of waste in a safe and environmentally responsible manner.

The WMP covers all waste generated by activities at the site, including solid waste, liquid waste, and semi solid or miscellaneous waste. For each waste type, the plan identifies how the waste is classified, where it can be stored, whether it can be reused, recycled, treated, or disposed of, and any environmental or worker safety considerations.

The primary goals of the plan are to reduce waste generation, minimize potential environmental and community impacts, protect wildlife by reducing attractants, ensure waste is sent only to approved facilities, and maintain accurate records of waste management activities. The plan also establishes responsibilities, management controls, and documentation requirements to help ensure waste is managed consistently and in compliance with regulatory requirements.

Imperial will continue to apply the waste management hierarchy when making waste management decisions. This approach prioritizes preventing waste where possible, followed by reuse, recycling, and recovery of materials before considering treatment or disposal. Given the remote location of Norman Wells and the limited transportation opportunities available through seasonal barge and winter road access, the plan also provides a framework for safely storing waste on site and coordinating waste shipments to approved facilities. Overall, the WMP supports the safe, responsible, and efficient management of waste throughout the closure and reclamation phases of the Norman Wells Facility.

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REVISION HISTORY AND CONFORMITY TABLE

Revision History

Date	Version	Revision	Details of Revision	Name
August 2013	1	Complete	Consolidated Norman Wells Operations waste management documents into a formal plan for submission to the SLWB.	Lindsay Hollands
April 2014	2	Complete	Updated glossary, Section 5.2, 6.2 and included a revised Appendix A.	Lindsay Hollands
June 2014	3	Complete	Added details on newly constructed lined bermed area in Well Services Yard, updated contact details and updated Section 10 to reflect position changes.	Lindsay Hollands
June 2015	4	Complete	Updated corporate logo, review and alignment with new water licence S13L1-007 and general content review and changes.	Lindsay Hollands
June 2018	5	Complete	Updated treatment programs and general content review and changes.	Sloan Leavitt
June 2021	6	Complete	Updated scrap metal locations and biocell storage usage.	Christine Wickens
August 2026	7	Draft	Minor updates to wording, terminology, and formatting throughout. Section 6.1 updates for F-31X process. Sections and subsections 8 and 9 reorganized to improve clarity.	Sam Bird

Conformity Table

Date submitted to SLWB	Version	Reason for Submission
August 2013	1	Water Licence Renewal (S03L1-001) Application
June 2014	3	Submitted post-hearing for renewal application S13L1-001
June 2015	4	Water Licence Renewal (S13L1-007)
June 2018	5	Updated document to reflect recent waste initiatives
June 2021	6	Updated document to show scrap metal locations and update to biocell storage usage
August 2026	7	Update to reflect activities and facilities at cessation of production.

GLOSSARY

The following terms are used throughout this document:

Term	Definition
Biocell	The area or engineered cell designed for the treatment of contaminated soil. The cell is designed to contain contaminated soil and runoff water to avoid contamination of the area around and under the cell.
Centrifuge	A machine designed to rapidly rotate and separate solids from liquids using centripetal force.
Dangerous Goods	Any product, substance, organism as defined by the <i>Transportation of Dangerous Goods Act</i> (TDGA) and <i>Transportation of Dangerous Goods Regulation</i> (TDGR) in any of the classes listed in the schedule provided in the regulations..
Domestic Waste	Also called a household waste, which can include garbage or rubbish and normally originates in a private home (i.e., food waste, paper, cardboard, etc.).
Empty Container	A container that has been emptied, to the greatest extent possible, using regular handling procedures, but its contents shall not exceed 3% of the container's original capacity or 2 liters, whichever is less. This does not include containers which previously contained mercury or class 2.3(<i>Compressed Gas (Toxic)</i>), 5.1(<i>Oxidizing Substances</i>), or 6.1(<i>Poisonous Substances</i>) materials of TDGR.
Generator	The owner or person in control of managing a waste at the time it is generated or a facility that generates waste.
Groundwater Treatment Facility	System designed to collect and treat contaminated groundwater.
Hazardous Waste	A waste which, because of its quantity, concentration, or characteristics, may be harmful to human health or the environment when improperly treated, stored, transported, or disposed (i.e., flashpoint < 60, pH <2 or >12, leachable BTEX, etc.).
Third Party Waste Receiver Approved by Imperial	A waste receiver/facility that has undergone an audit by Imperial and is approved to accept waste from Imperial facilities.

Inert Waste	A solid waste that does not exhibit hazardous properties and is generally stable in the environment (i.e. construction waste).
Landfarm	The area and associated engineered infrastructure designed to contain and treat contaminated soil. Imperial does not currently use any landfarms at the Norman Wells Operation.
Non-Hazardous Waste	A waste that does not exhibit hazardous properties. This means non-hazardous waste would have a flashpoint > 60, pH between 2 - 12, and no leachable BTEX, etc. This is equivalent to a non-DOW classification in Alberta. See Figure 3 of NWT Guideline for Hazardous Waste Management (Government of Northwest Territories, 2017).
Polymerization Technology	A technology that involves the use of polymer to polymerize a product into a solid state. Imperial uses this technology to solidify sludge onsite.
Receiver	A facility that is to receive a quantity of waste. The receiver may also be referred to as a consignee.
Sewage	All black-water (toilet waste) and grey water (i.e., wastewater from hand washing, etc.).
Third Party Waste Contractor or Transporter	A contract company that provides Imperial with waste management support. An example of this may include a transporter, or company that provides waste manifest tracking support.
Treatment or Treat	The handling or processing of a hazardous or non-hazardous waste in such a manner as to physically separate solids from liquids or to change the physical, chemical, or biological character of the waste in order to reduce potential hazards; and/or the volume.
Well Servicing	Maintenance performed on a well or activities to support well suspension and/or abandonment.
Waste	Any garbage, debris, chemical, or other material to be used, stored, disposed of, or handled on land, and as defined in section 2 of the <i>Northwest Territories Waters Act</i> .

LIST OF ACRONYMS

AB	Alberta (postal abbreviation)
A&R	Abandonment and Restoration; Abandonment and Reclamation
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BOL	Bill of Lading
CCME	Canadian Council of Ministers of the Environment
C&R	Closure and Reclamation
CPF	Central Processing Facility
EPS	Environmental Protection Service
ERP	Emergency Response Plan
ES	Environmental Services (internal Imperial department)
GNWT	Government of the Northwest Territories
CIRNAC	Crown Indigenous Relations and Northern Affairs Canada
MSDS	Material Safety Data Sheet
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	<i>Mackenzie Valley Resources Management Act</i>
CER	Canada Energy Regulator
NORM	Naturally Occurring Radioactive Material
NT	Northwest Territories (postal abbreviation)
NWT	Northwest Territories
PCB	Polychlorinated biphenyl
PPE	Personal Protective Equipment
ROW	Right of Way
SCARP	Spill Contingency and Response Plan
SDS	Safety Data Sheet
SLWB	Sahtu Land and Water Board
SSHE	Safety, Security, Health, and Environment

T	Tonne
TDG	Transportation of Dangerous Goods
TDGA	<i>Transportation of Dangerous Goods Act</i>
TDGR	Transportation of Dangerous Goods Regulations
WHMIS	Workplace Hazardous Materials Information System
WMP	Waste Management Plan

1 INTRODUCTION

Imperial Oil Resources N.W.T. Limited (Imperial) Norman Wells Facilities (NWF) is an upstream oil and gas field located approximately 700 km northwest of Yellowknife, Northwest Territories (NT). Production of oil and gas at NWF will end in August 2026 and activities at the site will transition to activities of decommissioning, care, maintenance, environmental site assessment, monitoring, and progressive reclamation. The NWF include infrastructure on the mainland adjacent to the Mackenzie River, on three natural islands (Bear, Goose and Frenchy's) and six artificial islands (1-Rayuka, 2-Rampart, 3-Decho, 4-Ekwe, 5-Iteh K'ee, 6-Little Bear) within the Mackenzie River (Appendix A).

This update of the Imperial Norman Wells Waste Management Plan (WMP) was developed in accordance with Imperial's Environmental Standards and the Guidelines for Developing a Waste Management Plan (Mackenzie Valley Land and Water Board, 2011).

At the time of submission, Imperial holds a Type A Water Licence (S13L1-007) issued by the Sahtu Land and Water Board (SLWB) and an Operations Authorization (OA1210-001) issued by the Canadian Energy Regulator (CER). The Water Licence serves to regulate the use of water and the deposits of waste and the Operations Authorization regulates oil and gas activities as they relate to Imperial's site. Both permits are scheduled to expire on May 3, 2028.

1.1 Effective Date

This update of the WMP is intended to become effective upon the end of oil and gas production at the field scheduled to occur by the end of August 2026.

2 SCOPE AND SITE SETTING

2.1 Purpose and Scope

The WMP is intended as a resource document and field guide to support activities for the NWF in a manner that ensures waste is safely and properly managed on site.

The WMP serves as a resource guide for employees and contractors at the Norman Wells Facilities. The WMP outlines the overall on-site waste management standards for hazardous, non-hazardous, and

domestic waste. The plan includes information, processes, and tools for waste management, storage and treatment locations and identifies all waste streams generated by activities at the site. For each waste stream, specific information regarding designation, potential classification, storage, treatment, recycling, disposal, potential environmental effects and worker safety and exposure issues are included (Appendix B).

The WMP addresses the management of the following categories:

- solid waste
- liquid waste
- semi-solid waste and miscellaneous

The following subjects are intended to be addressed in other management plans and are therefore not included in the scope of this WMP:

- air emissions (to be addressed in an Environmental Protection Plan)
- noise (to be addressed in a Safety Plan and Environmental Protection Plan)
- groundwater (addressed in the Groundwater Management Plan)

For procedures concerning spill and emergency response, please refer to the site-specific Emergency Response Plan (ERP) and Spill Contingency and Response Plan (SCARP). The most recent copies of these plans can be found on the [SLWB Public Registry](#).

2.2 Objectives

This WMP was developed based on the following objectives:

- define waste processes, key responsibilities, and management controls
- streamline on-site waste management techniques that eliminate or reduce environmental, land use, and social impacts as much as reasonably possible
- reduce wildlife attractants
- avoid the offloading of waste to unapproved facilities
- complete waste manifest stewardship in which all manifests are reconciled
- utilize best management practices to reduce and/or eliminate waste
- document the uncertainties, potential issues and opportunities that can be used as the basis for improving waste management strategies

2.3 Site Access

The Town of Norman Wells is accessible by daily commercial air service, barge service in summer, and a winter road during winter. These limitations require Imperial to schedule waste ship out programs in either the winter road season or the barge season.

2.3.1 Site Map

All waste treatment and storage locations are depicted in Appendix A.

3 WASTE MANAGEMENT APPROACH

3.1 Waste Management Process

The basis for waste management includes the following:

- Generation
- Characterization and Classification
- Storage
- Documentation (e.g., on-site inventory, waste inspections, transporter inspections)
- Transportation (e.g., on or off-site)
- Final Treatment or Disposal
- Reconciliation and documentation retention

3.2 Waste Management Hierarchy

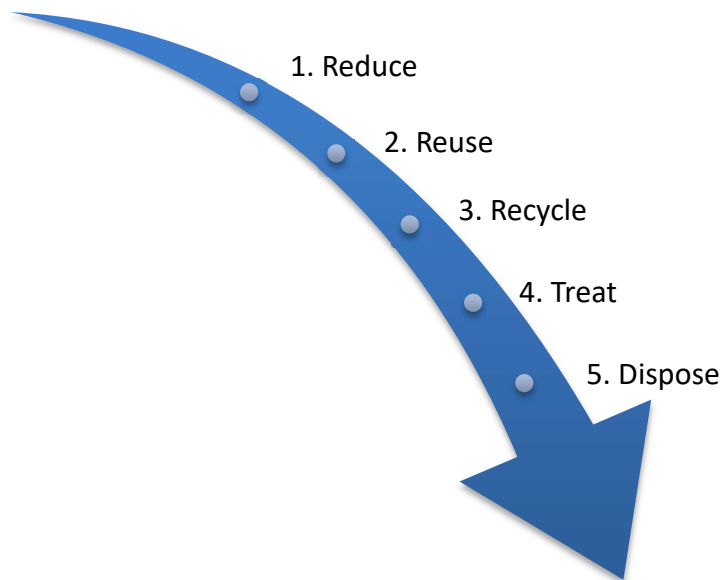
Imperial approaches waste management with an integrated systems approach, combining several alternative waste management methods. In most cases, no single approach is capable of meeting operational needs due to the:

- diversity of the waste streams,
- disparity in available infrastructure in the region, and
- various geographic limitations.

