

**Waste Management Plan
Fort Liard West
Northwest Territories
April 2021
Version 1**



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Glossary

Dangerous Goods	<p>Any product, substance or organism included by its nature or by the <i>Transportation of Dangerous Goods Regulations</i> (TDGR) in any of the classes listed in the schedule provided in the <i>Transportation of Dangerous Goods Act</i> (TDGA) [Transportation of Dangerous Goods Act (Canada)]</p> <p>Class 1: Explosives, including explosives within the meaning of the <i>Explosives Act</i> (Canada).</p> <p>Class 2: Gases; compressed, deeply refrigerated, liquefied or dissolved under pressure.</p> <p>Class 3: Flammable and combustible liquids.</p> <p>Class 4: Flammable solids; substances liable to spontaneous combustion and substances that on contact with water emit flammable gases.</p> <p>Class 5: Oxidizing substances; organic peroxides.</p> <p>Class 6: Poisonous (toxic) and infectious substances.</p> <p>Class 7: Radioactive materials and prescribed substances within the meaning of the <i>Atomic Energy Control Act</i> (Canada).</p> <p>Class 8: Corrosives.</p> <p>Class 9: Miscellaneous products, substances or organisms that are considered by the Lieutenant Governor in Council to be dangerous to life, health, property or the environment when transported and are prescribed to be included in this class.</p>
Well Waste (not including seismic shot hole drilling waste)	A mixture of water, cuttings, additives and various other wastes that are specifically related to the suspension and abandonment activities.
Grey Water	The liquid resulting from the treatment of sewage.
Hazardous Waste	<p>A contaminant which is a dangerous good that is no longer used for its original purpose and is intended for storage, recycling, treatment or disposal. Materials that do not meet the criteria in schedules I, III or IV, or the standards for dioxins and furans, of the Guideline for Industrial Waste Discharges in the NWT.</p> <p>A hazardous waste does not include a contaminant that is:</p> <ul style="list-style-type: none"> (a) household in origin, (b) included in class 1, Explosives or class 7, Radioactive materials of TDGR, (c) exempted as a small quantity, (d) an empty container, or

(e) intended for disposal in a sewage system or by land filling that meet the applicable standards set out in schedules I, III or IV of the Guideline for Industrial Waste Discharges in the NWT.

Household Hazardous Waste	Common everyday products that people use in and around their homes including paint, paint thinner, herbicides, and pesticides that, due to their chemical nature, can be hazardous if not properly disposed.
Kitchen Waste	In this document, kitchen waste is composed of foodstuff, paper products, plastic film wrapping, <i>etc.</i>
Non-hazardous Waste	Wastes that do not fall into the “Hazardous Waste” category.
Produced Water	Any water that is produced to the surface along with oil or gas.
Run off	In this document, excessive rain or snowmelt can produce overland flow to retention ponds.
Sewage	Human excrement, water borne human excretion or the water-carried wastes from liquid or non-liquid culinary purposes, washing, cleansing, laundering, food processing or ice production.
Testing Required	Occasionally, laboratory analysis may be required to fully characterize and classify a waste product.

1. Introduction

Paramount is the operator of the Liard West Project. The Project is situated in the NT, roughly 35 km north of the BC / NT border. From the Liard West Project area, Fort Nelson, BC is located approximately 200 km to the south, Trout Lake, NT is located roughly 150km to the east and Nahanni Butte, NT is located approximately 100km to the north. The hamlet of Fort Liard, NT is located within the Project area.

The Liard West Project encompasses all-season and winter access roads; well sites, pipelines, valve sites and gas dehydration facilities; a water disposal well at O-80; a repeater site; camp, decking and staging sites; and various borrow pits and sumps. Six natural gas wells (Paramount *et al* K-29A, 2K-29, 3K-29, M-25, 2M-25 and F-25a) on three lease sites (K-29, M-25 and F-25) are tied-in to a 37.2km main pipeline that connects the K-29 lease site to a facility at the abandoned/reclaimed BP Pointed Mountain plant site. The M-25 lease site is linked to the F-25 plant site via a 1.4 km pipeline lateral and the F-25 plant is linked to the main pipeline via a 3.3 km pipeline lateral. When active, produced water from wells on the K-29 and F-25 leases is transported via pipeline to an injection well located at O-80.

All project components have been built and the wells and pipelines in the Liard West Project are suspended, deactivated and/or decommissioned. Activity in the area has been limited in recent times to suspension activities, maintenance of access and monitoring. Future plans for the Liard West Project are currently undetermined and depend on future economic and political developments.

2. Environmental Overview

2.1 Terrain, Soil and Permafrost

The Project areas occur within the Liard Plains MB Ecoregion; immediately to the south and east lies the Liard Upland MB Ecoregion and, further to the west, the Central Mackenzie Plain Boreal Northern Cordilleran (Ecosystem Classification Group 2007). In the Project areas local terrain, soils and vegetation are directly representative of the Liard Plains MB Ecoregion, and to varying degrees the adjacent Liard Upland. In general, the Liard Plain MB Ecoregion exhibits one of the warmest climatic conditions in the NT. Productive deciduous, mixed-wood and conifer forests occur on the broad low-lying alluvial terraces of the Liard River (Ecosystem Classification Group 2007). Meander scrolls have developed on the Liard River floodplain, indicating an environment of active deposition and change. East of the Liard River plain are the gently undulating lacustrine deposits and lacustrine veneers of the Trout Uplands.

Soils of the Liard Plain, mainly poorly drained Regosols, are relatively young, due to ongoing deposition by the Liard River. Gleysols and Luvisols occur with lacustrine and till materials, while Organic soils occur under wetlands (Ecosystem Classification Group 2007). Permafrost is uncommon and is defined as being discontinuous sporadic.

Terrain, soils and permafrost in the Project areas have experienced relatively low levels of impacts prior to clearing and development undertaken for previously approved Project components; these include well leases, pipeline right-of-ways, access roads, sumps, camps and other facilities. Typical sources of potential impacts included contamination resulting from spills and/or poorly managed waste; altered, local terrain features (surface topography, site elevation, drainage patterns) resulting from soil movement; soil erosion

resulting from the removal of vegetative ground cover; and disruption of permafrost resulting in slumping and erosion.

2.2 Vegetation

Vegetation characteristic of the Liard Plain MB Ecoregion reflects the relatively warm climate and moist, rich site conditions (Ecosystem Classification Group 2007). Willow shrublands occur on recently flooded areas along the Liard River. Drier upland sites on alluvial terraces contain mixed deciduous and mixed wood forest of trembling aspen, balsam poplar and white spruce. Forest understories are often lush, and include species such as low-bush cranberry, prickly rose, red osier dogwood, dwarf red raspberry, meadow-horsetail and other herbs. On low-lying areas, rich willow-sedge fens occur.

2.3 Water and Aquatic Species

In the Liard Plain Ecoregion, water covers approximately 5% of the total land base, with the Liard River being the dominant aquatic feature (Ecosystem Classification Group 2007). Numerous ponds, channel marshes, and fens occur along the Liard River plain. The Muskeg River and Rabbit Creek, along with numerous other small permanent and intermittent streams, drain into the Liard Plain MB Ecoregion from the adjacent Liard Upland and Trout Upland ecoregions. Small shallow lakes occur in undulating areas, mainly in the south half of the Ecoregion.

Both ground and surface water have the potential to be impacted through changes in water quality and water volumes. Primary sources of impacts may include spills and/or releases, soil erosion, and water withdrawal from specified lake sources. Water withdrawals, and the effects and management of withdrawals, will continue to be addressed and managed as part of the new Type-B Water Licenses. To mitigate the ongoing risk of impacts from erosion, spills, and releases, Paramount will continue to employ specific industry best management practices and applicable mitigation measures along with the associated Project Spill Contingency Plan.

2.4 Wildlife

Wildlife species that occur in the region encompassing the Project area are those adapted generally and/or more specifically with the topography, hydrologic systems and vegetation communities occurring in the Liard Plain and Liard Upland ecoregions. Characteristic mammal species include moose, black bear, beaver, fox, wolf, lynx, marten, mink, snowshoe hare, wolverine, weasel and red squirrel. To a lesser degree species such as woodland caribou occur throughout the region. Common bird species include bald eagles, hawks, falcons, chickadees, northern shrike, redpolls, ravens, Canada jays, woodpeckers, sandhill cranes, grouse and owls. Common fish species include northern pike, grayling, walleye, burbot, suckers, whitefish, and a number of species of forage fish (i.e. minnows).

Overall, wildlife species' habitats and populations have been exposed to relatively low levels of impacts from approved developments that comprise the existing Projects. Sources of impacts have included the clearing and construction for well leases, the battery site, access roads, sumps, camps and other facilities.

3. Regulatory Framework

Managing oil and gas wastes in the NWT is challenging, due in part to the complex regulatory regime. Minimal waste facilities add to the complexity: if waste must be moved outside of the NWT for disposal, the regulatory regime becomes even more complex (see CAPP, 2009). In the past for the Liard West project area Paramount received oil and gas approvals from the National Energy Board (NEB). Since devolution and the creation of the Oil and Gas Regulator for Oil and Gas Operations ("OROGO") in the NWT, Paramount receives oil and gas approvals from OROGO. The Mackenzie Valley Land and Water Board (MVLWB) regulates the use of land and water and the deposit of waste through the issuance of Land Use Permits (LUPs) and Water Licences (WLs).

3.1 Assessment Processes

The Liard West development has been the subject to Environmental Assessment processes prior to licencing and permitting of activity. Some of the assessment processes were conducted prior to Paramount becoming the operator of a field: however, Paramount has assumed the outcomes and the responsibilities associated with those assessment processes since it has become the operator of a field. Examples of assessment processes are *Environmental Assessment of the Ranger Oil Ltd., Canadian Forest Oil Ltd. and Chevron Canada Resources Ltd. P-66/N-61/K-29 Gas Wells and Pipeline Tie-in Fort Liard, NT.*

3.2 Regulatory Approvals

Table 1 below lists Paramount's current LUPs and WLs for the Liard West Project Area. Given the current state of the projects (built and in some instances decommissioned and/or suspended) the scope of the LUPs and WLs are very limited. Activities contemplated include maintenance, access, suspensions and abandonments, reclamation and remediation. It is important to note that OROGO is the regulator for the down-hole activities of suspension and abandonment: however, surface use, waste disposal and water use for these activities is within the jurisdiction of the MVLWB.