The waste management program on site has been developed to follow the preferred waste management hierarchy (Mackenzie Valley Land and Water Board, 2011) and is shown in Figure A. The hierarchy

reflects the waste management options in order of preference. Reduction of waste is the most preferred method followed by reuse, recycle, recovery, treat, and disposal.

Figure A: Preferred Waste Management Hierarchy



4 WASTE CLASSIFICATION

4.1 Waste Streams

A list of waste streams currently generated at the Imperial site is provided in the Waste Information Table (Appendix B).

4.2 Other Types of Waste

The following section describes waste streams which may not appear in the Waste Information Table (Appendix B) but are to be included in this plan per the MVLWB guideline.

4.2.1 Non-Impacted Trees, Brush and Overburden

Clearing of trees and brush is necessary for: accessing right-of-ways (ROW), maintenance, abandonment, assessment, remediation, and surveillance activities. Excess vegetation can become a hazard when accessing equipment for maintenance or emergency response.

Imperial has an agreement that non-impacted trees and brush, and untreated wood and mixed wood may be taken to the Town of Norman Wells landfill upon permission from the Town of Norman Wells. It is the responsibility of Imperial to contact the Town of Norman Wells for permission and associated conditions.

No trees, brush, or wood waste are burned.

4.2.2 Drilling and Wellwork Waste

The terms and conditions regulating disposal of drilling and Wellwork waste are set out in Imperial's Type A Water Licence S13L1-007. A summary of drilling activity and disposal of drilling waste is provided in the Annual Water Use Report that Imperial submits to the SLWB each year.

4.2.3 Domestic Waste

Domestic waste is generated by Imperial personnel from garbage bins in offices and common rooms. Smaller garbage bins are also available at most field locations (e.g., island locations). Waste streams may include paper products, office stationery, and food. Similar to most office facilities, garbage bins are collected and compiled into large bins and collected by a local contractor.

The Town of Norman Wells maintains a site (the town landfill) for the disposal of domestic waste originating within the Town. Imperial holds a business licence from the Town which is renewed yearly. As a business, per Town of Norman Wells By-law No. 17-06 Imperial manages its own domestic garbage collection and removal to the Town's landfill.

4.3 Profiling

The Imperial Waste Information Table (Appendix B) profiles each waste stream generated on Imperial's site and provides detailed information on each.

Waste profile information includes the following:

- Waste Description: a brief description of a waste stream (i.e., oily rags). It highlights information (i.e., source and physical description) to help personnel classify specific waste streams.
- Designation: identifies waste streams as hazardous and/or non-hazardous.
- Storage On-Site: indicates the appropriate storage location and/or method(s) on-site for each waste stream.
- Treatment and Recycling On-Site: indicates, if any, treatment and recycling methods used for each waste stream.
- Offsite Disposal: identifies the offsite disposal facility.
- Worker Exposure, Safety Issues and Potential Environmental Effects: identifies potential worker exposure and safety concerns, exposure routes, recommended personal protective equipment, and potential environmental effects. The worker is expected to adhere to the methods outlined in each respective SDS as appropriate.

4.4 Common Waste Type Volumes

Waste streams listed in the following table (Table A) are those waste streams that are most commonly generated on site. This table does not include waste streams that are treated on site such as soil in the biocell. All volumes are measured in metric tonnes (T) unless otherwise stated and rounded to the nearest whole number. Volumes generated annually are variable depending on the activities on site (i.e., cessation of production, decommissioning, demolition, spill clean-ups, seasonal variability, etc.).

Table A: Commonly Generated Waste Types

Waste Stream	Source	Volume (T)
Impacted Soil	Material resulting from remediation activities from historical contamination and spills to soil.	50
Contaminated Water	Impacted run-off water exceeding Cat A/B guidelines per S13L1-007 Annex A (E), well workover fluid and/or spills to snow	5000 m ³

Waste Stream	Source	Volume (T)
Sludge	Well servicing mud/sludge, other liquids (i.e., Well Servicing Tank, Grizzly Tank)	20
Oily Rags	Maintenance and clean-up activities	10
Waste Lube Oil	Lubrication of machinery, engines, compressors, and vehicles	5
Empty Containers (barrels, pails)	Packaging from supplies	4
Waste Glycol	Heat trace, waste heat recovery unit	0.5
Batteries	Vehicles, equipment	1
Scrap Metal	Decommissioned equipment and surface facilities	500

4.4.1 Domestic Waste

Domestic waste is not tracked by Imperial.

4.4.2 Sewage

Similar to the municipal management of domestic waste, per Town of Norman Wells By-law No. 14-06, sewage is collected several times a week by a local contractor and then disposed of at the Town of Norman Wells sewage lagoon. Sewage volumes are not tracked by Imperial or the Town of Norman Wells. Approximately 800 m³ of potable water is delivered to Imperial each year. A similar volume of sewage is estimated to be generated. A small portion of potable water is used during the summer season for Imperial's car wash and does not leave as sewage.

5 STORAGE

Active waste storage and treatment facilities are those facilities that are currently maintained and used for daily work activities by Imperial.

There are a number of permanent and temporary waste storage and treatment facilities on site that exist to meet regulatory requirements and Imperial's internal standards. These storage areas as well as the containers in which waste is stored are described in this section.

Waste containers are moved around the site as needed and when full, are stored inside the gated and locked Hazardous Waste Storage Yard (Section 5.3).

5.1 Waste Containers

The following lists the type of waste containers used on site:

- **1 m³ Waste Totes:** solid waste including impacted soil/gravel, oily rags, batteries, bulbs, desiccants, filters, etc.
- **12 m³ Bins:** used for consolidating solid waste from 1 m³ totes, or for larger waste streams (i.e., soil or sludge). These bins allow for efficient waste shipment to end disposal facilities.
- **1 m³ Industrial Waste Bags:** solid waste with no leachate including pipeline insulation, mud material bags, etc.
- **Barrels/Drums:** liquid waste including used oils, Varsol, and solvents.
- **20 L-40 L Plastic Pails:** small volumes of waste oils and waste Varsol.
- **Wooden Crates:** used for storing solid waste (e.g., electronic waste) and solids generated from the centrifuge.

Waste totes and industrial waste bags can hold approximately 1 m³ and are provided as needed by Imperial's third-party waste contractor. The totes are made of waterproof polyethylene and are lined with a plastic liner (Image A). 1 m³ Industrial waste bags are a woven polypropylene material with drawstring top.

The 12 m³ bins are also provided as needed by Imperial's third-party waste contractor (Image C). Bins are made of steel and have a 100% seal capability and can be transported directly on flatbed trucks. These bins are lined with a woven polypropylene liner.

Barrels, drums, and pails (full and/or un-rinsed) are also stored inside the gated and locked Hazardous Waste Storage Yard (Section 5.3) but must be on pallets above ground to prevent deterioration and to facilitate inspection for leaks (Image B). Empty barrels originating from local product distributor are returned to the distributor for recycling and reuse. Empty drums and barrels are defined as containers not cleaned that contain less than 3% of original contents. These empty containers are acceptable for reuse provided that they are being used to store waste original product.

In the event that a particular waste container is unavailable due to unforeseen circumstances, safe, suitable alternative containers may become necessary to employ. Imperial would make the SLWB aware of such circumstances and intentions.



Image A: Waste Tote with liner bag



Image B: Barrels for waste liquid



Image C: 12 m³ waste bin

5.2 Temporary Soil Storage Areas (Lined and Bermed)

Temporary soil storage areas are designed for storing impacted material while soil treatment options are being evaluated or for logistical reasons. For example, a lined bermed cell may be built to allow work to continue when cross-river access by road or barge to the mainland is unavailable, or when winter road or summer barge access out of Norman Wells is not feasible.

Lined bermed cells are constructed to the size identified in task planning. The location, size, and need for temporary soil storage areas require approval from the SLWB prior to construction. Once a temporary soil storage area is no longer needed, it is decommissioned.

In addition to construction of temporary soil storage areas, in some cases the biocell may be used for temporary storage of impacted soil. The decision to use the biocell for temporary soil storage will depend on current and projected future biocell treatment needs. Leveraging excess biocell capacity for temporary storage is the preferred alternative to constructing a temporary soil storage cell.

Table B outlines the temporary soil storage areas at the Imperial site.

Table B: Temporary Soil Storage

Location	Type of Storage
Refinery Tank Farm Area	Lined Bermed Cell

Former Refinery Site Area	Lined Bermed Cell
Projects Yard	Lined Bermed Cell
Former B-33X Area	Lined Bermed Cell

5.3 Hazardous Waste Storage Yard

Industrial waste (hazardous or non-hazardous) is stored in waste containers (Section 5.1) at the Hazardous Waste Storage Yard which is located on the mainland of Imperial's lease (Appendix A and C). A fence with a locked gate surrounds the perimeter of the yard, limiting access into and out of the facility. Access is given by the Environmental Designate who holds the key for the Hazardous Waste Storage Yard.

The Hazardous Waste Storage Yard (Receiver Number NTR 019) received approval from the Government of Northwest Territories (GNWT) on February 3, 1999 (Image D). It serves as a storage facility where waste is separated and stored prior to being shipped offsite for disposal.

This facility is approximately 45 metres by 20 metres and is lined, bermed and contains a sump with a collection point. When required, the sump can be drained via a vacuum truck and transported to the F-31X Treatment and Injection Facility (Section 6.1).

Clear signage within the Hazardous Waste Storage Yard helps to maintain proper separation of waste.

Empty waste totes are readily available to any personnel and are located outside of the Hazardous Waste Storage Yard (Appendix C).



Image D: Hazardous Waste Storage Yard

5.4 Scrap Metal Storage

Scrap metal (e.g., old pipe, used equipment, used electrical cable, etc.) generated the Imperial site is segregated and stored at specific locations (Appendix A). Once volumes are economically viable, scrap metal is evaluated for recycling and/or disposal at third party facilities.

5.5 Soil Containment Facility

Three 3-sided bins are located within a lined bermed area within the Well Services Yard and are utilized for smaller volumes (but greater than 1 m³) of impacted soils or impacted materials with a low-liquid, high-solid ratio. These materials are usually unsuitable for separation in the F-31X Treatment Facility (Grizzly Tank). The bins allow for both the decanting and storage of materials while it is being characterized for onsite treatment (Section 6) or awaiting transport to an offsite disposal facility. Three-sided bins vary in size, with the capacity being 40-60 m³ (Image E).



Image E: Soil Containment Facility – 3-sided Bins

6 TREATMENT ONSITE

6.1 F-31X Treatment and Injection Facility

6.1.1 Components

The F-31X Treatment and Injection Facility is a solid/liquid separation system. The system includes the following components:

- **Grizzly Tank (Tank 002):** A double walled tank with weirs that separate solids from liquids. It has a holding capacity of 53 m³.
- **Tank 001:** A singled walled 445 m³ skim tank within a lined and bermed area.
- **F-31X Injection Well:** A water injection well which accepts fluids from Tank 001. Produced water via the CPF was also injected when the facility was producing oil and gas.

6.1.2 Acceptable Material

The purpose of the facility is to accommodate material containing a higher content of liquids than solids. Only solid/liquid material containing solids that can easily settle are accepted and treated in this facility. Solid/liquid materials which are mostly solid and cannot reduce in volume through settling are under no circumstances, accepted in this facility.

Table C lists acceptable and unacceptable material for the F-31X Treatment and Injection Facility.

Table C: Acceptable Material for F-31X Treatment and Injection Facility

Acceptable Material	Unacceptable Material
Hydrovac Material	Vessel and Tank Bottoms
Impacted Snow and Water	Impacted Soil and Gravel
Well Workover Materials (diluted)	Hydromatation Filters
Surface water run-off that does not meet S13L1-007 criteria	
Biocell Sump Runoff	
Excess Chemicals (diluted)	

6.1.3 Process Overview

Material (liquids containing solids) are collected via truck (e.g., vacuum truck, hydrovac truck, etc.,) and transported to the F-31X Treatment and Injection Facility (Image F). In the treatment and injection process, liquids containing solids enter the system through the Grizzly Tank (Tank 002), as shown in the process overview figure (Figure B). The weir system in the Grizzly Tank separates the liquid-solid mixture allowing the solids to settle to the bottom of the Grizzly Tank. The remaining liquids pass through into Tank 001. Prior to the end of production, a skimmer in Tank 001 separated oil from water; the resulting treated water was injected into the F-31X injection well and the oil was sent to the CPF for processing. Following cessation of production, any hydrocarbon fractions present in the water will remain, to be injected into F-31X.

If the material being trucked to the F-31X Treatment and Injection Facility is entirely liquid (oil and/or water with no solids) it can be pumped directly into Tank 001 (instead of going through the Grizzly tank first).

Level indicators are installed in Tank 001 and will shut down the system in the event of an overflow or emergency situation.

The sludge/solids that settle out in the Grizzly Tank (Tank 002) are removed via vacuum trucks and taken to the onsite centrifuge where the solids will be further separated from the liquids. The liquids are recovered from the centrifuge and recycled back to the F-31X Treatment and Injection Facility. The solids are stored onsite until they can be treated or transported to approved offsite facilities for treatment and/or disposal.

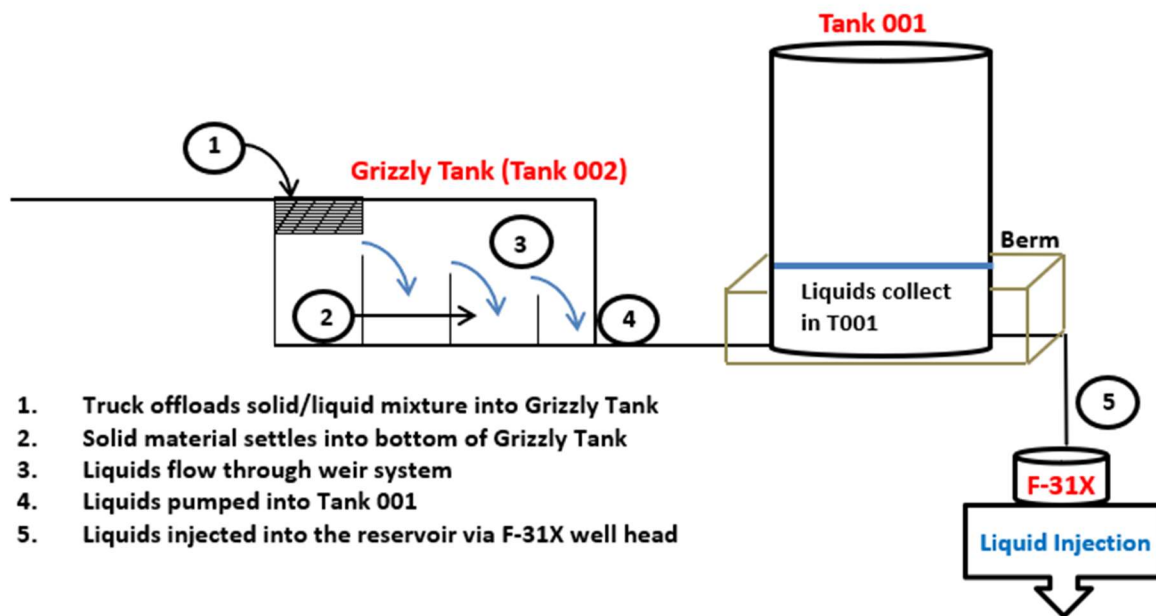


Figure B: Process Overview for F-31X Treatment and Injection Facility



Image F: F-31X Treatment and Injection Facility

6.2 Soil Treatment Facility

The biocell is used for the treatment hydrocarbon impacted soil from the soil containment facility and various temporary soil storage areas on site only.

6.2.1 Re-Construction and Monitoring

The biocell was originally constructed in 2001, as two separate cells each with a 2,000 m³ capacity. These engineered cells were lined with a synthetic liner and had independent leachate/runoff collection sumps.

In 2012, the two cells were decommissioned, and one larger cell was constructed over the former footprint. This cell was designed and constructed with perimeter berms, dual ramp access, a liner system comprising a compacted clay base, a double-sided geocomposite layer, a High-Density Polyethylene

(HDPE, 30 mil) liner and a second double-sided geocomposite layer and a 0.4 m thick surface traffic support layer which allows for in-cell use of heavy equipment without damaging the primary liner. At either end of the biocell are fluid collection sumps for leachate and runoff collection. The cell is surrounded by a perimeter berm which extends approximately 0.5 m above the base elevation of the traffic layer. A perimeter fence is also in place and the ramps into the biocell are gated to control access and traffic.

In 2014, a second identical cell was constructed parallel to the existing cell. Each cell has a capacity of treating 5,000 m³ of soil.

Access into and out of each cell is controlled by Imperial via the site supervisor.

6.2.2 Soil Acceptance Guidelines and Process

Soil is sampled and analyzed before being accepted into the biocell for treatment (Figure C). Soil placed for temporary storage is typically sampled after placement to characterize the soil for future transport and disposal.

A list of acceptance criteria is provided in the *Biocell Acceptance and Remediation Guidelines* (Appendix D). The acceptance guidelines default to background levels when applicable (i.e., inorganics). Debris is removed from incoming soil on a best effort basis.

As outlined in Section 5.2, in addition to treating soil that meets the biocell acceptance criteria described in the guidelines, the biocell may be used for temporary storage of untreatable impacted soil. The decision to use the biocell for temporary soil storage will depend on current and projected future biocell treatment needs. Use of excess biocell capacity for temporary storage is an effective alternative to constructing a temporary soil storage cell.

Soil that does not meet the current Biocell Acceptance and Remediation Guidelines may also be placed in the biocell for pilot treatment studies with approval of the site supervisor. Movement of soil to the biocell for temporary storage or treatment must be approved by the site supervisor to properly track volumes and biocell capacity.

Imperial expects to engage with communities and regulators to discuss possible pilot treatment studies before they are initiated at site.

6.2.3 Soil Treatment

The biocell has been used most often for the treatment of hydrocarbon contaminated soil. The following sections describe the typical process for treating hydrocarbon contaminated soil. Similar processes would be developed for new treatment methodologies.

Once hydrocarbon contaminated soil has been pre-screened for acceptance it is placed in windrows (Image G) to optimize volume capacity while still providing access to heavy equipment. When necessary, commercial fertilizer aiming to achieve and maintain a Carbon:Nitrogen:Phosphorous (C:N:P) ratio of 100:2.5:1 may be added to enhance microbial activity and the biodegradation process.

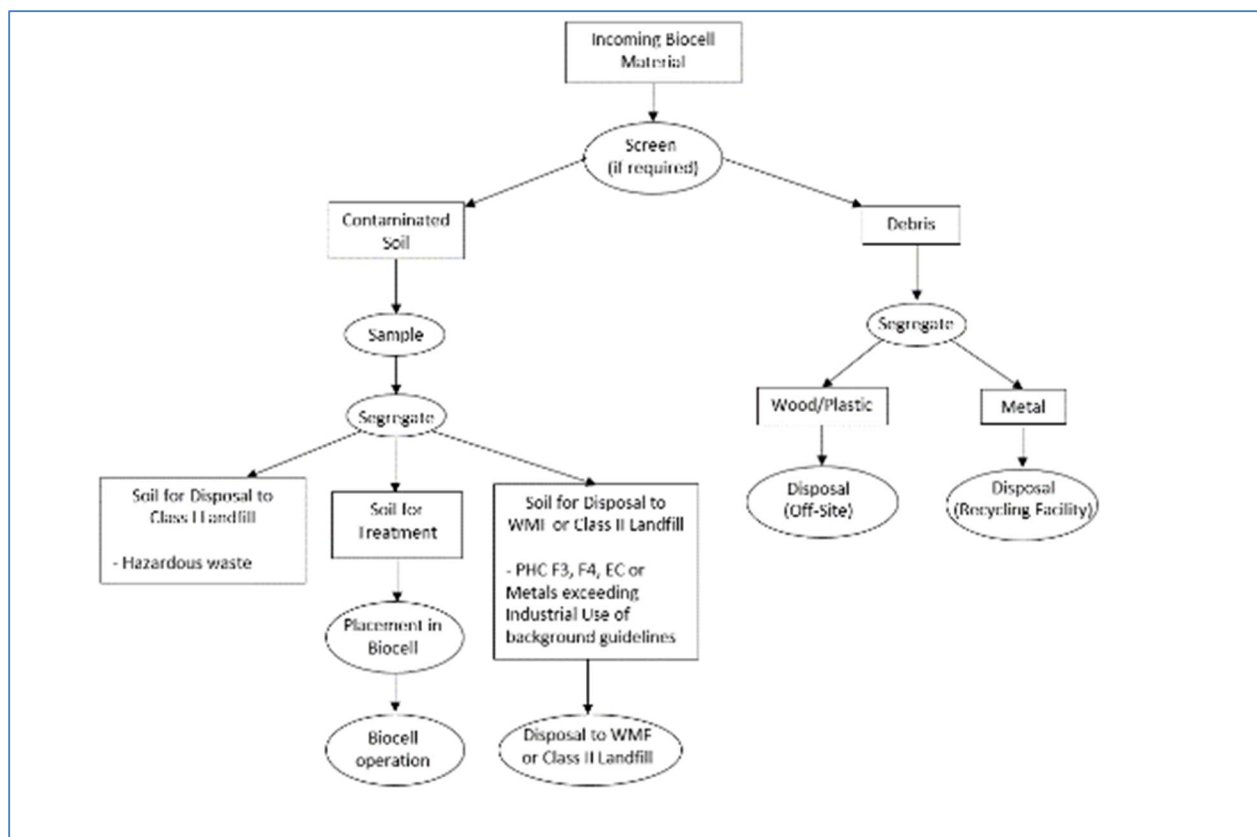


Figure C: Biocell Soil Material Acceptance Process



Image G: Soil Placed in Windrows

Hydrocarbon contaminated soil is typically mechanically aerated during summer months with an attachment on a tracked excavator until biotreatment targets are achieved (Image H). Depending on the initial hydrocarbon concentrations it typically takes 1-5 years to reach desired biotreatment results.

Heavier hydrocarbon impacted soils or soils impacted with salt or metals are not suitable for biotreatment and are evaluated for other soil treatment options or shipped to approved end disposal facilities for treatment and/or disposal.



Image H: Biocell Treatment – Aeration/Twister Bucket

6.2.4 Soil Sampling, Tracking and Disposition

Soil windrows are sampled periodically as treatment proceeds to monitor the progress of hydrocarbon degradation.

Excess liquids (including snowmelt, rainfall, and windrow leachate) that collect in the biocell sumps are removed via vacuum truck and transported to the F-31X Treatment and Injection Facility or pumped back into the windrows when useful to improve soil moisture levels for bioremediation. Volumes of liquids removed from the sumps are measured and tracked on biocell-specific waste tracking forms.

Volumes of soil stored and treated each year along with source location and final destination are reported in the annual Closure and Reclamation report submitted to the SLWB and CER.

6.3 Well Servicing Tank

The Well Servicing Tank (commonly referred to as “Big Red”) is a single walled, lined and bermed storage tank with a holding capacity of 59 m³. It is located on mainland of Imperial’s site in the Well Services Yard

(Appendix A). “Big Red” is used for well servicing projects for the storage of well workover material. A series of weirs (similar to the Grizzly Tank, Section 6.1) allows solid and liquid separation. Liquids are removed via a vacuum truck and transported to the F-31X Treatment and Injection Facility. Solids are removed via a vacuum truck and taken to the onsite centrifuge where the solids will get further separated from the liquids and shipped to offsite disposal facilities for treatment and/or disposal.