Table 1: Current LUPs and WLs

Liard West	Registry Link
MV2020A0009	https://mvlwb.com/registry/MV2020A0009
MV2020L1-0006	https://mvlwb.com/registry/MV2020L1-0007

4. Waste Management Strategy

Poor waste management practices can result in direct or indirect adverse environmental effects and can pose health and safety risks to employees and members of the general public. Furthermore, poor waste

management practices can ultimately result in substantial financial and legal liabilities. To prevent poor waste management practices and minimize potential adverse effects to environment, health and safety, Paramount Resources Ltd. (Paramount) has developed this Waste Management Plan (WMP), which falls under Paramount's Health, Safety and Environment Policy (Appendix 2).

The basis of Paramount's waste management system is the waste management hierarchy (Figure 1). The overriding principle of the waste management hierarchy is the reduction, if not the elimination, of both the volume and toxicity of waste. In the waste management hierarchy, disposal is the least preferred waste management option. Disposal also involves the greatest potential liability.

4.1 Waste Minimization

Waste minimization includes source reduction (reducing the amount and/or toxicity of waste generated). In some cases, reduction at the source will not yet be technically possible or economically feasible. Therefore, opportunities for reuse (reusing materials without changing the physical properties), recycling (reusing materials by changing the physical properties) and recovery (extracting a useful component) will be investigated for all wastes that are unavoidably generated.

The concept of waste minimization is a cornerstone to the Environmental Protection Plan: waste that is not generated need not be managed. Waste that is generated but is of the lowest possible volume and/or toxicity, can be managed most cost-effectively. Potential benefits to a waste minimization program are:

- increased revenue;
- reduced costs of operating, materials, waste management and disposal,
- energy, and facility cleanup;
- improved operating efficiency;
- reduced regulatory compliance concerns;
- reduced potential for both civil and criminal liability; and
- enhanced public perception of the company and the industry as a whole.

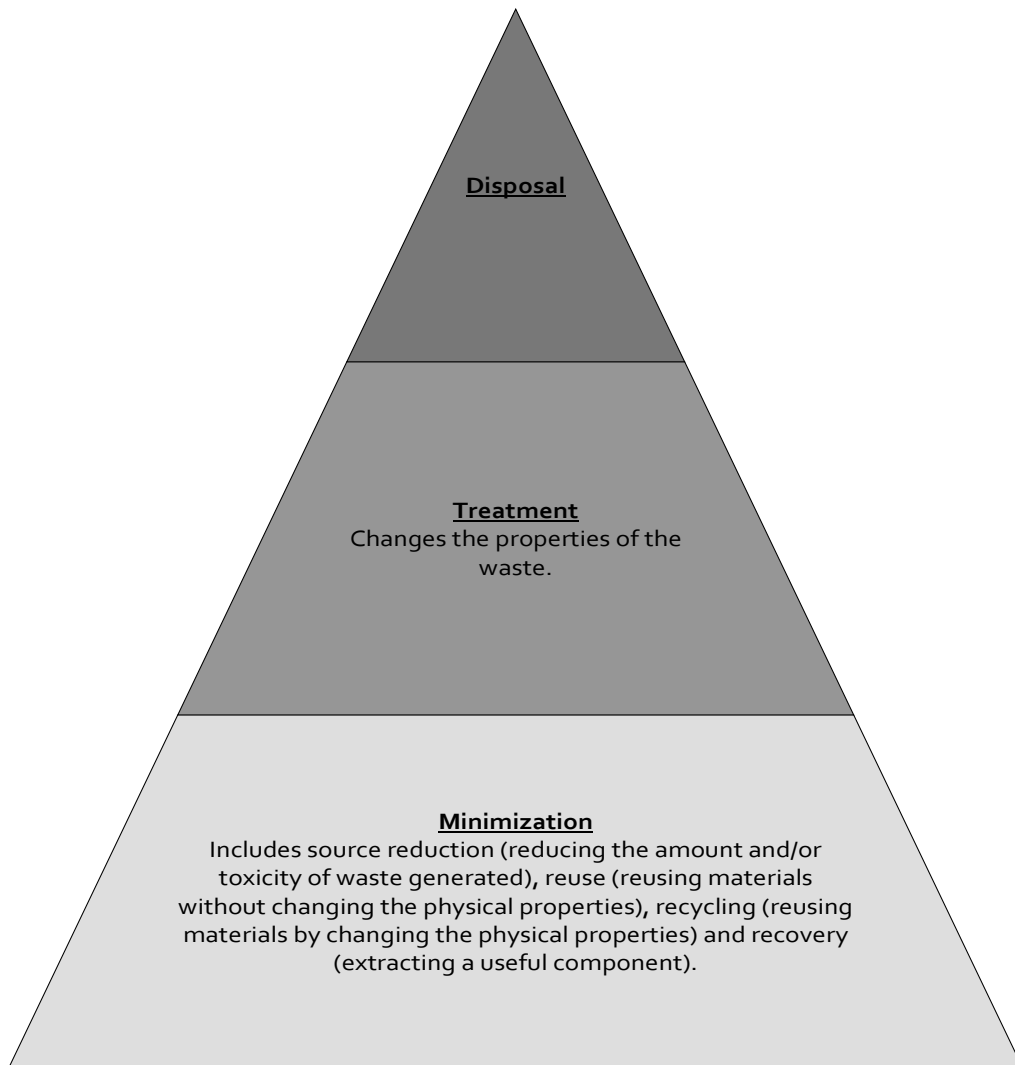


Figure 1: The waste management hierarchy presents options to minimize the amounts and hazard of waste.

4.2 Waste Treatment and Disposal

Waste treatment is any method, technique, or process that changes the physical, chemical, or biological character of a waste. Treatment renders the waste less hazardous and, therefore, recyclable or safer to transport, store, and dispose of. Treatment should be investigated for any waste that is unavoidably generated and that cannot be reused, recycled or recovered. Waste disposal generally is the discharge, deposition, injection, dumping or placing of any waste into or on land, water or air. Table 2 describes various waste treatment and disposal options.

4.3 Waste Characterization and Classification

Waste characterization is the assessment of the physical, chemical and toxicological characteristics (e.g., properties) of the waste. Refer to and Directive 58: Oilfield Waste Management Requirements for the Upstream Petroleum Industry (AER, 1996); Waste Profile Sheets (CAPP, 2006) and Oilfield Waste Management in the Northwest Territories (CAPP, 2009) to assist with the characterization of common waste. Once a waste has been characterized, it can be classified into one of two classes: hazardous waste and non-hazardous waste (Figure 2).

Given that the project areas are in states of deactivation, suspension or abandonment waste generation is limited. Waste will be created during further short-term activities such as suspension, abandonment and reclamation. The majority of wastes created will be either from camp operations or well operations. Waste would be stored for a short amount of time at well sites and camp sites, then transported to an approved facility outside of the Northwest Territories. Estimates for volumes of waste are as follows:

- 15m³ of cement returns per well for abandonment/suspension activities;
- 15m³ of well fluid per well for abandonment/suspension activities;
- 10m³ garbage per abandonment or suspension;
- Camp garbage of 15 m³ per well abandonment or suspension;
- Temporary camp grey/black water is estimated at 0.33m³ per person per day;
- Incinerable camp waste is estimated at 1.8 kg per person per day.

Waste will be stored as per Table 5 and any conditions in project approvals.

Table 2: Treatment / Disposal Options for the Fort Liard Project.

Option	Class ¹	Description ¹
Thermal Treatment – is an effective method for removing organic components in oilfield waste. The treatment may involve destruction, recovery or reduction of the contaminants and/or waste material in which it is found.	Campsite Incinerators*	Campsite incinerators have a burning capacity of less than 90.7 kg/hr and are used to dispose of only kitchen waste. 50 person camp with estimated volume of 1.8kg per person per day
	Open Burning*	Open burning of select wastes (See Appendix 1 for details) may be suitable, as no economical recycling exists. The <i>Forest Protection Act</i> (NWT) requires that anyone wishing to start or kindle a fire during the closed season (May 1 to September 30) within a forested area must obtain a Permit to Burn from the local Renewable Resource Officer
Recycling Depots/Facilities	Recycling Depots/Facilities	The physical properties of various materials are changed at recycling facilities. Often, materials are accepted at depots for sorting and holding prior to delivery at facilities.
	Vendor Programs	Vendors may accept used containers (<i>e.g.</i> , propane tanks) for reuse and/or recycling.

Notes:

- * Potential local waste treatment / disposal option.
- ¹ Classes and Descriptions are According to Alberta Regulation.

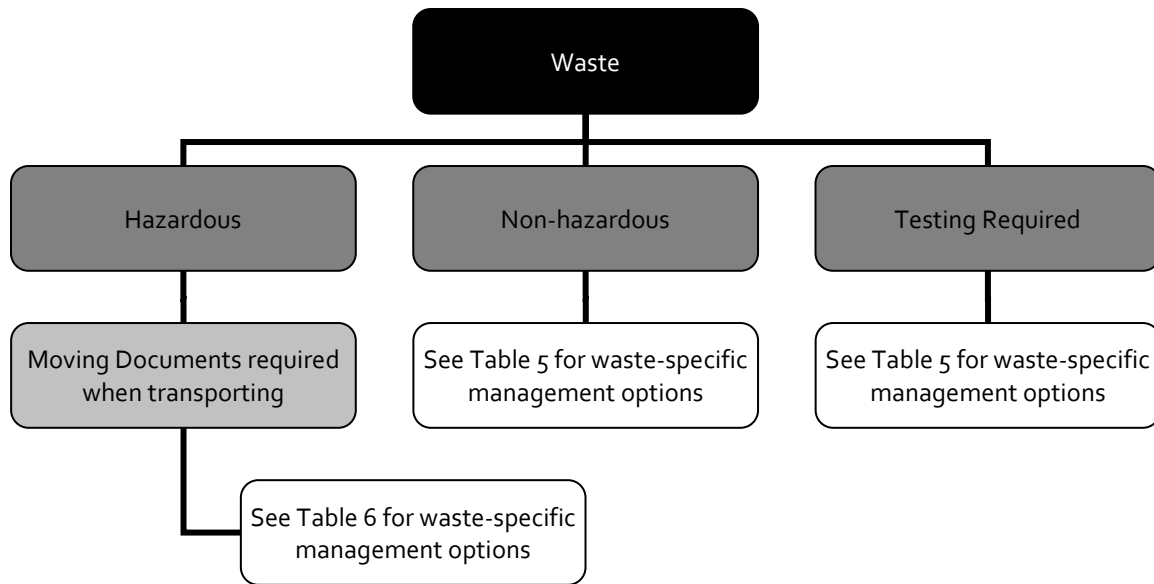


Figure 2: Waste identification, classification and segregation flowchart.

4.4 Waste Segregation

Waste segregation is an important step towards minimizing waste, as it prepares the waste for further processing. Through waste segregation, recyclable wastes can be separated from disposable wastes and hazardous wastes can be separated from non-hazardous wastes, which is important as hazardous waste is always more difficult to manage. Waste segregation will create a variety of options, other than disposal, resulting in environmentally conscious waste management. Ultimately, these options will allow Paramount to reduce waste disposal costs. Figure 3 and Table 3 illustrate Paramount's segregation strategy and provides insight into how waste will be processed.

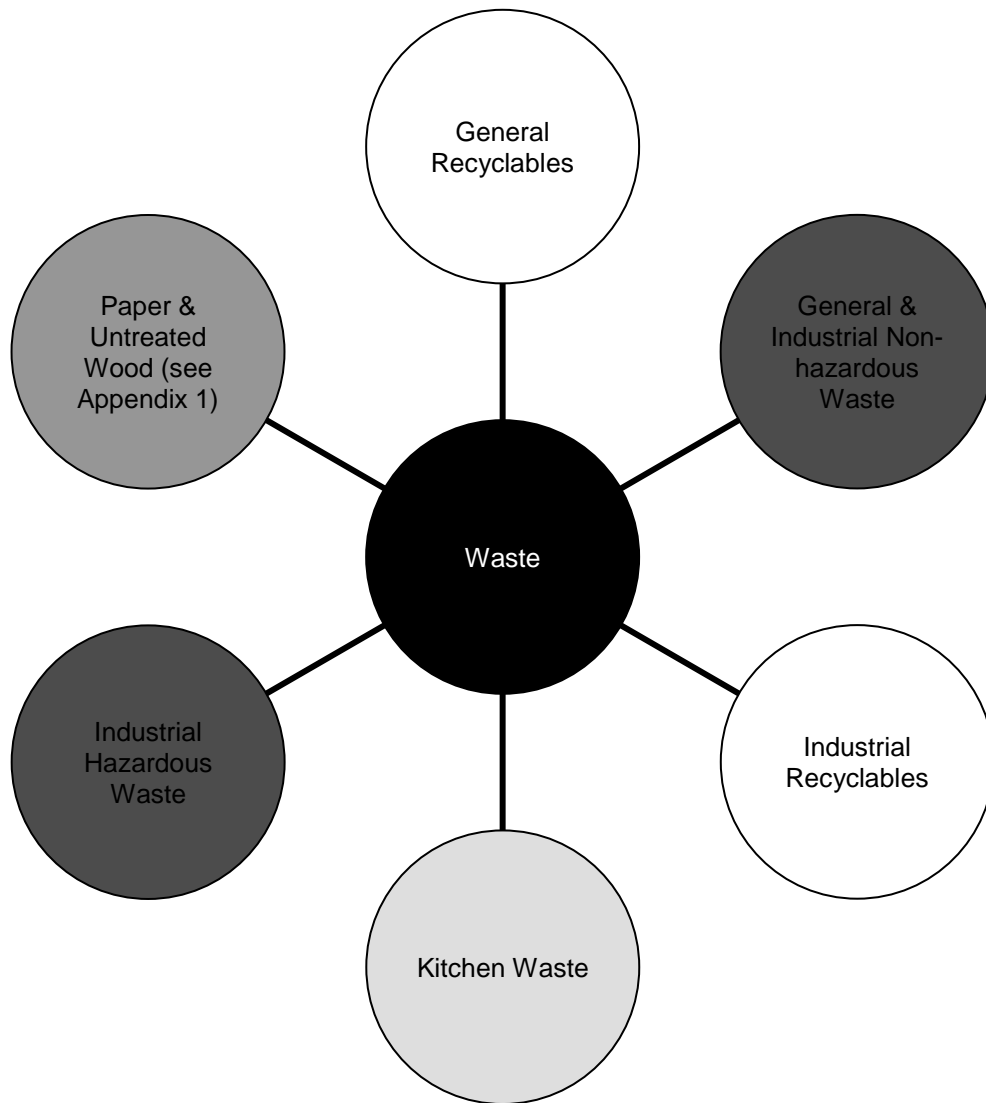


Figure 3: Segregation diagram for generated waste (see table 2 for details).





<u>LEGEND</u>	
	Recycled at appropriate and approved facilities (see Table 3)
	Incinerated locally
	Open Burned locally with a Permit (or alternatively incinerate locally)
	Disposed at appropriate and approved facilities (see Table 3)

Table 3: Waste Segregation Details

Container Label		Container Type	Details
General & Industrial Non-hazardous Waste	Various	Wildlife proof waste Receptacle	General & Industrial Non-hazardous Waste
	Kitchen Waste	Wildlife proof waste Receptacle	Foodstuff, paper products, plastic film wrapping, <i>etc.</i>
	Untreated Wood	Temporary stockpiles	Excess slash, construction material, <i>etc.</i>
General Recyclables	Beverage Containers	Wildlife proof waste Receptacles	General Recyclables
	Plastic Grocery Bags	Wildlife proof waste Receptacles	Keep clean and dry in a big disposal bag.
	Various	Wildlife proof waste Receptacles	Household hazardous waste [aerosol paint/sprays; acetone; air fresheners (aerosol); ammonia; all-purpose cleaners; antifreeze; barbecue starters; batteries (household and vehicle); brake fluid and lining; butane refills; degreasers; car waxes/polishes; disinfectants; furniture polish/wax; gasoline; drain cleaners; insecticides; kerosene; lacquers; nail polish and remover; oven cleaners; paint thinners; photographic chemicals; paint and varnish; rust remover; turpentine; smoke detectors; spa and pool chemicals; waxes; wood preservatives/finishes]; cell phones; electronics; ink cartridges; milk jugs and cartons and tires
Industrial Hazardous Waste	--	Oilfield waste bin	Industrial Hazardous Waste
Industrial Recyclables	Plastic	Oilfield waste bin	Industrial Recyclables
	Scrap Metal	Oilfield waste bin	--

Container Label		Container Type	Details
	Used Oil	Oilfield Waste Bin;	--
	Used Oil Filters	Oilfield Waste Bin	--

4.5 Waste Storage

Because of local treatment/disposal and access limitations, waste may need to be stored for short periods while awaiting transport to appropriate and approved facilities. Wastes could be stored at any location in the project areas where activities are taking place. Paramount will identify where waste will be stored in a given activity season to Inspectors and the MVLWB as part of the commencement of the land-use operation notification. Waste should be removed from project locations and areas as soon as practical and in the same season as activities when feasible. Therefore, storage areas and containers become important considerations. General principles for the storage of non-hazardous waste are listed below.

1. The regular collection, grading and sorting of waste contribute to good housekeeping practices.
2. Placing scrap containers near where the waste is produced encourages orderly waste disposal and makes collection easier. The location of the stockpiles should not interfere with work but they should still be readily available when required.
3. Storing kitchen waste in a manner likely to attract wildlife is a violation of the NWT *Wildlife Act*. The following recommendations will minimize the attraction of carnivores to a camp:
 - o Kitchen wastes should be incinerated daily. If kitchen wastes must be stored, airtight, sealed containers to prevent wildlife from being attracted to odors must be used.
 - o All food in the camp should be stored in the kitchen or in a building attached to the kitchen, to ensure that there is only one area where food odors occur.
 - o Storing all food, waste, recyclables and debris that may attract wildlife within sealed animal proof containers until final disposal.
 - o Ensuring sealed animal proof containers are cleaned once emptied to minimize the attraction of wildlife
 - o All grey water pits should utilize a grease trap, have lime added to them every second day and be covered to minimize odors and the potential attraction of carnivores.
 - o No wildlife should be purposefully encouraged to habituate to human presence (*i.e.*, do not feed wildlife).
4. All waste receptacles should be clearly labeled and in good condition, not leaking and protected from the weather.
5. Inspect waste receptacles weekly and note any deterioration or corrosion in an inspection log. Clean-up any messes immediately.

General principles for the storage of hazardous waste are listed below [from the *Guideline for Hazardous Waste Management* (GNWT, 2017)].

1. Drainage into and from a waste storage site should be controlled to prevent spills or leaks from leaving the site and to prevent run off from entering the site.
2. Access to a waste storage site should be controlled. Only persons authorized to enter and trained in waste handling procedures should have access to the waste storage site.
3. Waste storage sites should have emergency response equipment appropriate for the waste stored on site. Furthermore, hazardous waste storage sites are expected to meet all local bylaw and zoning requirements. It is recommended that the local Fire Chief be advised of the storage facility and its content for emergency planning and response purposes.
4. Where long term storage of hazardous waste is required, quantity requirements (see Schedule I *Guideline for the General Management of Hazardous Waste in the NWT*) should be recognized. If quantity requirements are exceeded, the hazardous waste storage site should be registered in accordance with Section 3.4 of *Guideline for the General Management of Hazardous Waste in the NWT*.
5. Be sure that waste storage containers are compatible with chemical waste. Use containers that are made of or lined with materials which will not react with, and are otherwise compatible with, the waste to be stored. The original containers should be used, where possible.
6. Be sure that waste storage containers are sound, sealable and not damaged or leaking. Regular inspections for signs of leaks or deterioration should be performed and recorded.
7. Any container used to store hazardous waste must be labeled according to the requirements of the *Work Site Hazardous Materials Information System* (WHMIS) of the Safety Act (2006) or the relevant Transport Authority, if transport is planned.
8. Waste containers must be closed at all times, except when being filled. Do not leave funnels in the containers.
9. Maintain a record of the type and amount of waste in storage.