6.4 Centrifuge

The centrifuge is a solid/liquid separation system and is not a disposal facility. The centrifuge is operated on an as needed basis and is constantly monitored while in use.

6.4.1 Acceptable Material

The purpose of the centrifuge facility is to separate material that contains a higher content of liquids than solids. Only liquid material containing solids that are greater than one centimeter and heavier than water is accepted and treated in this facility. Materials that are acidic or corrosive are not accepted in this facility.

Table D lists acceptable and unacceptable material for the centrifuge facility.

Table D: Acceptable Material for the Centrifuge Facility

Acceptable Material	Unacceptable Material
Kill fluid generated from Well Work	Acidic Material
Grizzly contents upon approval	Corrosive material

6.4.2 Process Overview

Material (liquids containing solids) are collected via truck (e.g., vacuum truck) and transported to the centrifuge facility. In the centrifuge process, liquids containing solids enter the system through the offload station. The material then flows through the centrifuge where solids are separated from the liquids. Discharged solids are released from the centrifuge into a lined wooden crate. The solids are then stored onsite in labelled wooden crates until they can be transported to offsite facilities for treatment and/or disposal (Section 8).

The remaining liquids discharge back into the mud system's front mixing tank. Once the mixing tank is full, paddles within the tank are used to stimulate the suspension of solids. After the solids are fully suspended the material is then recycled through the centrifuge. This process is repeated until no more solids are generated. Any materials that are lighter than water will always continue to return with the liquid output. In the case of kill fluid material treatment, the final product can be tested and potentially re-used as a base for mixing new kill fluid product.

Any remaining liquid product that cannot be re-used will be taken to the F-31X Treatment and Injection Facility.

6.5 Sludge Treatment

Imperial generates approximately 20 T of sludge annually. Sludge waste is generally composed of various heavy hydrocarbons and water. Sludge is generated by maintenance activities such as tank cleanings. Sludge material cannot be treated at the F-31X Treatment and Injection Facility due to the high solid contents.

Polymerization technology is used to solidify sludge material before it is sent to an off-site disposal facility. Solidified sludge is considered less hazardous than the liquid sludge at the disposal facility. As an example, sludge material generated from cleaning the Grizzly (Tank 002) and Refinery Tank 119 in 2016 was temporarily stored in two 60 m³ open top rental tanks onsite. A benign polymer was added to the sludge to start the solidification process and was then mechanically mixed by an excavator until the material solidified. After the material was solidified, it was placed in a storage bin in the temporary soil facility until it could be shipped to an approved facility on the winter road.

7 HISTORICAL WASTE STORAGE AND TREATMENT LOCATIONS

There are a number of historic waste storage and treatment locations at Imperial. A historic waste storage and/or treatment location refers to an area that no longer exists as an active site and is in the Closure and Reclamation (C&R) phase. These locations are intended to be managed under a C&R Plan which describes the coordinated actions planned to return the site and affected areas to established settings that are compatible with a healthy environment. An update to the C&R Plan is currently underway as a major component of Environmental Assessment EA2526-01 conducted by the Mackenzie Valley

Environmental Impact Review Board. An annual C&R Progress Report is submitted to the SLWB and CER as a condition within the existing Water Licence and Operations Authorization..

The following historical waste locations are included in Appendix A; however, they are not used as part of Imperial's current waste management system.

- Historic Sumps
- Tank 401 Area
- Tank 53 Area
- Norman Wells Landfarm
- Battery 3 Landfarm

8 WASTE RECEIVERS AND TRANSPORT

8.1 Approved Third Party Waste Receiver

Imperial audits all potential waste receiver facilities to confirm that their safety, environment, regulatory, and financial systems meet Imperial standards. If the audit is successful, the receiver facility is added to an internal list of approved third-party waste receiver facilities. All industrial waste (hazardous or non-hazardous) generated at Imperial's operation that can not be practically treated is to be taken to one of these approved facilities.

As there is no industrial landfill in Norman Wells, all oilfield waste generated by Imperial that cannot be managed onsite within the capacity of existing facilities is shipped to facilities in Alberta, British Columbia, or Northwest Territories for treatment and/or disposal.

All domestic waste is stored in domestic bins designed to prevent access by wildlife. Domestic waste is collected by a local contractor and disposed of in the Town of Norman Wells landfill.

8.2 Transportation Preparation

Prior to transporting waste (i.e., waste totes, industrial waste bags, barrels, etc.) from the point of generation, the following steps are performed:

- Waste Inspection: a visual inspection of the container contents to verify waste stream. If unknown waste is encountered, the appropriate people will be notified, and an investigation will be conducted to determine the source and type of waste.
- Container Inspection: containers will be visually inspected for leaks, integrity, and double containment (i.e., bag inside of waste tote). Any damaged containers will be taken out of service.
- Labeling: all waste containers are labeled to help identify waste stream and location of generation.
- Load Preparation: each container is sealed and properly strapped. A visual inspection is conducted to ensure that the seal is adequate for the waste stream and that the lid, tarp, bung, etc., is securely tightened.

The primary means of transportation on and around Imperial's site is by loader or equivalent equipment. Persons moving waste are responsible for the safe handling of waste while it is in transport.

For off site transport and disposal, the following steps must be completed prior to completing the required shipping documentation:

- Classify the waste (e.g., non-hazardous vs. hazardous)
- Determination of disposal or treatment option
- Identify approved facility nearest to Imperial and capable of handling the waste stream classified
- Contact the approved waste facility to notify them of the shipment

9 DOCUMENTATION – INSPECTIONS, RECORDING AND TRACKING

9.1 Transportation-Related Documents

Any waste transported off site to approved facilities is accompanied by a federal waste manifest. A bill of lading accompanies the federal waste manifest for the duration of transportation to the approved waste facility.

Both the shipper and licenced transporter are required to sign federal waste manifests and any other transportation documentation that may exist. Signatures from both parties serve to acknowledge a transfer of liability from the generator to the waste transporter.

Imperial is committed to completing Waste Transporter Inspection checklists on waste transporters that are hauling industrial waste to the approved disposal facility for Imperial. The Waste Transporter

Inspection checklist is primarily made to ensure the transporters have the correct information and training prior to transporting the waste.

9.2 Federal Waste Manifest

The *Transportation of Dangerous Goods Regulations* requires that a completed hazardous waste manifest form accompany shipments of hazardous waste. Manifests are available from the GNWT Environment and Climate Change (ECC) Regional Offices.

The Federal Waste Manifest provides:

- Step by step instructions on how to complete the manifest with the required information.
- Examples of how to fill in manifests are provided on the back of the manifest. The Environment and Regulatory Advisor or designate can also assist in completing the manifest paperwork.
- An internal waste reconciliation process ensures all waste manifests are received and to confirm waste volumes received by the offsite disposal facility.

The completed manifest form provides:

- Detailed information on the types and amounts of hazardous waste shipped;
- A record of the firms or individuals involved in the shipment; and
- Information on the storage, treatment or disposal of the waste and confirmation that they reached their intended final destination.

The Generator (Consignor), Carrier, and Receiver (Consignee) must each complete their portion of the manifest. The information provided on the manifest as well as other TDGR requirements (i.e., labelling and placarding) are also intended to assist first responders (police, ambulance, fire fighters) with hazard information should a transportation accident occur.

Waste manifest completion instructions are provided on the reverse side of each manifest. Further assistance in completing a waste manifest may be obtained by contacting the regional GNWT ECC office.

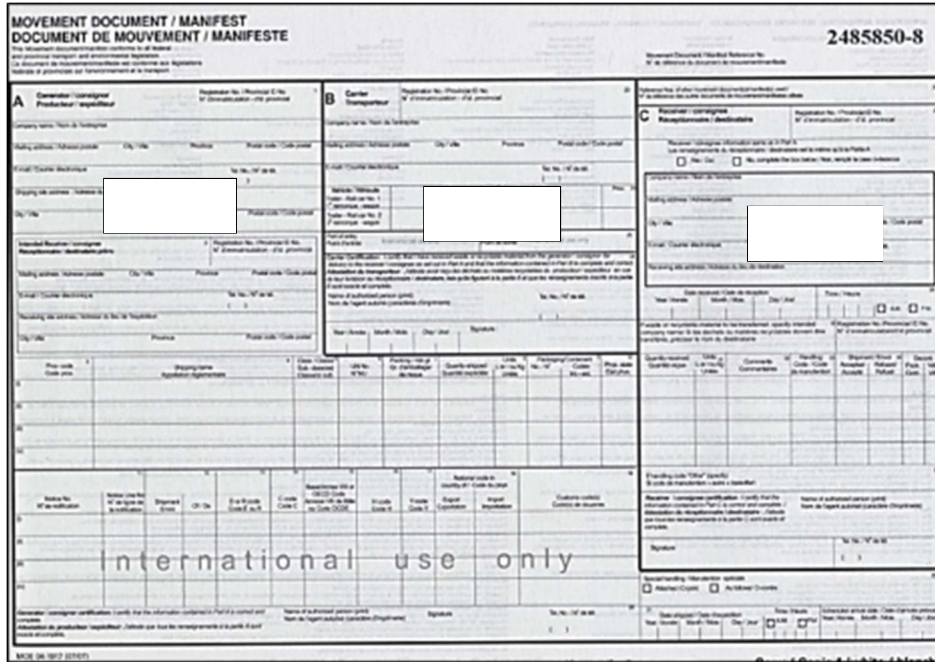


Image I: Federal Waste Manifest

9.3 Inventory and Inspection On-Site

Waste generated and stored on site is tracked and recorded using the *Norman Wells Waste Movement Form* (Appendix E). The waste generator must indicate the containers place of origin and its destination location. The form is then provided to the loader operator for movement. Once the container is safely moved and stored, the loader operator will complete and submit the form to the Imperial site supervisor.

Inspections of the Hazardous Waste Storage Yard are completed monthly by the Environmental designate. This process confirms the amount and types of waste being stored on site and is used as an opportunity to check conditions in the Hazardous Waste Storage Yard (e.g., fence, lock, standing water, waste labels, waste container integrity, general housekeeping, etc.) and the surrounding area.

The Hazardous Waste Storage Yard is also inspected by the CIRNAC Inspector as part of the site inspection. The CIRNAC Inspector ensures compliance with Water Licence conditions.

10 KEY RESPONSIBILITIES

10.1 All Personnel

- Ensure care and consideration is used when working with waste on site. (e.g., proper PPE for the job, safe handling, etc.)
- Refer to this WMP for information on waste.
- Store waste in the designated area(s) of the Hazardous Waste Storage Yard.
- Label all waste, indicating the waste stream and waste source if possible. It is the responsibility of the person generating the waste to label the waste container. Refer to product MSDS, as required.
- Ensure all waste containers (e.g., waste totes, barrels, etc.) are properly sealed. Container contents must not be exposed to or open to the environment (e.g., weather).
- Ensure each waste container contains only one waste stream; mixed waste is not acceptable.
- Report any waste near misses and/or hazard reports.
- If safe to do so, take immediate action to prevent and/or contain a spill.
- Contact the Environment and Regulatory Advisor or designate for guidance, concerns, and/or potential issues.

10.2 Specific Roles

10.2.1 Operations and Contract Employees

In addition to the responsibilities listed above, operations and contract employees must execute the following:

- Fill out the *Norman Wells Waste Movement Form* for any waste container needing to be moved (Appendix E).
- Inform and demonstrate to new operators and contractors all waste management practices on site.
- Notify the SSHE Coordinator if unidentified waste is found. Unidentified waste should be treated as hazardous until determined otherwise.
- Handle empty containers as you would containers full of original contents. Refer to product SDS for information.

10.2.2 Environmental Designate (SSHE Coordinator)

- Coordinate waste shipment(s) to approved facilities.
- Initiate federal manifesting, ensuring the manifest is properly completed and signed prior to shipment off site to approved facilities.

- Train and provide ongoing guidance to all Imperial personnel on waste management practices on site.
- Monitor and inventory all waste on site.
- Control and document waste movement (off site) through the quarterly waste manifest tracker.
- Provide onsite guidance in the event of a waste related spill.
- Provide expertise to area management to ensure compliance with regulatory requirements and Imperial's standards.
- Review and update this WMP.
- Advise personnel on protective equipment and safe handling standards.
- Advise personnel of the potential health and safety hazards.