Waste will be temporary stored at locations where it is generated, this includes wellsites and camp sites identified on the Project Maps found in Appendix A. Waste will be removed in the same season during and at the conclusion of operations.

4.6 Determining Destinations for Waste

Since local treatment and disposal options are limited, distance and shipping become the key considerations when determining the best waste management options. Table 4 lists waste management facilities currently closest to the Fort Liard, NWT Project area that may be used by Paramount.

4.7 Waste Transporting and Tracking

4.7.1 Waste Contractors

Transportation means will be carefully selected and checked with respect to health, safety and environment (HSE) requirements. Transporters of waste will be provided with instructions on how to handle emergency situations. When using waste contractors, the following details will be verified.

- Contracts with waste contractors contain appropriate provisions regarding HSE.

- Equipment provided for the storage and transport of wastes, such as waste bins or containers and trucks, are in good working order prior to being accepted by Paramount.
- Waste materials transferred to contractors are packaged and labeled appropriately.
- Shipping documentation is completed in accordance with approved procedures and rests with Paramount at the end of the project.
- Waste consignments reach the specified final disposal site and are disposed of at an approved facility.
- Transportation costs and tipping fees are a major component of the waste management program and require close monitoring and control.

4.7.2 Trucking

At its most efficient, trucking occurs on a “back haul” when goods have been transported to Fort Liard. The ideal situation is to take advantage of the back haul. Therefore, anyone responsible for arranging the transport of goods to Fort Liard will be responsible for arranging a back-haul load. The Operations Manager (see Appendix 4 for contact information) can be consulted for assistance in identifying back haul loads.

4.7.3 Tracking Hazardous and Non-Hazardous Waste

Paramount’s hazardous waste generator registration number is NTG 000104. The Federal Transportation of Dangerous Goods Act and Regulations (TDG) identify requirements for the transportation of dangerous goods. According to these regulations, Paramount is responsible for the safe handling and transport of all hazardous material. It is Paramount’s responsibility to ensure that anyone involved in the handling, offering for transport or transporting dangerous goods must be trained and certified or working under the direct supervision of a trained and certified individual.

MOVEMENT DOCUMENTS

When completed, project produced Movement Documents provide:

- detailed information on the types and amounts of wastes being shipped;
- a record of various firms or individuals involved in the shipment; and
- information on the treatment storage, and/or disposal of wastes when they reach their final destination.

A Movement Document must be used for all shipment of hazardous wastes as defined in the province or territory of destination or origin and Interprovincial Movement of Hazardous Waste Regulations. Paramount will utilize Movement Documents for non-hazardous wastes as well.

Movement Document completion instructions are provided in Figure 4 and Table 4 as well as on the reverse side of each Movement Document. Further assistance in completing a Moving Document may be obtained by referring to the DRAFT - Instructions for Completing Each Item on the Movement Document (Environment Canada, 2017) or by contacting the Motor Carrier Services of the GNWT Department of Transportation.

MOVEMENT DOCUMENT DISTRIBUTION

All Movement Documents must be tracked through their cycle by the waste generator. Movement Documents must be kept on file for a minimum period of two (2) years.

- Consignor (i.e., Paramount) forwards copy 1 (white) to the appropriate territorial authority and retains copy 2 (green).
- The carrier takes copies 3, 4, 5 and 6 with the shipment to give to consignee/receiver (i.e., facility).
- The consignee completes part C and forwards copy 3 (yellow) to the appropriate authority.
- The consignee gives copy 4 (pink) to the carrier, retains copy 5 (blue) and forwards copy 6 (brown) to the consignor. The consignor forwards a photocopy of copy 6 (or faxes copy 6) to Paramount's Environmental Specialist, HSE Department (see Appendix 5 for contact information). Once the HSE Department receives a photocopy of copy 6, information is entered and stored in a database for Paramount's use.

5. Waste Specific Management Options

Management options for wastes generated by the oil and gas sector in the Northwest Territories are very limited because of little to no waste infrastructure. Therefore, waste generated by the Fort Liard Project is primarily treated or disposed off-site.

Figure 4 Movement Document Completion Instructions

MOVEMENT DOCUMENT / MANIFEST
DOCUMENT DE MOUVEMENT / MANIFESTE

- This Movement document/manifest conforms to all federal and provincial transport and environmental legislation.
Ce document de mouvement/manifeste est conforme aux législations fédérale et provinciale sur l'environnement et le transport.

SAMPLE FOR ILLUSTRATION ONLY

2486089-2

Movement Document / Manifest Reference No.
N° de référence du document de mouvement/manifeste

[illegible]

Table 4: Movement Document Completion Instructions

BOX #	Box label	Instructions for Box Entries		
1	Generator & Registration No.	Paramount Resources Ltd. Suite 2800 421 7 th Avenue SW Calgary, AB T2P 4K9 Telephone No.: 403.290.3600	Registration No.: NTG000104	
2	Intended Receiver	Water Treatment Plants Tervita Energy Services Newalta Corporation	See waste facility brochures below.	
3	Provincial Code	See Table 5		
4	Shipping Name			
5	Class			
6	UN No.			
7	Packing Risk Group			
8	Quantity Shipped and Units	Enter the quantity of waste being shipped in metric units. Indicate the units used as with either kilograms (kg) or litres (L). If the exact amount of waste is not known enter "est." Before the number for an estimated amount.		
9	Packaging	Enter the number of individual packages used to ship waste in the column head "No."		
		Enter the codes for the type of packaging used in the shipment in the column headed "Codes".	Code	Container
			01	Drum
			02	Tank
			03	Bulk (e.g., Vac Truck, End Dump, etc.)
			04	Carton
			05	Bag
			06	Roll off or lugger
		07	Other (e.g., pail, palette, etc.)	
10	Physical state	Enter the physical state of the waste as solid (s), liquid (l) or gas (g).		

Table 5 Paramount Resources Ltd. NWT Abandonment Waste Stream and Waste Management Plan.

Because of the small volume of various wastes which may be generated during this activity, a combination waste bin will be provided, and a specialized waste management contractor will handle disposal of the contents at the end of the project

Waste	Storage	NWT Classification	BC Classification	AB Classification	AER Code	Shipping Name	Class	UN #	Packing Group	Disposal
Aerosol Cans (flammable)	Waste Bin-HAZ	HAZ	HAZ	DOW	WSTCGS	AEROSOLS, flammable	2.1	UN1950	-	Turnkey management of HAZ waste provided by contractor
Aerosol Cans (non-flammable)	Waste Bin-HAZ	HAZ	HAZ	DOW	EMTCON	AEROSOLS, non - flammable	2.2	UN1950	-	Turnkey management of HAZ waste provided by contractor
Barrels, Pails (Completely Empty)	Waste Bin	Non-HAZ	Non-HAZ	Non-DOW	EMTCON	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Batteries (Dry Cell)	General Recyclable – Various [see <i>Guideline for the Management of Waste Batteries</i> (GNWT, 1998) for recommendation]	Non-HAZ	Non-HAZ	Non-DOW	BATT	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Batteries (Dry Cell)		HAZ	HAZ	DOW	BATT	Batteries, dry, containing potassium hydroxide solid, electric storage	8	UN3028	III	Turnkey management of non-HAZ waste provided by contractor
Boiler Blowdown Water (contaminated with HAZ material - dependent on boiler chemicals)	Steel Tank	HAZ	HAZ	DOW	BLBDWT	Environmentally hazardous substance, liquid, N.O.S.	9	UN3082	III	Service rig contractor to arrange transport & disposal at licenced facility in BC or AB
Boiler Blowdown Water (non-contaminated with HAZ material)	Steel Tank	Non-HAZ	Non-HAZ	Non-DOW	BLBDWT	-	-	-	-	Service rig contractor to arrange transport & disposal at licenced facility in BC or AB
Cardboard	Stockpile	Non-HAZ	Non-HAZ	Non-DOW	-	-	-	-	-	Incinerate daily
Cement Returns	Retarded or diluted in steel tank	Non-HAZ	Non-HAZ	Non-DOW	Cement	-	-	-	-	Transport & disposal at licenced facility in BC or AB
Chemicals (inorganic)	Original Containers	HAZ	HAZ	DOW	INOCHM	Dependent on specific waste characteristics (consult TDG Regulations)			Contact Chemical Waste Exchange	
Construction and Demolition Material (uncontaminated)	Stockpile	Non-HAZ	Non-HAZ	Non-DOW	CONMAT	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Contaminated Debris and Soil (Chemical/Solvent/Oil/Produced Water)	Contact Paramount Environmental Dept				SOILCH SOILCO SOILPW	Dependent on specific waste characteristics (consult TDG Regulations)			Contact Paramount Environmental Dept for approved landfill location	
Corrosion Inhibitor/Oxygen Scavenger Solutions	Original Containers	HAZ	HAZ	DOW	CORINH	Dependent on specific waste characteristics (consult TDG Regulations)			Turnkey management of HAZ waste provided by contractor	
Filters – Lube Oil	Waste Bin-HAZ	HAZ (depending on flash point and BTEX content)	HAZ (depending on flash point and BTEX content)	DOW (depending on flash point and BTEX content)	FILLUB	Environmentally Hazardous Substance, Solid N.O.S. (lead)	9	UN3077	III	Turnkey management of HAZ waste provided by contractor
Filters – Reverse Osmosis (Granular Activated Carbon, Silica Sand)	Waste Bin- non HAZ	Non-HAZ	Non-HAZ	Non-DOW	FILWTT	Filters (Media) - Water Treatment	-	-	-	Turnkey management of non-HAZ waste provided by contractor