10.2.3 Foreman and Supervisor

- Ensure resources are available to operators and contractors to ensure expectations of waste management on-site are met.
- Advocate that waste is managed appropriately, meeting regulatory requirements and Imperial's standards.
- Advise personnel on protective equipment and safe handling standards.
- Advise personnel of the potential health and safety hazards.
- Provide support as needed to ensure compliance with Imperial's standards and regulatory requirements.

10.2.4 Environment and Regulatory Advisor

- Mentor and provide oversight to operations to ensure waste is managed appropriately, meeting regulatory requirements and Imperial's standards.
- Provide expertise to area management to ensure compliance with regulatory requirements and Imperial's standards.
- Lead actions in the event of a waste related spill.
- Ability to initiate federal manifest paperwork, ensuring the manifest is properly completed and signed prior to shipment off site to approved facilities.
- Review and endorse content of this WMP.

10.2.5 Prime (On-Site) Contractor Supervisor

- Enforce Imperial's waste management expectations on site.
- Complete Imperial requested waste management work orders.
- Work with Environment and Regulatory Advisor and designate to provide guidance and support on concerns and/or potential issues related to contract personnel and Imperial's waste management.

10.2.6 Waste Contractor

- Complete Imperial requested waste management work orders.
- Coordinate waste transport to Imperial approved waste disposal facilities
- Provide support on waste manifest paperwork and tracking

11 WASTE MANAGEMENT PLAN REVIEW AND UPDATE

Imperial shall review the effectiveness waste management practices described in the *Norman Wells Waste Management Plan* once per year using the information within the *Annual Closure and Reclamation* report, spill reports and feedback from staff and contractors at site.

RESOURCES

Canadian Association of Petroleum Producers. (2009). Guide: Oilfield Waste Management in the Northwest Territories.

Canadian Association of Petroleum Producers. (2012). Guide: Waste Profile Sheets.

Exxon Mobil Corporation. (2004). ExxonMobil Canada West Operations Waste Management Manual.

Government of Northwest Territories. (1998). General Management of Hazardous Waste.

Mackenzie Valley Land and Water Board. (2011). Guidelines for Developing a Waste Management Plan.

Town of Norman Wells. By-Law No. 17-06, By-Law No. 14-06

LIST OF APPENDICES

Appendix A: Imperial Waste Storage and Treatment Locations

Appendix B: Waste Information Table

Appendix C: Waste Storage Area Map

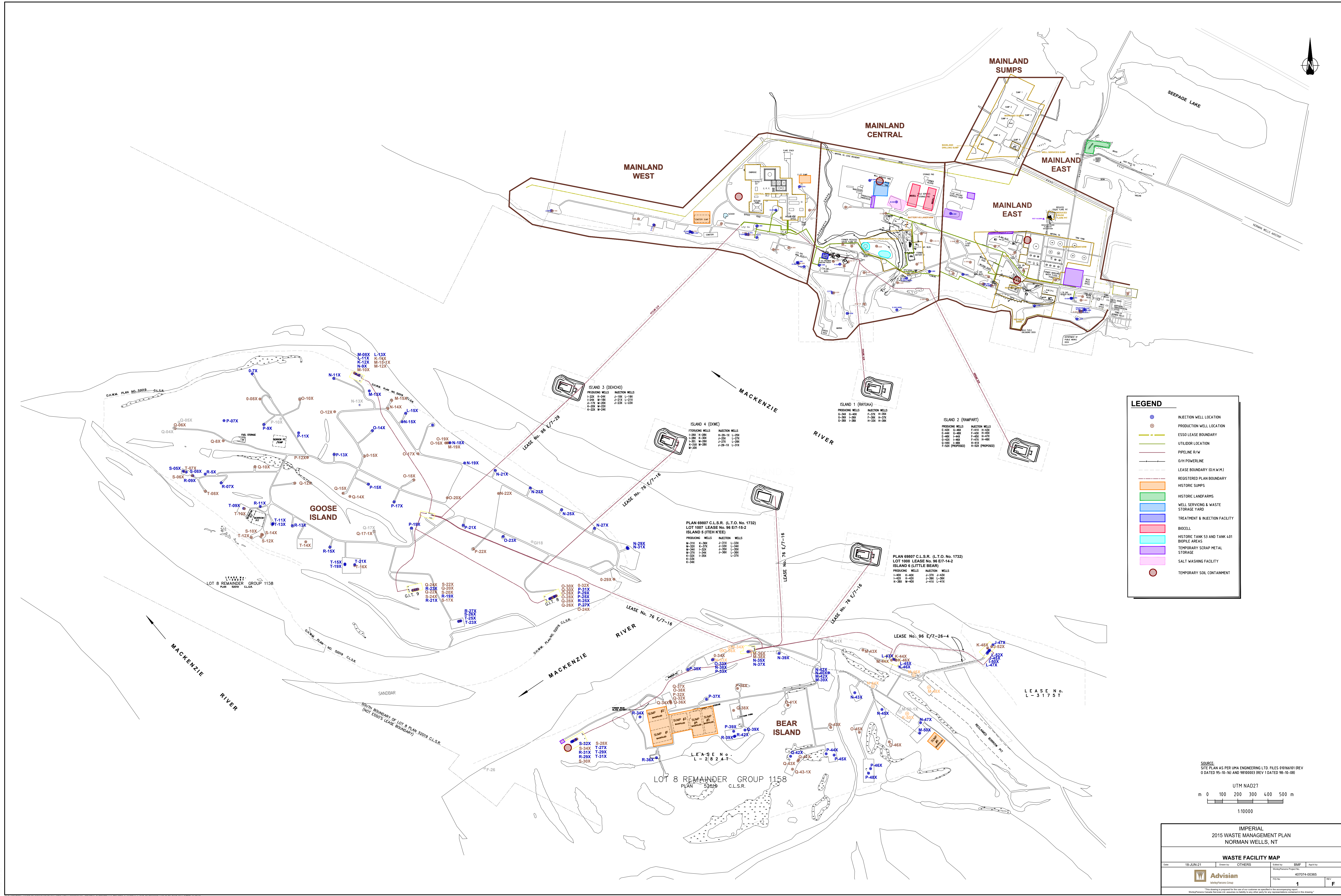
Appendix D: Biocell Acceptance and Remediation Guidelines

Appendix E: Waste Movement Form



Appendix A: Imperial's Waste Storage and Treatment Locations

A figure displaying current and historical waste storage and treatment locations is filed behind this page.





Appendix B: Imperial's Waste Information Table

Imperial's Waste Information Table is filed behind this page.

WASTE INFORMATION TABLE

The following table outlines waste types generated by Norman Wells Operations.

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NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
A. Solid Waste					
Aerosol Spray Cans Source: Lubricating sprays, spray paint, etc. Physical Description: Empty canister with nozzle	Non-HW or HW Depending on the original contents.	Empty aerosol spray cans must be stored in a sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Aerosol spray cans containing residuals must be punctured and liquids recovered. Liquids must be stored in a sealed and properly labeled waste tote/barrel/drum/pail in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	To empty aerosol spray cans, it is important to open the safety valve prior to puncturing the can. Aerosol spray cans containing compressed gases or liquids, especially when these substances are flammable, toxic, or corrosive, should only be punctured under controlled conditions.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • flammability • compressed gases exploding Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Asbestos* Insulation and Gaskets *This is not a regular waste type encountered at NWO Source: Historic - old refinery Physical Description: Fibrous solid to dust-like powder. White to grey-brown in color. Odorless SPECIALLY TRAINED AND LICENSED PERSONNEL MUST BE ENGAGED WHEN DEALING WITH ASBESTOS MATERIAL AS IT IS EXTREMELY DANGEROUS TO HUMAN HEALTH.	<i>HW</i>	DO NOT HANDLE - Contact Environmental Technician or Environment and Regulatory Advisor immediately.		Dispose of according to specifically trained and licenced personnel.	Potential worker exposure and safety concerns: - airborne asbestos fibers Most probable worker exposure routes: - inhalation, skin/eye contact (irritant) Recommended personal protective equipment: - in accordance with specifically trained and licenced personnel Potential environmental effect: - indoor and outdoor air and dust pollution - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Batteries – Large Wet Cell (Acid) Source: Vehicle maintenance, large electrical equipment change-outs, portable or emergency electrical equipment and some instruments Physical Description: Solid containing acid. Various sizes. Heavy MAY CONTAIN SMALL AMOUNTS OF ENERGY/LIFE. DO NOT INCINERATE.	<i>HW</i>	Store in a sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Stack batteries neatly for added safety.		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • unneutralized acid (corrosive) • acid solubilized lead • cadmium in Ni/Cd batteries Most probable worker exposure route: • skin/eye contact Recommended personal protective equipment: • acid-resistant gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • fluid may have high heavy metals contents • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Batteries – Small Wet Cell (Alkaline) Source: Small electronics and office equipment Physical Description: Solid containing alkali DO NOT INCINERATE	HW	Store in a sealed and properly labeled waste tote in designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). <i>A single waste tote is available outside of the Waste Storage Yard for convenient use. See Norman Wells Waste Storage Yard Operator Site Map (Appendix C).</i>		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • unneutralized acid (corrosive) • acid solubilized lead • cadmium in Ni/Cd batteries Most probable worker exposure route: • skin/eye contact Recommended personal protective equipment: • acid-resistant gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • fluid may have high heavy metals contents • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Bulbs - Fluorescent Source: Office and building bulb change-outs Physical Description: Solid opaque glass, breakable. AVOID DIRECT CONTACT WITH BROKEN BULBS	<i>Treat as HW</i>	Package in original boxes if possible and store in a sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). <i>A single waste tote is available outside of the Waste Storage Yard for convenient use. See Norman Wells Waste Storage Yard Operator Site Map (Appendix C).</i>		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • exposure Most probable worker exposure route: • skin/eye contact Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Bulbs – Non Fluorescent Source: Office and building bulb change-outs Physical Description: Solid opaque glass, breakable	Non-HW	Store in a sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). <i>A single waste tote is available outside of the Waste Storage Yard for convenient use. See Norman Wells Waste Storage Yard Operator Site Map (Appendix C).</i>		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • exposure Most probable worker exposure route: • skin/eye contact Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Chemical Totes (Empty) – NALCO Source: Containers for additives used in pipeline maintenance programs (i.e. corrosion prevention) Physical Description: Solid container (Steel or Plastic)	<i>HW</i>	Store empty containers in Yard A on the backside of the chemical dock. Ensure that all caps/lids are in place and will not leak. Containers must be completely empty, if residual chemical is present notify Flint to have residual chemical removed.		Return steel totes to NALCO via Velocity. Plastic totes are to be sent to a recycling facility via velocity.	Potential worker exposure and safety concerns: • exposure Most probable worker exposure routes: • inhalation, skin/eye contact Recommended personal protective equipment: • chemical resistant gloves and coveralls • safety glasses / goggles • coveralls, boots, hardhat • face shield as appropriate • breathing mask or SCBA as appropriate Potential environmental effect: • soil and surface water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Construction and Demolition Material Source: Construction and demolition activities Physical Description: Solid, inert, wood, pallets, metal	<i>Non-HW</i>	Scrap metal: Store appropriately in the designated area(s). Wood: Store neatly stacked in the designated area of the Waste Storage Yard.	Re-use as appropriate.	Scrap Metal: Imperial approved waste receiver facility. Wood: Contact Environmental Technician or Environment and Regulatory Advisor.	Potential worker exposure and safety concerns: • exposure to potentially impacted materials (i.e. asbestos, oils, etc.) • sharp objects • heavy objects (back injuries) • dust, fibers Most probable worker exposure routes: • skin/eye contact, dust inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hardhat • dust mask as appropriate Potential environmental effects: • soil/water impacts • indoor/outdoor air pollution/dust