Waste	Storage	NWT Classification	BC Classification	AB Classification	AER Code	Shipping Name	Class	UN #	Packing Group	Disposal
Grease Cartridges (Completely Empty)	Waste Bin- non HAZ	Non-HAZ	Non-HAZ	Non-DOW	EMTCON	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Hydraulic and Transmission Oil	Waste Bin- non HAZ				HYDOIL	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Kitchen Waste	Temporary Waste Receptacle	Non-HAZ	Non-HAZ	Non-DOW	-	-	-	-	-	Incinerate daily
Incinerator (kitchen waste)	General & Industrial non- HAZ Waste	Non-HAZ	Non-HAZ	Non-DOW	INCASH	-	-	-	-	Turnkey management of non-HAZ waste (ash) provided by contractor
Lead Based Products (Pipe Dope/Greases)	Waste Bin-HAZ	HAZ	HAZ	DOW	LDDOPE	Dependent on specific waste characteristics (consult TDG Regulations)				Turnkey management of HAZ waste provided by contractor
Lubricating Oil (Hydrocarbon and Synthetic)	Above ground disposal tanks; L&P Disposal Receptacles	Non-HAZ (unless containing heavy metals such as Vanadium or Lead	Non-HAZ (unless containing heavy metals such as Vanadium or Lead	Non-HAZ (unless containing heavy metals such as Vanadium or Lead	LUBOIL	-	-	-	-	Turnkey management of HAZ waste provided by contractor
Metal (Scrap) (uncontaminated)	Industrial Recyclable – Scrap Metal	Non-HAZ	Non-HAZ	Non-DOW	SMETAL	-	-	-	-	Recycle location - TBD
Mud Sacks – Completion/Abandonment	Waste Bin- non HAZ	Non-HAZ	Non-HAZ	Non-DOW	EMTCON	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Pipe Dope Containers/Brushes (Completely Empty & Dry)	Waste Bin- non HAZ	Non-HAZ	Non-HAZ	Non-DOW	EMTCON	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Sewage (Temporary Camps)	Sewage Sump or Storage Tank	Non-HAZ	Non-HAZ	Non-DOW	-	-	-	-	-	Transport & disposal at licenced facility in BC or AB
Thread Protectors – Casing/Tubing	Waste Bin- non HAZ	Non-HAZ	Non-HAZ	Non-DOW	THPROT	-	-	-	-	Turnkey management of non-HAZ waste provided by contractor
Water - Contaminated Produced (Including Brine Solutions)	Storage Tank				WATER					Transport & disposal at licenced facility in BC or AB
Wash Fluids - Water	Steel Tank	Testing Required			WSHWTE	Environmentally Hazardous Substance	9	UN3082	III	Transport & disposal at licenced facility in BC or AB
Water - Grey (Temporary Camp)	Sewage Sump or Grey water holding tank	Non-HAZ	Non-HAZ	Non-DOW	-	-	-	-	-	Transport & disposal at licenced facility in BC or AB

DOW: Dangerous Oilfield Waste HAZ: Hazardous

Packing Group: A group in which dangerous goods are included based on the inherent danger of the dangerous goods.

Packing Group I indicates great danger

Packing Group II indicates medium danger

Packing Group III indicates minor danger

6. References

Canadian Association of Petroleum Producers (CAPP). 2006. Waste Profile Sheets. Prepared by Wotherspoon Environmental Inc., Calgary, AB. 59pp.

Canadian Association of Petroleum Producers (CAPP). 2009. Oil and Natural Gas Waste Management – Northwest Territories. Prepared by Priddis Environmental Solutions Ltd., Calgary, AB.

Energy Resources Conservation Board (AER). September 2007. Draft Directive 50: Drilling Waste Management. Calgary, AB.

Energy Resources Conservation Board (AER). 1996. Directive 50: Drilling Waste Management. Calgary, AB.

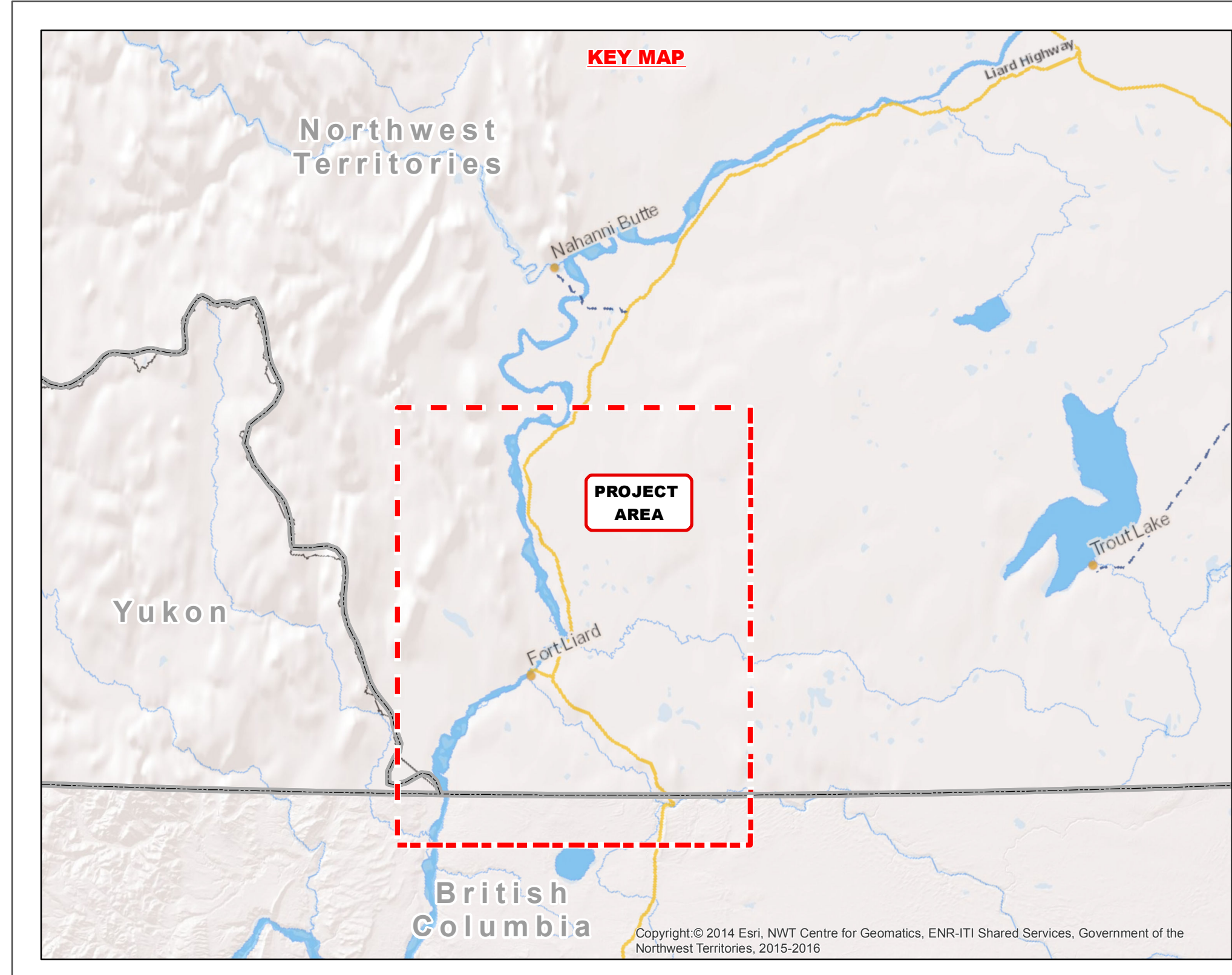
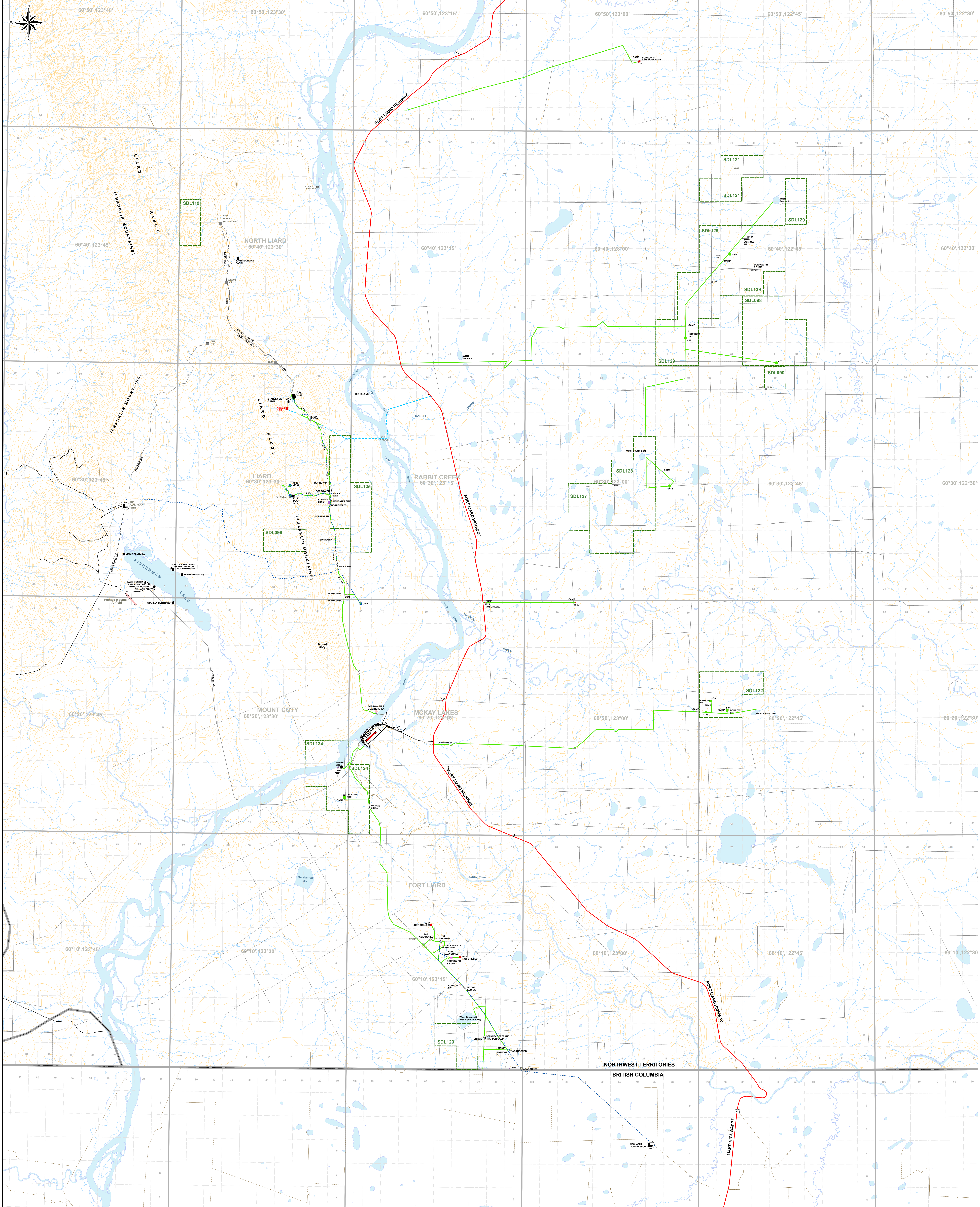
Energy Resources Conservation Board (AER). 1996. Directive 58: Oilfield Waste Management Requirements for the Upstream Petroleum Industry. Calgary, AB. 138pp+ apps.