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Desiccant (including hydromation filter media) Source: Molecular sieves from gas dryers and instrument air dryers Physical Description: Small bead/pellet. Varies in size and color	HW	Store in sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile hydrocarbons • dust Most probable worker exposure routes: • skin/eye contact, dust/vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil/water impacts • indoor/outdoor air pollution/dust • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Domestic Garbage Source: Office waste Physical Description: Paper, cardboard, food waste, stationary supplies	<i>Non-HW</i>	Store in designated blue metal bins around site. Separate recyclables (i.e. pop cans) into designated recycling bins located in the CPF Kitchen.		Garbage is collected and disposed of by the local contractor hired by Imperial. If items are too large for the blue bin they will be hauled via truck upon approval from the Town of Norman Wells. Pop cans are taken to the Norman Wells Recycling Depot.	Potential worker exposure and safety concerns: - impacted materials - sharp objects - heavy objects (back injuries) - dust, fibers Most probable worker exposure routes: - skin/eye contact, dust inhalation Recommended personal protective equipment: - n/a Potential environmental effects: - soil/water impacts - indoor air pollution/dust

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Drums / Barrels Source: Liquid supplies (i.e. glycol, lube oil, varsol) Physical Description: Steel or plastic, may be full or contain residual liquids NOTE: An empty drum/barrel is defined as one that has not been purged or rinsed and contains less than 2.5 cm (~ 1 inch) of residual material at the bottom or less than 3% of its original contents, whichever is the lesser amount.	Non-HW	Empty drums/barrels must be stored and labeled with the original contents on pallets upright with lids and bungs in place in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Full drums/barrels that constitute HW must be stored on pallets upright with lids and bungs in place in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). At all times barrels should be on pallets off the ground to ensure container integrity.	Empty Glycol drums/barrels may be used for storing waste glycol. Empty Lube Oil drums/barrels may be used for storing waste lube oils. Empty Varsol barrels/drums may be used for storing waste varsol. THE USE OF BARRELS/DRUMS BY EMPLOYEES OR OTHER INDIVIDUALS FOR RAINWATER COLLECTION OR OTHER PURPOSES IS NOT ALLOWED.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - residual liquids and /or free/volatile hydrocarbons - low flashpoint / flammable / explosive residues/mixtures - unneutralized residual acids or caustics Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Filters (Impacted and Non Impacted) (i.e. sock filters, cartridge filters, - glycol, compressor oil, lube oil) Source: Equipment and maintenance activities Physical Description: Sock filters, cartridge filters. Usually cylindrical and varies in size.	Non-HW or HW	Store in a sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Fluid removed from spent process filters via compaction may constitute a HW.		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile hydrocarbons • low flash point / flammability of some filters Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate • carbon filter mask as appropriate Potential environmental effects: • air pollution/dust • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Gas Cylinders Source: Instrumentation maintenance activities Physical Description: Sock filters, cartridge filters. Usually cylindrical and varies in size.	Non-HW or HW depending on the original contents	Empty gas cylinders be stored in a sealed and properly labeled waste container in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • flammability • compressed gases exploding Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts harmful to terrestrial and aquatic ecosystems
Hydromatation Filter Medium See Desiccant					

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Impacted Debris and Soil - Oil / Produced Water/ Condensate / Chemicals Source: Release, accident, or leak Physical description: Solid (soil, shale, vegetation)	<i>Treat as HW</i> Testing is required to determine leachate toxicity.	Small volumes of excavated/collected impacted debris and soil must be stored in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Large volumes of excavated/collected impacted debris and soil - contact Environmental Technician or Environmental Advisor on a case by case basis.	Large volumes of impacted debris and soil MUST be laboratory tested prior to treatment to determine characterization. Dependent upon characterization test results, some form of bioremediation (i.e. biocell, land treatment) may be appropriate but is determined by the Environmental Technician or Environmental Advisor. Impacted debris and soil tested and confirmed UNSUITABLE for bioremediation is handled in accordance with site capabilities and characterization test results. Liquids from settling and melting (i.e. oil, rain water) are collected via a vacuum truck and transported to the F-31X Treatment and Injection Facility.	Bio-remediated and/or non-impacted soil is reintroduced for use on site, after confirmatory laboratory testing. Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation. Any waste shipped off site goes to an Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of crude oil, produced water, condensate • low flashpoint / flammable residues Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate • carbon-filter mask as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Impacted Snow and Ice - Oil / Produced Water/ Condensate / Chemicals Source: Release, accident, or leak Physical description: Solid and/or liquid (snow/ice)	<i>Normally a Non-HW</i>	Small volumes of impacted snow and ice must be stored in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (imperviously lined and bermed area). Large volumes of impacted snow and ice – contact Environmental Technician or Environmental Advisor.	Snow/ice melt is collected via a vacuum truck and transported to the F-31X Treatment and Injection Facility.	Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation.	Potential worker exposure and safety concerns: • free/volatile components of crude oil, produced water, condensate • low flashpoint / flammable residues Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate • carbon-filter mask as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Liners (Impacted or Non Impacted) Source: Cleanup activities, temporary cell decommissioning Physical description: Plastic material and usually black in color	Non-HW or HW	Cut into small pieces and store in sealed and properly labeled waste containers in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of crude oil, produced water, condensate • low flashpoint / flammable residues Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate • carbon-filter mask as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Mud Material Bags (Empty) Source: Mud for rig activities Physical Description: Empty bags, paper lined with a waxy substance	<i>Non-HW</i>	Store in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - dust inhalation Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate - carbon filter mask as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems - air pollution/dust
NALCO Chemical See Chemical Totes (Empty) – NALCO					

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Oily Rags Source: Drips, leaks, maintenance work Physical Description: Oily and dirty cloths, absorbent pads, used clothing, etc.	HW	Store in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of crude oil, produced water, condensate • low flashpoint / flammable residues Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate • carbon-filter mask as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Pails - (Empty or Full - Previously containing Non-HW or HW material) Source: Containers from small volume liquid supplies Physical Description: Plastic or metal NOTE: An empty drum/barrel is defined as one that has not been purged or rinsed and contains less than 2.5 cm (~ 1 inch) of residual material at the bottom or less than 3% of its original contents, whichever is the lesser amount.	Non-HW or HW	Empty or full pails must be stored with labels on pallets upright with lids and bungs in place in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	Empty, rinsed metal pails can be re-used as appropriate. NOTE: A rinsed empty container means a container that has been rinsed three times using for each rinse a clean solvent that is equal to 10% of the container volume and that is capable of removing the contained waste.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - residual liquids and /or free/volatile hydrocarbons - low flashpoint / flammable / explosive residues/mixtures - unneutralized residual acids or caustics Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate - carbon-filter mask as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Pallets Source: Various activities Physical Description: Solid wood containing nails. Heavy	<i>Non-HW</i>	Re-usable pallets should be stored neatly outside of the fenced area of the Waste Storage Yard. Broken pallets should be segregated from re-usable pallets and stored neatly outside of the fenced area of the Waste Storage Yard.	Re-use pallets on site as appropriate.	Contact Environmental Technician or Environment and Regulatory Advisor for disposal options.	Potential worker exposure and safety concerns: • n/a Most probable worker exposure routes: • skin/eye contact Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat Potential environmental effects: • n/a

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Paint and Paint Cans Source: Building and operational maintenance activities Physical Description: Paint and empty cans	Paint: <i>HW</i> Paint Cans: <i>Non-HW</i>	<u>Paint:</u> Store in original containers sealed with lid. <u>Empty Paint Cans (containing no pourable paint):</u> Paint cans must be stored on pallets open in a covered area to air dry paint. Once dry secure lids and dispose of in sealed and properly labeled waste tote in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	<u>Paint:</u> Reuse as appropriate.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of paint solvents • low flashpoint / flammable components of paint Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • chemical resistant gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Refractory Brick* *This is not a regular waste type encountered at NWO Source: Used for high temperature insulation (i.e. in vessels). Has not been used recently at NWO Physical Description: Brick	Non-HW or HW	Refractory brick must be stored in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	Re-use on site as needed.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - dust inhalation Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate - carbon filter mask as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems - air pollution/dust

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Scrap Metal Source: Equipment change-outs, maintenance activities, construction and decommissioning activities. Physical Description: Various sizes of steel, iron, aluminum, copper, old equipment.	<i>Non-HW</i>	Store in the designated area(s) of Yard "D" (across from Flint Shop). Scrap must be neatly stored and on pallets off of the ground. Old equipment must be drained of fluids and stored on pallets with labels in the designated area of the Waste Storage Yard (imperviously lined and bermed area).	Re-use on site as appropriate.	Those items that are stored in the Waste Storage Yard are disposed of yearly at an Imperial approved waste receiver facility. When scrap metal quantities amount to be economically viable, scrap metal is disposed of at an Imperial approved waste receiver facility. This may exceed 1 year.	Potential worker exposure and safety concerns: • exposure to impacted materials • sharp objects • heavy objects (back injuries) Most probable worker exposure routes: • skin/eye contact Recommended personal protective equipment: • impact gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Sludge Material Source: Maintenance activities; primarily tank bottoms. Well work over fluids. Physical Description: Various hydrocarbons mixed with water. Composition dependent on source.	HW	Store in designated storage tanks or storage bins.	Sludge from the Grizzly and Well work over fluids can be centrifuged at the onsite centrifuge to separate solids from liquids. Liquids are to be taken to F-31X Treatment and Injection Facility. Sludge that cannot be treated at the F-31X Treatment and Injection Facility nor the onsite centrifuge can be treated using polymerization technology onsite. Contact Waste Contractor	Solids from the centrifuge are generated at the centrifuge and put into lined wooden crates. All solids generated are to be taken to an Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - free/volatile components of crude oil, produced water, condensate, or any other chemical - low flashpoint / flammable residues Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - Chemical gloves - Safety glasses / goggles - Coveralls, boots, hard hat - face shield as appropriate - carbon-filter mask as appropriate Potential environmental effects: - sludge (primarily hydrocarbons) are harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Smoke Detectors Source: Building and operational maintenance activities Physical Description: Round device containing a battery compartment.	<i>Non-HW</i>	Store inside a large container clearly labeled "Smoke Detectors" with a tight fitted lid. Oil absorbent matter (i.e. rags) must be placed around the item to protect it from breaking or sudden shock.		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - ionization technology which can contain minute amounts of radioactive material Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - chemical resistant gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Spent Pigs Source: Preventative maintenance work on pipelines Physical Description: Solid plastic. Various colors and sizes.	Non-HW	Store in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). <i>A single waste tote is available outside of the Waste Storage Yard for convenient use. See Norman Wells Waste Storage Yard Operator Site Map (Appendix F).</i>		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
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B. Liquid Wastes

Closed Drain System Fluids Source: Building floor drains/sumps Physical Description: Liquid	Normally a Non-HW	Closed drain system fluids are collected <i>via</i> floor drains and pumped through the CPF closed drain system.	Closed drain systems are emptied via vacuum truck and taken to the F-31X Treatment and Injection Facility.	Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems
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NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Collected Surface Water Runoff (Meeting Release Criteria) Source: Seasonal run off and snow melt Physical Description: Water from ditches, bunkers, impound basins, and excavations	<i>Non-HW</i>	Store in surface runoff collection points (i.e. impound basins, ditches, bunkers, excavations, etc.).	All surface water runoff must be tested as per Sahtu Land and Water Board Licence S13L1-007 prior to discharge. Bunkers and ditches usually require field screening tests. Impound basins require laboratory testing. Contact Environmental Technician or Environmental Advisor for more information. <i>If the above procedures have been performed and a surface water runoff does not meet Sahtu Land and Water Board License specifications then the water is taken to F-31X Treatment and Injection Facility. Surface Water Release forms must be filled out and submitted to Environmental Advisor with 24 hours of treatment.</i>	Bunkers and ditches that meet the Sahtu Land and Water Board License field test specifications can be discharged by operators and contractors. Impound basins that meet the Sahtu Land and Water Board License laboratory test specifications can be discharged by permission from the Environmental Technician or Environment and Regulatory Advisor. <i>Water resulting from the F-31X Treatment and Injection Facility is injected into F-31X well into the sub-surface formation.</i>	Potential worker exposure and safety concerns: - free/volatile components of oil or condensate Most probable worker exposure routes: - skin/eye contact, inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Collected Surface Water Runoff (Impacted) Source: Seasonal run off and snow melt Physical Description: Water from ditches, bunkers, impound basins, and excavations	<i>Non-HW</i>	Store in surface runoff collection points (i.e. impound basins, ditches, bunkers, excavations, etc.).	All surface water runoff must be tested as per Sahtu Land and Water Board Licence S13L1-007 prior to discharge. Bunkers and ditches usually require field screening tests. Impound basins require laboratory testing. Contact Environmental Technician or Environmental Advisor for more information. <i>If the above procedures have been performed and a surface water runoff does not meet Sahtu Land and Water Board License specifications then the water is taken to F-31X Treatment and Injection Facility. Surface Water Release forms must be filled out and submitted to Environmental Advisor with 24 hours of treatment.</i>	Bunkers and ditches that meet the Sahtu Land and Water Board License field test specifications can be discharged by operators and contractors. Impound basins that meet the Sahtu Land and Water Board License laboratory test specifications can be discharged by permission from the Environmental Technician or Environment and Regulatory Advisor. <i>Water resulting from the F-31X Treatment and Injection Facility is injected into F-31X well into the sub-surface formation.</i>	Potential worker exposure and safety concerns: - free/volatile components of oil or condensate Most probable worker exposure routes: - skin/eye contact, inhalation Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Glycols (Used) Source: Heat trace, heat exchangers, radiators Physical Description: Liquid with anti-freeze type properties. Usually yellowish in color.	Normally a Non-HW NOTE: Glycols may constitute a HW/DOW depending on its BTEX content, leachate characteristics, and flash point.	Store in barrels and labeled on pallets upright with lids and bungs in place in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	Empty Glycol drums/barrels may be used for storing waste glycol.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile glycol • low flash point / flammability Most probable worker exposure routes: • skin/eye contact, vapor inhalation. Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Lube Oils (Used) Source: Engine oils, compressor oils, gear oils, transmission oils, hydraulic oils, etc.) Physical Description: Liquid oil with oily consistency for lubrication in machinery. Usually yellowish in color	HW	Store in barrels/drums and labeled on pallets upright with lids and bungs in place in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	Empty Lube Oil drums/barrels may be used for storing waste lube oil.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile lube oil • low flash point / flammability Most probable worker exposure routes: • skin/eye contact, vapor inhalation. Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
C. Semi-Solids and Miscellaneous					
Grizzly Tank (Tank 002) Material Source: Solids that separate out from the F-31X Treatment and Injection Facility Physical Description: Semi-solid material	<i>HW</i>	Store in Grizzly Tank (Tank 002).	Semi-solid mixture collected directly from the Grizzly Tank (Tank 002) is removed via vacuum truck and is transported to the onsite centrifuge where the solids separate from liquids if material is deemed acceptable. If the material is not accepted at the centrifuge the material can be evaluated for sludge polymerization treatment. Liquids generated from on-site treatment will be recycled through the F-31X Treatment and Injection Facility.	Solids will be sent to an Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Heat Exchanger Material Source: Cleaning of heat exchangers Physical Description: Semi-solid material	<i>HW</i>	Leave in the heat exchanger. NOTE: Waste is generated when heat exchanger(s) undergo cleaning. This event occurs every ~10 years during Operations and will occur during decommissioning activities.	Semi-solid is removed via a vacuum truck and taken to the F-31X Treatment and Injection Facility.	Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Inlet Separator Material Source: Cleaning of inlet separator Physical Description: Semi-solid material	<i>HW</i>	Leave in the inlet separator. NOTE: Waste is generated when the inlet separator(s) undergoes cleaning. This event occurs every ~1-3 years during Operations and will occur during decommissioning activities.	Semi-solid is removed via a vacuum truck and transported to the F-31X Treatment and Injection Facility.	Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Laboratory Waste Source: On site laboratory analysis (field tests) Physical Description: Solid or liquid. Preservative vials, nitrile gloves, laboratory reagents, glassware, old lab equipment.	<i>HW</i>	Laboratory reagents must be collected in labeled barrels/pails as advised by the Environmental Technician or Environmental Advisor. Keep reagents separated, do not commingle. NOTE: Solid laboratory reagents must be stored in a barrel/pail that is compatible with the reagent, as some reagents may be corrosive. Old laboratory equipment, glassware, empty preservative vials, etc., must be disposed of in appropriate laboratory waste containers (in lab) and compiled into a larger waste tote for appropriate disposal. Full waste totes must be stored in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - toxic compounds - spontaneously combustible - oxidizing (reactive) compounds - corrosive compounds Most probable worker exposure routes: - skin/eye contact, vapor inhalation Recommended personal protective equipment: - chemical resistant gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - fluid may have high heavy metals contents - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Mercury (Used) Source: Old laboratory equipment Physical Description: Thermometers	<i>HW</i>	Store inside a large container clearly labeled "Mercury-DO NOT OPEN" with a tight fitted lid. Oil absorbent matter (i.e. rags) must be placed around the item to protect it from breaking or sudden shock. Mercury containing waste containers must be stored in the "red shed" located within the fenced area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - mercury Most probable worker exposure routes: - skin/eye contact, vapor/dust inhalation Recommended personal protective equipment: - chemical resistant gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Naturally Occurring Radioactive Material (NORM)* *This is not a regular waste type encountered at NWO Source: By-product waste streams, impacted equipment/materials. Can be generated from radioactive salts (barium sulphate) in produced water (radium) and radon in natural gas Physical Description: Various forms SPECIALLY TRAINED AND LICENCED PERSONNEL MUST BE ENGAGED WHEN DEALING WITH NATURALLY OCCURRING RADIOACTIVE MATERIAL AS IT IS EXTREMELY DANGEROUS TO HUMAN HEALTH.	NORM	Refer to the Imperial document <i>Alberta Program for the Management of Naturally Occurring Radioactive Material (NORM) which can be found on the Environmental Toolbox</i> NOTE: If you encounter NORM's, contact the Environmental Technician or Environment and Regulatory Advisor immediately.	Refer to the Imperial document <i>Alberta Program for the Management of Naturally Occurring Radioactive Material (NORM) which can be found on the Environmental Toolbox</i> Equipment exposed to NORM's must be cleaned, tested, and classified prior to the equipment being put back into service.	Refer to the Imperial Document <i>Alberta Program for the Management of Naturally Occurring Radioactive Material (NORM). A copy can be provided by the Environmental Technician or Environment and Regulatory Advisor.</i>	Potential worker exposure and safety concerns: - long-term unprotected overexposure to radiation is associated with increased risk of lung cancer and leukemia - inhaling/ ingesting alpha and beta dust - external exposure to gamma radiation is a concern, but not a serious hazard Can be controlled by: - limiting exposure duration, distance and proper PPE Recommended personal protective equipment: - gloves; leather or rubber coveralls (plastic are easier to decontaminate and hooded are preferred when working inside tanks) - rubber boots - HEPA respirator / supplied air goggles or full face respirator Protect yourself because breathing in the dust is the biggest risk! Potential environmental effects: - Radioactive impaction of soils, exposure to humans, wildlife and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Pigging Wax Solvent Source: Preventative maintenance for the removal of wax deposits Physical Description: Semi-solid waxy solvent; liquid and wax	<i>HW</i>	Large volumes must be stored in sealed and properly labeled drums/barrels in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>).	Pigging wax solvent may be re-used as appropriate.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, vapor inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
PCB* (Material and Equipment) *This is not a regular waste type encountered at NWO Source: (i.e. old transformers). Electrical non-conducting fluids used as insulators and heat exchanging fluids to prevent overheating in transformers, capacitors and older electrical switching units. Banned in 1977. Physical description: Metal equipment or other solids impacted with PCB liquids. PCB liquids are clear to yellow, are not soluble in water and have a bitter smell. May be cloudy after used. SPECIALLY TRAINED AND LICENSED PERSONNEL MUST BE ENGAGED WHEN DEALING WITH PCB-CONTAINING MATERIALS AND EQUIPMENT AS IT IS EXTREMELY DANGEROUS TO HUMAN HEALTH.	HW/DOW	PCB-containing materials and equipment - contact Environmental Advisor on a case by case basis. NOTE: All PCB-containing material in storage must be properly labeled and registered with Environment Canada. NOTE: If you encounter PCB's, contact the Environmental Technician or Environment and Regulatory Advisor immediately.		Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - PCBs Most probable worker exposure routes: - skin/eye contact, vapor/dust inhalation Recommended personal protective equipment: - chemical resistant gloves - safety glasses / goggles / face shield - safety boots, disposable coveralls - carbon filter mask or SCBA Potential environmental effects: - Non-biodegradable and can bio-accumulate in all types of life forms through the food chain and eventually to humans. Heating or incineration can produce dioxins and furans.

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Salt Bath Heater Salt Source: Salt bath heater Physical Description: Salt consistency that can liquefy at high temperatures	Non-HW	Store spent/unclean salt in sealed and properly labeled waste totes in the designated area of the Waste Storage Yard (<i>imperviously lined and bermed area</i>). Store clean salt bath heater salt temporarily behind F-107 for reuse	Re-use in as appropriate.	Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: - oxidizing salts (i.e. NaNO_3, NaNO_2) - dust Most probable worker exposure routes: - skin/eye contact Recommended personal protective equipment: - gloves - safety glasses / goggles - coveralls, boots, hard hat - face shield as appropriate Potential environmental effects: - soil and/or water impacts resulting from salt - harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Sewage Source: Human waste Physical Description: Semi-solid containing mainly water	<i>Non-HW</i>	Store in on-site sewage storage tanks.		Town of Norman Wells sewage lagoon.	Potential worker exposure and safety concerns: • biohazardous materials (i.e. fecal coliform) Most probable worker exposure routes: • skin/eye contact Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat Potential environmental effects: • soil and groundwater impacts

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Tank and Vessel Bottom Materials Source: Cleaning of tank and vessel bottoms Physical description: Semi-solid material	<i>HW</i>	Leave in the tank and vessel bottoms. NOTE: Waste is generated when tank and vessel bottoms undergo cleaning. This event occurs every ~1-3 years during Operations and will occur during decommissioning activities.	Small Volumes: Semi-solid is removed via a vacuum truck and taken to the F-31X Treatment and Injection Facility. Large Volumes: On-site sludge polymerization treatment will be evaluated.	Fluid resulting from the treatment facility is injected into F-31X well into the sub-surface formation.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts • harmful to terrestrial and aquatic ecosystems