Environment Canada. 2017. Movement documents for hazardous waste or recyclables. Available online at: <https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/permit-hazardous-wastes-recyclables/fact-sheets-international-movement/movement-documents.html>

Government of the Northwest Territories. 1998. Guideline for the Management of Waste Batteries. Available online at: <https://www.enr.gov.nt.ca/sites/enr/files/guidelines/batteryguideline.pdf>

Government of the Northwest Territories. 2017. Guideline for Hazardous Waste Management. https://www.enr.gov.nt.ca/sites/enr/files/resources/128-hazardous_waste-interactive_web_0.pdf

Appendix 1: Project Maps





OVERVIEW MAP SHOWING

FORT LIARD

As-Build June 2017
60°50', 123°45" to 60°10', 122°45"
NORTHWEST TERRITORIES

5

2.5

0

5

10

15

5

2.5

0

5

10

15

Kilometers
Miles

Scale: 1:75,000

Leases

- Abandoned
- Built
- Built - Tied-In
- Foreign
- Reclaimed
- Suspended

Facilities

- Camp - Built
- Camp - Foreign
- Battery - Built
- Sump - Built
- Borrow Pit - Built
- Decking Site - Built

Gathering System

- Built
- Not Used
- Not Built
- Foreign
- Suspended

Access Roads

- Access Built
- Access Foreign

Road

- Built
- Foreign

Bridge

- Built

Gas Plant / Compressor

- Built

Cabins

- Built

Transportation

- Highway
- Old Paramount Ice Road
- Road
- Trail
- Cut Line

Boundaries

- SDL Lands
- Provincial Boundaries
- Contours


Hydrography

- Waterbody
- Watercourse

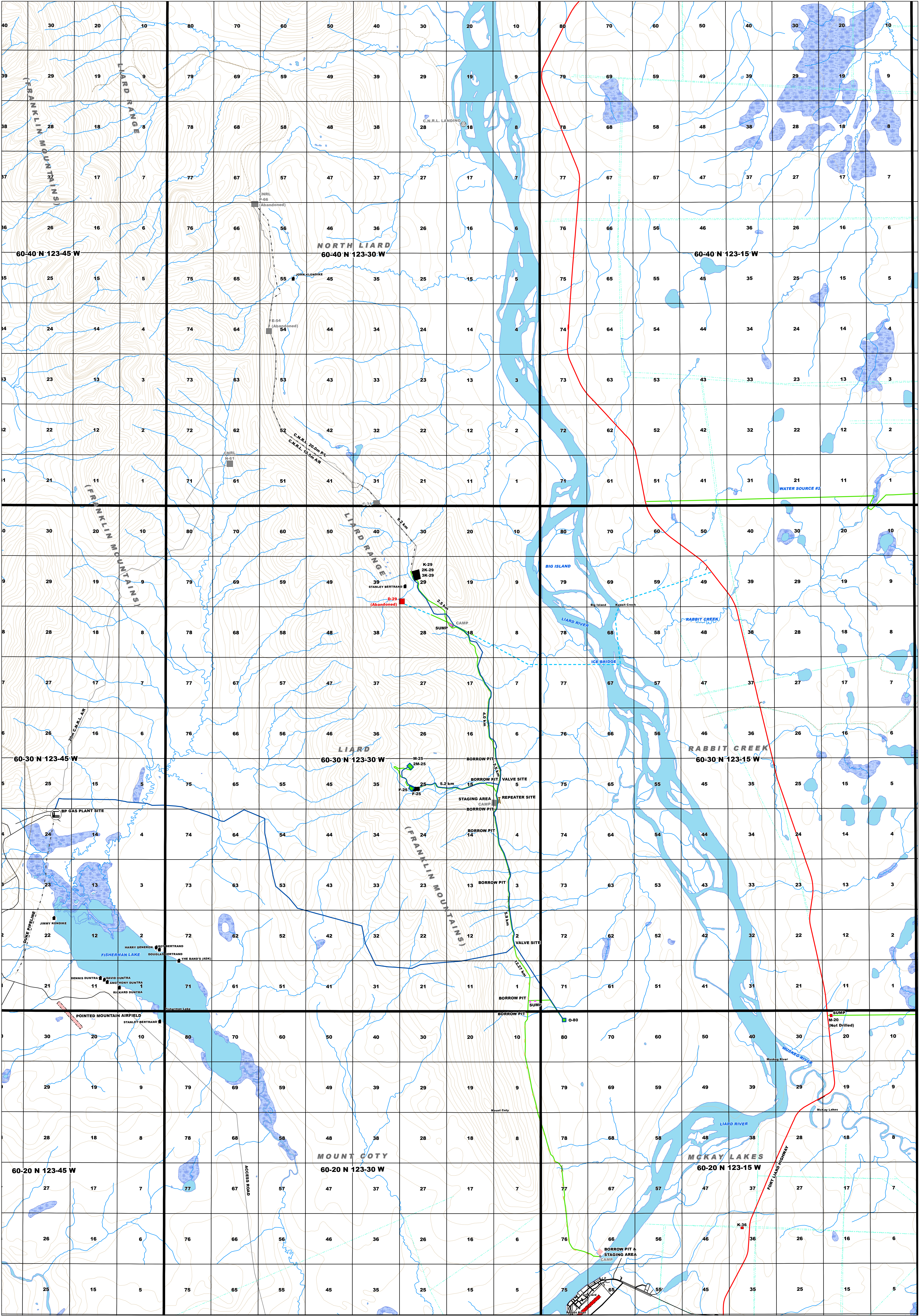
DISCLAIMER:
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Job No.: 170347C MXD No.: 170347-OM-01.mxd Coordinate System: NAD 1983 UTM Zone 10N

REVISION	DESCRIPTION	DRAWN BY	DATE
01	Original Map Created	KDG	2017-06-28



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100 West 14th Ave. Suite 201
www.ugsc.ca



As-Built Map
FORT LIARD WEST
2013
Northwest Territories
NAD 1983 UTM Zone 10N

Legend

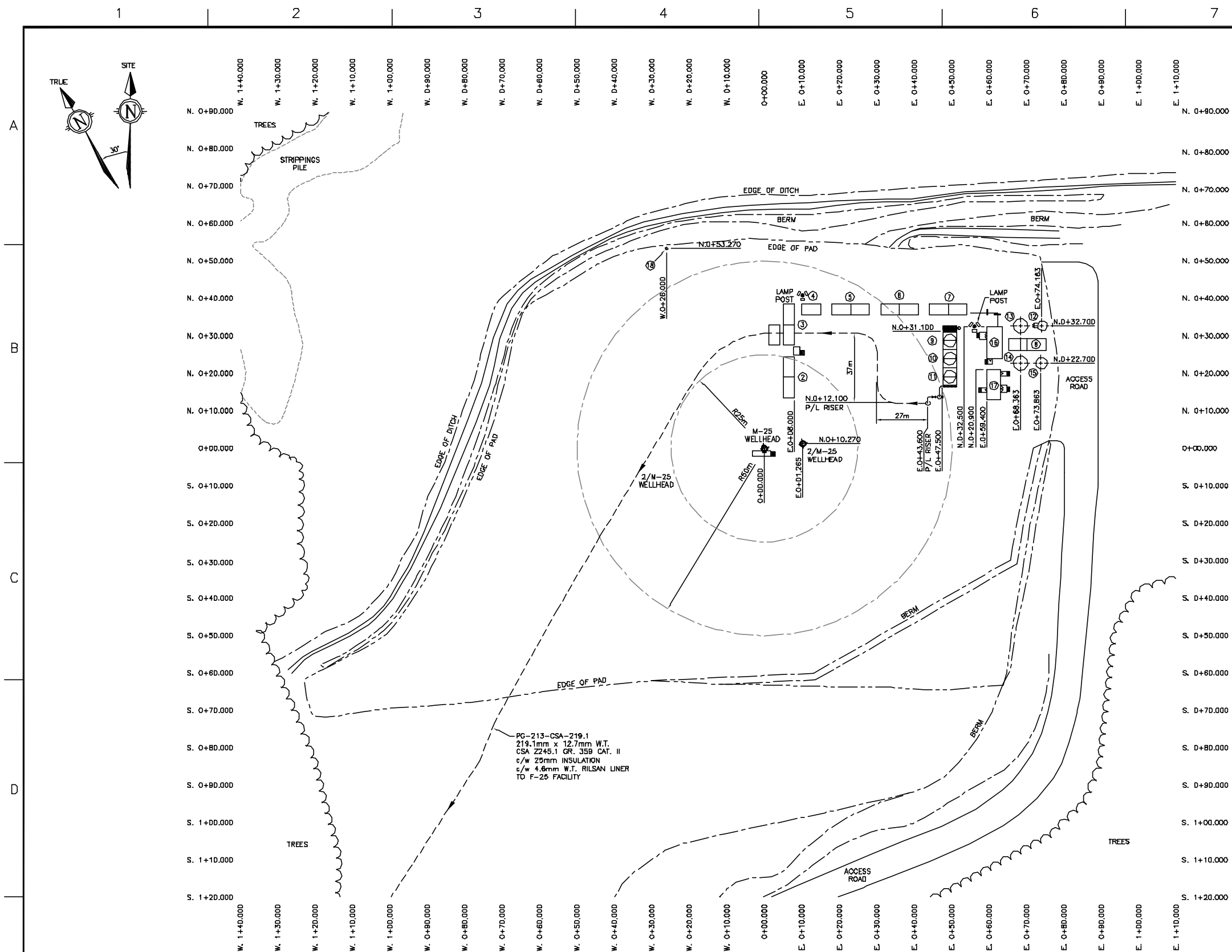
Cabins	Transportation	Leases	Battery	Watercourse
Seismic	Fort Liard Highway	Built	Built	String Bog
Airstrip	Old Paramout Ice Road	Built - Tied-in	Built - Tied-in	Waterbody
Built	Road	Foreign	Reclaimed	Wetland
Foreign	Trail	Gas Plant	Borrow Pit	Contours
Gathering System	Access Built	Camp	Other	
Built	Access Foreign	Built	Foreign	
Not Used	Bridge	Decking Site - Built		
Not Built	Barge			
Foreign				

OVERVIEW MAP
SCALE 1:1,250,000

UGS
UNIVERSAL
Geomatics Solutions

Tech: snicholson
Revised: 20 Aug 2013
Job No.: 05-0399G
Filename: Fort Liard_West.mxd
Projection: NAD 1983 UTM Zone 10N

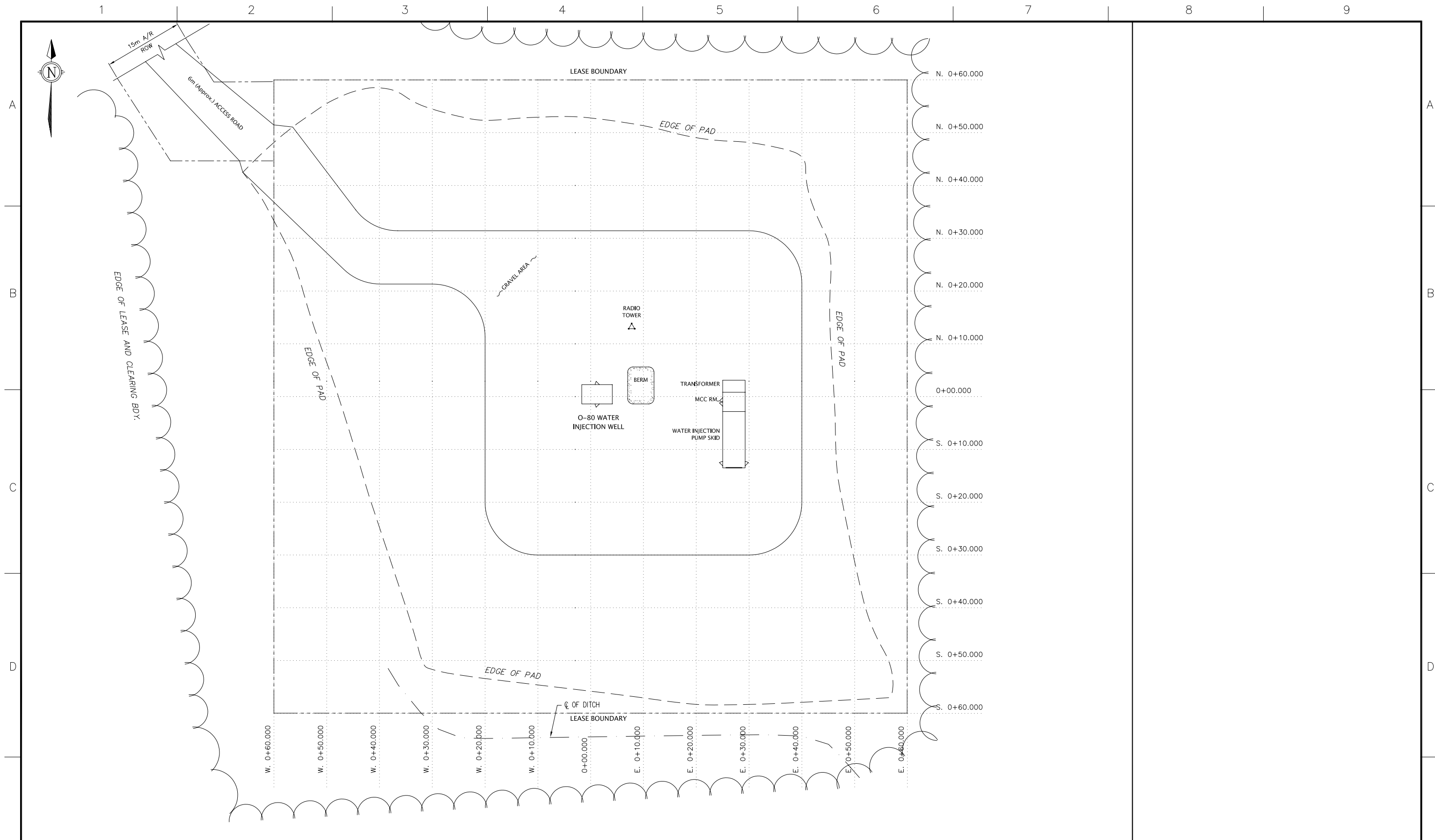
Appendix 2: Paramount HSE Policy

[illegible][illegible]

E									1A	PRELIMINARY (2/M-25 WEL TE-IN)	QQ	04.01.26	DE	MJ
									1	REVISED P/L RISER LOCATION	MAA	00.06.13		M.J.
									O	ISSUED FOR CONSTRUCTION	MAA	00.08.07		M.J.
									C	ISSUED FOR ENGINEERING	MAA	00.04.25		M.J.
									B	ISSUED FOR APPROVAL	CMK	00.03.21		M.J.
									A	PRELIMINARY	MAA	00.02.29		M.J.
	DWG. NO.	DESCRIPTION	REV. NO.	DESCRIPTION	BY	DATE	CHECKED	ENG.	REV. NO.	DESCRIPTION	BY	DATE	CHECKED	ENG.
	REFERENCE DRAWINGS			REVISIONS					REVISIONS					

ChevronTexaco

DRAWN MAA		DATE 00.02.28	FORT LIARD M-25 WELLSITE NORTH-WEST TERRITORIES PLOT PLAN			
CHECKED		DATE				
ENG. M.J.		DATE				
BM			ACAD NO. FLB10001101	CHEVRON DWG. NO. FLB-1000-11-01	REV. 1A	
SCALE (0 sizes) 1:500		UNITS RED'D	VENDOR SHOP ORDER		VENDOR DWG. NO.	
					SHT	



								0	ISSUED FOR CONSTRUCTION	DE	03.01.02			MJ
								A	PRELIMINARY – PUMP SKID ADDITION	DE	02.12.06	MA		MJ
DWG. NO.	DESCRIPTION	REV. NO.	DESCRIPTION	BY	DATE	CHECKED	ENG.	REV. NO.	DESCRIPTION	BY	DATE	CHECKED	ENG.	
REFERENCE DRAWINGS			REVISIONS					REVISIONS						



DRAWN DE		DATE 00.01.11		FORT LIARD 0-80 WELLSITE NORTHWEST TERRITORIES PLOT PLAN					
CHECKED BF		DATE							
ENG. LS		DATE 00.01.16							
IBM				ACAD NO. FLF10002001		CHEVRON DWG. NO. FLF-1000-20-01		REV. 0	
SCALE (D SIZE) 1:300		UNITS REQ'D		VENDOR SHOP ORDER		VENDOR DWG. NO.		SHT 1	

Appendix 3: Beverage Container Preparation

Container Type	Picture	Instructions
Aluminum Can		Empty container Do not need to crush
Glass Bottle		Remove cap Empty container Leave label on Do not break or crush
Plastic Bottle		Remove cap Empty container Leave label on
Juice Box and Drink Pouch		Empty container Take straw out
Juice Carton		Remove cap Empty container
Bi-metal Can		Empty container Leave label on Do not break or crush
Bag-in-a-Box		Empty container Keep the bag and box together
Large Milk Containers		Remove cap Empty container Rinse container out Squash container
Small Milk Containers		Remove cap Empty container Rinse container out Leave label on

Appendix 4: Paramount Contact Information

Title	Name	Contact
Completions Field Supervisor	TBD	
Completions Supervisor	Richard Bean	
Road and Bridge Maintenance Supervisor	TBD	
Construction Supervisor	Tyler Wilson	
Director, HSE	Darren Erdely	
Director, Asset Management	John Hawkins	
Environmental Coordinator	Ian Keir	
Director, Drilling & Completions	Andre Poitras	
Manager, Drilling and Completions	Tim Wood	
Regulatory and Community Affairs Advisor	Terence Hughes	
Onsite HSE Advisor	TBD	

- Contact information has been removed due to privacy and security concerns for individuals and the organization. Contact information will be provided prior to activities to the Inspector(s) and the MVLWB. Paramount will request that this information not be disclosed on the public registry.

Appendix 5: Environment Canada Technical Document for Batch Waste Incineration



Technical Document for Batch Waste Incineration:

Executive Summary and Overview of the Six-Step Process for Batch Waste Incineration

January 2010

Acknowledgements:

Environment Canada would like to acknowledge the work of A.J. Chandler & Associates Ltd. in the preparation of this technical document.

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978-1-100-14951-6

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Aussi disponible en français.

EXECUTIVE SUMMARY

Incineration is recognized as an effective and environmentally sound disposal method for a wide range of wastes, and is used in facilities and jurisdictions across Canada. Waste generators located in remote areas may have limited options for cost-effective and environmentally sound waste management, and incineration may therefore be considered an appropriate waste management option. Remote commercial activities, such as exploration and development of natural resources, can create large volumes and varieties of wastes that must be managed appropriately. Residual wastes from industry, research activities, and the health care sector may require thermal treatment as an environmentally sound method to control the spread of disease from plants, animals or humans. Furthermore, there are certain locations in Canada where incinerating waste is an important means of avoiding potentially dangerous interactions between humans and wildlife. In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option.

There are, however, some important potential environmental concerns associated with waste incineration that must be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of mercury, as well as dioxins and furans (PCDD/F), which are persistent organic pollutants (POPs). Mercury and POPs bio-accumulate in the environment and may cause adverse effects to human health and the environment. They can also be transported over long ranges; data from measurements in the North reveal concentrations far greater than what might be explained by local production. Dioxins/furans can be generated when inadequate incineration technology is used or when an incinerator is improperly operated. Mercury is not created in an incineration system; emissions are directly related to the presence of mercury in certain waste materials. Therefore, the best method to control mercury emissions is to limit the quantity of mercury in the waste fed to the incinerator.