NORMAN WELLS OPERATIONS WASTE INFORMATION TABLE

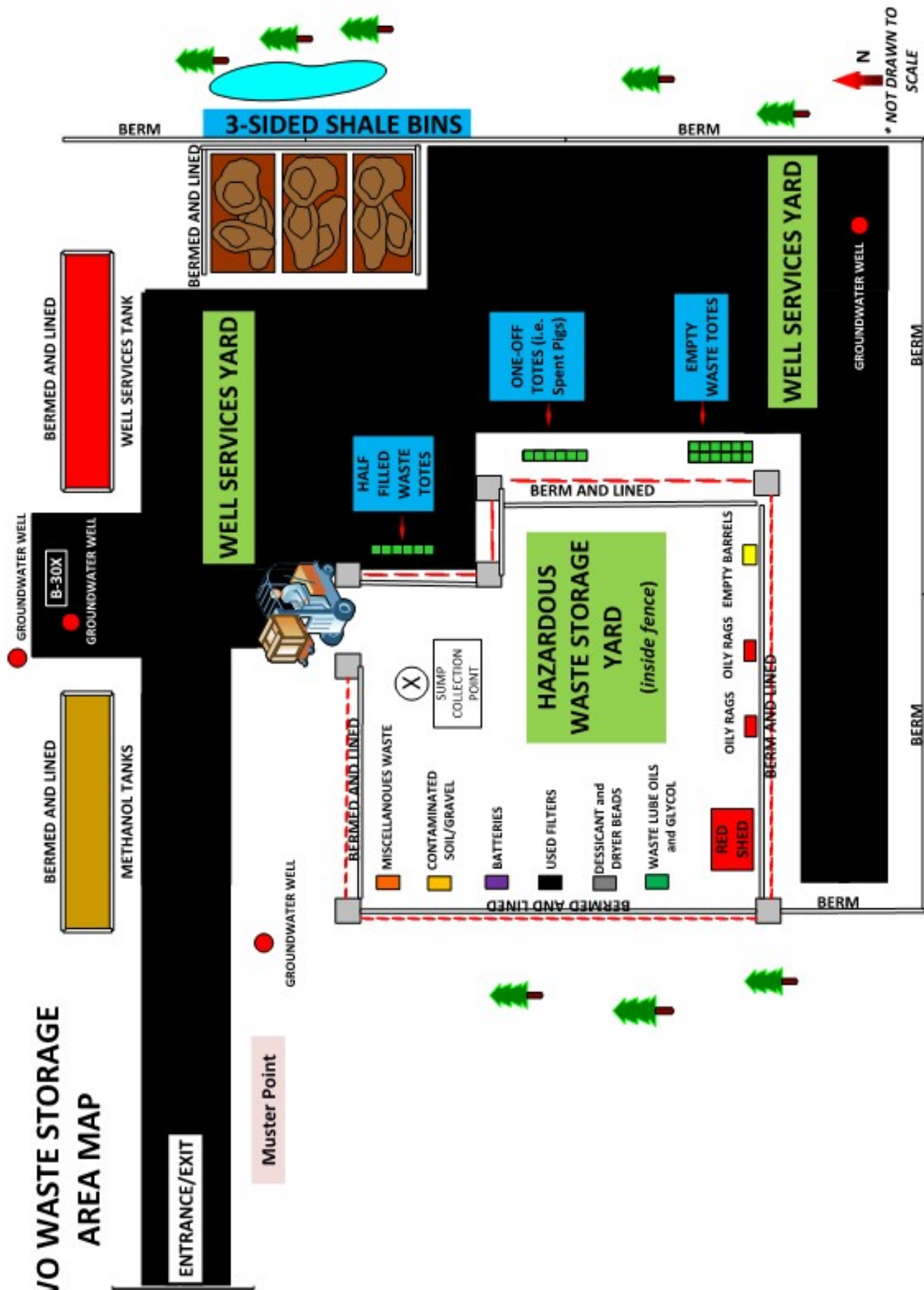
Waste Description	Designation	Storage On-Site	Treatment and Recycling On-Site	Offsite Disposal	Worker Exposure, Safety Issues and Potential Environmental Effects
Well Workover Materials Source: Rig work and activities Physical Description: Semi-solid mixture containing residual hydrocarbon and additives (specific additives for mud mixing)	<i>HW</i>	Semi-solid mixture is stored in the well services open top tank.	Semi-solid mixture settles naturally in the Well Services Tank ("Big Red") allowing the excess fluid to be removed and taken to the F-31X Treatment and Injection Facility. Semi-solid mixture collected directly from the Well Services Tank is removed via vacuum truck and transported to the on-site centrifuge where the liquids and solids will further separate.	Fluid resulting from the treatment facility and on-site centrifuge is injected into F-3X1 well into the sub-surface formation. Solids generated from the on-site centrifuge will be transported to an Imperial approved waste receiver facility.	Potential worker exposure and safety concerns: • free/volatile components of oil or condensate • low flashpoint / flammable residues • spontaneous combustion potential Most probable worker exposure routes: • skin/eye contact, inhalation Recommended personal protective equipment: • gloves • safety glasses / goggles • coveralls, boots, hard hat • face shield as appropriate Potential environmental effects: • soil and/or water impacts harmful to terrestrial and aquatic ecosystems



Appendix C: Norman Wells Waste Storage Area Map

The Norman Wells Waste Storage Area Map depicts both the Well Services Yard and the Hazardous Waste Storage Yard and is filed behind this page.

NWO WASTE STORAGE AREA MAP





Appendix D: Biocell Acceptance and Remediation Guidelines

The Biocell Acceptance and Remediation Guidelines is filed behind this page.

TABLE A1
BIOCELL ACCEPTANCE AND REMEDIATION GUIDELINES
FINE GRAINED SOIL

Parameter	Biocell Acceptance Level		Remediation Guideline		Reference
	Residential/Parkland Use	Industrial Land Use	Residential/Parkland Use	Industrial Land Use	
pH/Salinity/Sodicity					
pH	6 - 8	6 - 8	6 - 8	6 - 8	CCME (2007)
EC	5 - 8 (organic soil)	5 - 8 (organic soil)	5 - 8 (organic soil)	5 - 8 (organic soil)	Background
	< 2 dS/m	< 4 dS/m	2 dS/m		CCME (2007)
	< 4 dS/m (organic soil)	< 4 dS/m (organic soil)	3 dS/m	4 dS/m	Background
SAR	< 5	< 12	5	12	CCME (2007)
Metals	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Antimony	< 20	< 40	20	40	CCME (1991)
Arsenic	< 12	< 12	12	12	CCME (2007)
Arsenic	< 21	< 21	< 21	< 21	Background
Barium	< 500	< 2,000	500	2,000	CCME (2007)
Beryllium	< 4	< 8	4	8	CCME (1991)
Boron (hot water soluble)	< 4	< 4	< 4	< 4	Background
Cadmium	< 10	< 22	10	22	CCME (2007)
Chromium (total)	< 64	< 87	64	87	CCME (2007)
Cobalt	< 50	< 300	50	300	CCME (1991)
Copper	< 63	< 91	63	91	CCME (1991)
Hexavalent Chromium	< 0.4	< 1.4	0.4	1.4	CCME (2007)
Fluoride (total)	< 400	< 2,000	400	2,000	CCME (1991)
Nickel	< 50	< 50	50	50	CCME (2007)
Nickel (mineral soil)	< 100	< 100	< 100	< 100	Background
Lead	< 140	< 600	140	600	CCME (2007)
Mercury	< 6.6	< 50	6.6	50	CCME (2007)
Molybdenum	< 10	< 40	10	40	CCME (1991)
Molybdenum (mineral soil)	< 45	< 45	< 45	< 45	Background
Selenium	< 1	< 2.9	1	2.9	CCME (2009)
Selenium (mineral soil)	< 4	< 4	< 4	< 4	Background
Thallium	< 1	< 1	1	1	CCME (2007)
Thallium (mineral soil)	< 2.6	< 2.6	< 2.6	< 2.6	Background
Tin	< 50	< 300	50	300	CCME (1991)
Vanadium	< 130	< 130	130	130	CCME (1991)
Zinc	< 200	< 360	200	360	CCME (1991)
Hydrocarbons	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
	no free phase hydrocarbons*	no free phase hydrocarbons*	no free phase hydrocarbons	no free phase hydrocarbons	
PHC F1	< 5,000	< 10,000	210	320	CCME (2008)
PHC F2	< 3,000	< 5,000	150	260	CCME (2008)
PHC F3	< 3,000	< 5,000	1,300	2,500	CCME (2008)
PHC F4	< 5,600	< 6,600	5,600	6,600	CCME (2008)
Benzene	< 1,000	< 1,000	0.0068	0.0068	CCME (2007)
Toluene	< 1,000	< 1,000	0.08	0.08	CCME (2007)
Ethylbenzene	< 1,000	< 1,000	0.018	0.018	CCME (2007)
Xylenes	< 1,000	< 1,000	2.4	2.4	CCME (2007)
Polycyclic Aromatic Hydrocarbons (PAHs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Benzo(a)anthracene	< 1	< 10	1	10	CCME (1991)
Benzo(a)pyrene	< 0.6	< 1.4	0.6	1.4	CCME (2010)
Benzo(k)fluoranthene	< 1	< 10	1	10	CCME (1991)
Indeno(1,2,3-cd)pyrene	< 1	< 10	1	10	CCME (1991)
Naphthalene	< 0.013	< 0.013	0.013	0.013	CCME (2010)
Phenanthrene	< 0.046	< 0.046	0.046	0.046	CCME (2010)
Pyrene	< 7.7	< 100	7.7	100	CCME (1991, 2010)

Notes: * Soil may be pre-processed prior to placement in biocell if free phase hydrocarbon is present.

TABLE A2
BIOCELL ACCEPTANCE AND REMEDIATION GUIDELINES
COARSE GRAINED SOIL

Parameter	Biocell Acceptance Level		Remediation Guideline		Reference
	Residential/Parkland Use	Industrial Land Use	Residential/Parkland Use	Industrial Land Use	
pH/Salinity/Sodicity					
pH	6 - 8	6 - 8	6 - 8	6 - 8	CCME (2007)
EC	5 - 8 (organic soil) < 2 dS/m	5 - 8 (organic soil) < 4 dS/m	5 - 8 (organic soil) 2 dS/m	5 - 8 (organic soil) 4 dS/m	Background CCME (2007)
SAR	< 4 dS/m (organic soil) < 5	< 4 dS/m < 12	3 dS/m 5	4 dS/m 12	Background CCME (2007)
Metals	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Antimony	< 20	< 40	20	40	CCME (1991)
Arsenic	< 12	< 12	12	12	CCME (2007)
Arsenic	< 21	< 21	< 21	< 21	Background
Barium	< 500	< 2,000	500	2,000	CCME (2007)
Beryllium	< 4	< 8	4	8	CCME (1991)
Boron (hot water soluble)	< 4	< 4	< 4	< 4	Background
Cadmium	< 10	< 22	10	22	CCME (2007)
Chromium (total)	< 64	< 87	64	87	CCME (2007)
Cobalt	< 50	< 300	50	300	CCME (1991)
Copper	< 63	< 91	63	91	CCME (1991)
Hexavalent Chromium	< 0.4	< 1.4	0.4	1.4	CCME (2007)
Fluoride (total)	< 400	< 2,000	400	2,000	CCME (1991)
Nickel	< 50	< 50	50	50	CCME (2007)
Nickel (mineral soil)	< 100	< 100	< 100	< 100	Background
Lead	< 140	< 600	140	600	CCME (2007)
Mercury	< 6.6	< 50	6.6	50	CCME (2007)
Molybdenum	< 10	< 40	10	40	CCME (1991)
Molybdenum (mineral soil)	< 45	< 45	< 45	< 45	Background
Selenium	< 1	< 2.9	1	2.9	CCME (2009)
Selenium (mineral soil)	< 4	< 4	< 4	< 4	Background
Thallium	< 1	< 1	1	1	CCME (2007)
Thallium (mineral soil)	< 2.6	< 2.6	< 2.6	< 2.6	Background
Tin	< 50	< 300	50	300	CCME (1991)
Vanadium	< 130	< 130	130	130	CCME (1991)
Zinc	< 200	< 360	200	360	CCME (1991)
Hydrocarbons	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
	no free phase hydrocarbons*	no free phase hydrocarbons*	no free phase hydrocarbons	no free phase hydrocarbons	
PHC F1	< 1,000	< 10,000	30	320	CCME (2008)
PHC F2	< 1,000	< 5,000	150	260	CCME (2008)
PHC F3	< 750	< 2,500	300	1,700	CCME (2008)
PHC F4	< 2,800	< 3,300	2,800	3,300	CCME (2008)
Benzene	< 1,000	< 1,000	0.0095	0.0095	CCME (2007)
Toluene	< 1,000	< 1,000	0.37	0.37	CCME (2007)
Ethylbenzene	< 1,000	< 1,000	0.082	0.082	CCME (2007)
Xylenes	< 1,000	< 1,000	11	11	CCME (2007)
Polycyclic Aromatic Hydrocarbons (PAHs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Benzo(a)-anthracene	< 1	< 10	1	10	CCME (1991)
Benzo(a)pyrene	< 0.6	< 1.4	0.6	1.4	CCME (2010)
Benzo(k)fluoranthene	< 1	< 10	1	10	CCME (1991)
Indeno(1,2,3-cd)pyrene	< 1	< 10	1	10	CCME (1991)
Naphthalene	< 0.013	< 0.013	0.013	0.013	CCME (2010)
Phenanthrene	< 0.046	< 0.046	0.043	0.046	CCME (2010)
Pyrene	< 7.7	< 100	7.7	100	CCME (1991, 2010)

Notes: * Soil may be pre-processed prior to placement in biocell if free phase hydrocarbon is present.



Appendix E: Norman Wells Waste Movement Form

The Norman Wells Waste Movement Form is filed behind this page.