The *Stockholm Convention on Persistent Organic Pollutants (POPs)* (which entered into force in May 2004 and to which Canada is a Party), identifies incineration as a potential source of POPs, and establishes a range of measures to reduce and, where feasible, eliminate their release. It also requires that the best available techniques (BAT) and best environmental practices (BEP) be applied for both new and substantially modified sources of POPs. Additionally, the Canadian Council of Ministers of the Environment (CCME) adopted the Canada-wide Standards for Dioxins and Furans in 2001, identifying incineration for action to reduce emissions, and adopting specific air emission standards. The CCME also adopted the Canada-wide Standards for Mercury Emissions in 2000 which include limits on mercury emissions from incinerators. Both mercury and dioxins/furans are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

The Technical Document for Batch Waste Incineration was developed to provide guidance for owners and operators on proper system selection, operation, maintenance and record keeping, with the goals of achieving the intent of the Canada-wide Standards for dioxins/furans and mercury, and reducing releases of other toxic substances. The document includes:

- A discussion of the importance of reducing, reusing and recycling to divert wastes from disposal;
- Methods for the selection of appropriate incineration technologies to meet specific waste management requirements;
- Operational requirements that should allow batch incinerators to meet the intent of the Canada-wide Standards for dioxins/furans and mercury, and to reduce the release of other toxic substances; and

- Recommendations on record keeping and reporting.

This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 kg to 3000 kg of waste/batch, the latter representing the largest batch incinerator currently in use in Canada. Batch waste incinerators are those that operate in a non-continuous manner (i.e. they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Air emission testing completed by Environment Canada in 2002 using a modern Canadian-built batch waste incinerator demonstrated that, when properly operated and maintained, these systems are capable of meeting the Canada-wide Standards for dioxins/furans (80 pg I-TEQ/Rm³ @ 11% O₂) and mercury (20 µg/Rm³ @ 11% O₂). Stack testing can be carried out as required by the regulatory authorities (e.g. federal, provincial/territorial) to verify that these standards are met.

The Technical Document recommends and describes a six-step process for batch waste incineration:

- Step 1 – Understand Your Waste Stream
- Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System)
- Step 3 – Properly Equip and Install the Incinerator
- Step 4 – Operate the Incinerator for Optimum Combustion
- Step 5 – Safely Handle and Dispose of Incinerator Residues
- Step 6 – Maintain Records and Report

This process will assist owners and operators of batch waste incinerators to achieve the intent of the Canada-wide Standards for dioxins/furans and mercury, and reduce the potential for releases of other toxic substances to the environment.

OVERVIEW OF THE SIX-STEP PROCESS FOR BATCH WASTE INCINERATION

Step 1: Understand Your Waste Stream

The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed, where practical, to:

- Determine the quantity of waste generated in the various parts of an operation;
- Characterize the waste from each type of operation;
- Examine the waste stream to determine what opportunities exist for:
 - Reducing the quantity of waste generated;
 - Reusing materials; and
 - Recycling as much as possible before considering disposal.

Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be completed. Owners should investigate waste generation and diversion data from similar operations/facilities in order to estimate the waste types and quantities that will be generated at their own facilities. Sources of such information may include industry associations, waste industry consultants, provincial/territorial authorities and other regulatory bodies.

Based on the results of the waste audit/characterization, an assessment of appropriate disposal options should be undertaken. Where possible, disposal alternatives (other than incineration) for the residual waste stream (i.e. post 3Rs – Reduce, Reuse, Recycle) should be examined. When assessing disposal options, it is important to note that waste should neither be open-burned nor burned in a barrel. In both cases, the appropriate temperatures for a clean burn will not be achieved, and toxic contaminants, in particular dioxins and furans, will be released.

Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)

The characteristics of the residual waste stream destined for incineration should be incorporated into a call for proposals from incinerator manufacturers. Specifying the quantity and composition of the waste stream will ensure that proposals include suitable incinerators. It should be noted that incinerators built for a specific waste stream, such as animal carcasses, liquid wastes and hazardous wastes, are available and should be used as required.

For facilities with existing incinerators, owners/operators should reassess the suitability of the existing system to manage the current waste stream.

For facilities incinerating **more than 26 tonnes of waste per year**, dual chamber controlled air incinerators are the recommended configuration. These systems are capable of incinerating a wide range of wastes and, when properly maintained and operated, will achieve emissions of PCDD/F and mercury below the level of the Canada-wide Standards. These systems should be equipped with a large secondary chamber sized to provide a residence time of at least one second at a temperature higher than 1000°C, to ensure complete combustion and minimize PCDD/F emissions.

For facilities incinerating **less than 26 tonnes of waste per year**, “determined efforts”

as defined in the Canada-wide Standards for dioxins and furans¹ should be undertaken. Should circumstances restrict the ability to use a dual-chamber incinerator with a large secondary chamber, a single chamber incinerator with an afterburner should be used. It should be noted that such systems are less likely to be able to meet the emission standards than dual chamber incinerators.

Step 3: Properly Equip and Install the Incinerator

Building Considerations

- Incinerators should be installed inside a building to protect the equipment and the operators from weather conditions.
- In designing the installation site, care should be taken to maximize clearance between incinerator components, including the stack, and combustible construction materials.
- Insulation should be used to protect combustible building materials.
- The building should be equipped with sufficient fresh air inlet capacity for the incinerator. Both combustion air and dilution air for the barometric damper are required. Care should be taken to introduce air in a manner that does not lead to low-temperature operating problems.

Equipment Considerations

The incinerator system should come complete with the following equipment to monitor and record performance parameters:

- A scale to measure the weight of all materials charged to the incinerator; and
- A computerized process control and data acquisition system to store operating data from the incinerator.

Operational data should be collected and stored, at a minimum, every minute that the system is operating. The intent is to be able to summarize operating parameters during start-up, operation and cool-down for every cycle. If the required operating conditions are not achieved these data will allow the operators, the manufacturers and the regulator to identify the contributing factors for the failure. From this information, operating procedures can be adjusted to improve performance. Provisions should be made for the manufacturers to be able to remotely access and review the operating data for trouble shooting purposes.

It is highly recommended that batch incinerators not be equipped with heat recovery devices. The temperature of the stack gases in heat recovery systems will be lower than in systems without heat recovery, and may be in a temperature range that can lead to the formation of greater quantities of PCDD/F. Similarly, air pollution control systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures higher than 700°C to reduce the chances of the inadvertent formation of PCDD/F through the *de novo* synthesis process.

If it is necessary to introduce additional waste to the incinerator during the burn cycle, the incinerator should be equipped with a ram charge system to limit the disruption of combustion in the primary chamber during the waste charging process.

¹ Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

Step 4: Operate the Incinerator for Optimum Combustion

Operational Considerations

Wastes received at the incinerator building should be separated according to their heating value characteristics: wet or low-energy wastes (e.g. food waste); mixed wastes with average energy values; and other materials with high energy values, such as oily waste materials. To facilitate this separation, all waste should be collected in transparent bags. To further assist with separation, wastes could be collected in coloured-coded bags.

Batch incinerators are designed to accept wastes within a specified range of energy (i.e. calorific) values. The operator should select waste from each category and mix it to achieve the manufacturer's specified input calorific value. Each bag should be weighed, its source should be noted, and the total weight of each category should be tallied before completing the loading. This information should be recorded by the computerized data acquisition equipment installed with the incinerator. (Refer to step 6 for further record keeping requirements).

Batch incinerator systems have limited charging capacity (both in terms of waste quantity and the calorific value of the waste charge). To assist the operator with the charging task, particularly for smaller incinerators, several batches could be weighed and placed in their own containers prior to loading the incinerator. The same weighing and logging procedures should be used for each batch and, once recorded, the batch can be charged when appropriate.

When the incinerator is charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle. The operator should observe the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. The rate of combustion can be slowed by reducing the quantity of under-fired air. The primary chamber should be operated in the temperature range specified by the manufacturer (typically 500°C to 800°C).

When satisfied that the burn is proceeding in a controlled manner, the operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle should not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste should be added to the primary chamber unless the incinerator is equipped with an appropriate ram feed device.

When the burn is complete and the unit has cooled, the operator should open the door only when wearing protective equipment such as gloves, dust mask, face shield and goggles.

The operator should remove the ash from the previous burn cycle before reloading the incinerator. Any unburned materials found in the ash should be recharged to the primary chamber after the operator has cleaned the air ports, and before putting a fresh charge into the incinerator.

Training Considerations

Operators should be properly trained by the incinerator manufacturer. The training course should include, as a minimum, the following elements:

- System safety including identification of hazards that the operator should recognize;
- Waste characterisation and how waste composition can affect operation;
- Loading limitations, including materials that should NOT be charged to the incinerator, and the allowable quantities of different types of wastes that can be charged;
- Start-up procedures for the incinerator and the normal operation cycle;
- Operation and adjustment of the incinerator to maximise performance;
- Clean out procedures at the end of the cycle;
- Troubleshooting procedures;
- Maintenance schedule; and
- Record keeping and reporting.

Managers should be involved in the training session so that continuity can be maintained with different operators.

Step 5: Safely Handle and Dispose of Incinerator Residues

Ash from the primary chamber of the incinerator can contain materials deleterious to the operator's health and the environment. Operators should use personal protective equipment when handling this material. The material should be carefully removed from the hearth and placed in covered metal containers suitable for transporting the ash to an approved disposal site. The operator should weigh, and maintain records of, the quantity of ash produced.

Step 6: Maintain Records and Report

To demonstrate appropriate operation and maintenance of the incinerator, the facility should maintain records and prepare an annual report containing at least the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of any refresher courses;
- All preventative maintenance activities undertaken on the equipment;
- Records of operation of the incinerator - in electronic format with full data backup;
- Summarized annual auxiliary fuel usage;
- A list of all shipments of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site;
- Results of any emissions measurements or any ash sampling data collected during the period.

All raw data records from the operation of the incinerator should be retained for inspection by the appropriate authorities for the period designated by those authorities, or for at least 2 years. The owner should work with the incinerator manufacturer or supplier and the regulators to determine the appropriate level of summary data that should be sent to the regulatory body (e.g. federal, provincial/territorial). The reports should be approved by the facility's senior management before submission.