



NORTHWEST TERRITORIES
**POWER
CORPORATION**

Empowering Communities

WASTE MANAGEMENT PLAN

**TALTSON HYDROELECTRIC FACILITY
PLANT #129
TALTSON RIVER, NORTHWEST TERRITORIES**

Issue Date: May 2021

Document Maintenance and Control

The Director, Health, Safety & Environment is responsible for the distribution, maintenance and updating of the Waste Management Plan. This Waste Management Plan will be updated:

- i. Annually, taking into account changes in the law, environmental factors, NTPC policies, and Facility characteristics; and/or
- ii. Addition/deletion of wastes used at the site.

Changes in phone numbers, names of individuals, etc. that do not affect the intent of the plan are to be made on a regular basis. Plan updates will be issued as per the Waste Management Plan distribution list. The Waste Management Plan holder is responsible for adding new and/or removing obsolete pages upon receipt of updates.

DOCUMENT HISTORY				
Revision #	Revised Section(s)	Description of Revision	Prepared by	Issue Date
01	All	Review and update	NTPC	June 2015
02	All	Review and update	NTPC	August 2016
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06	Appendix H	Revised Appendix I in accordance with MVLWB WL and LUP conditions (Part E, conditions 4 & 31)	NTPC	August 2019
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08	2.2.2, 2.2.2.1 2.2.6, Table 2-1, Table 2-2	Revised to include Hydro Refurbishment info per conformity table	NTPC	May 2021
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1 INTRODUCTION

1.1 INTRODUCTION

The Northwest Territories Power Corporation (NTPC) has prepared this Waste Management Plan (WMP) for the Taltson Hydroelectric Facility (the Facility) located on the Taltson River, Northwest Territories. The Facility is a remote hydroelectric power generating facility located 56 km northeast of Fort Smith (refer to Figure 1.1). The nearest community is Fort Smith. The facility operates under the MVLWB Type A Water Licence MV2011L4-0002. The facility is a fly in access only using the airstrip or landing on the Twin Gorges Reservoir. In the winter of 2019/2020 a historical winter road from Fort Smith was reconstructed that will be operated for the duration of the overhaul under MVLWB Type B Water Licence MV2019L8-0008 and Type A Land Use Permit MV2019F0015.

The Taltson facility consists of a hydroelectric plant, substation and surge tower situated on the east side of the Taltson River 250m southwest of the main dam. The headgate house sits on the upstream side of the dam in the forebay. Support facilities include two staff houses, camp accommodations building, and a garage located east of the plant. The 800m airstrip is located 3km southeast of the plant with a storage shed and fuel storage building at its western end. The facility also includes a backup diesel generator, waste incinerator, two septic fields, temporary sewage lagoon and fuel storage areas.

The Facility layout including the locations of the plant, main buildings, crew accommodations, key facility infrastructure, waste incinerator, septic fields, temporary sewage lagoon, hazardous material storage areas and surrounding water bodies are shown on Figure 2.1 and 2.2.

The production of waste material as a result of electricity generation and other activities is a normal result of ongoing activities. NTPC generates/handles waste materials at its power generation facilities and has a responsibility to protect and conserve the environment. Proper management of waste, sewage and hazardous materials is important for the protection of the health and safety of employees, the public and the environment.

1.2 PURPOSE

The purpose of the WMP is to provide a consolidated source of information on the safe and environmentally sound transportation, storage, and handling of the waste, sewage and hazardous products used and generated at the Taltson Hydroelectric Facility. A hazardous material is one that, as a result of its physical, chemical or other properties, poses a hazard to human health or the environment when improperly handled, used, stored, disposed of, or otherwise managed.

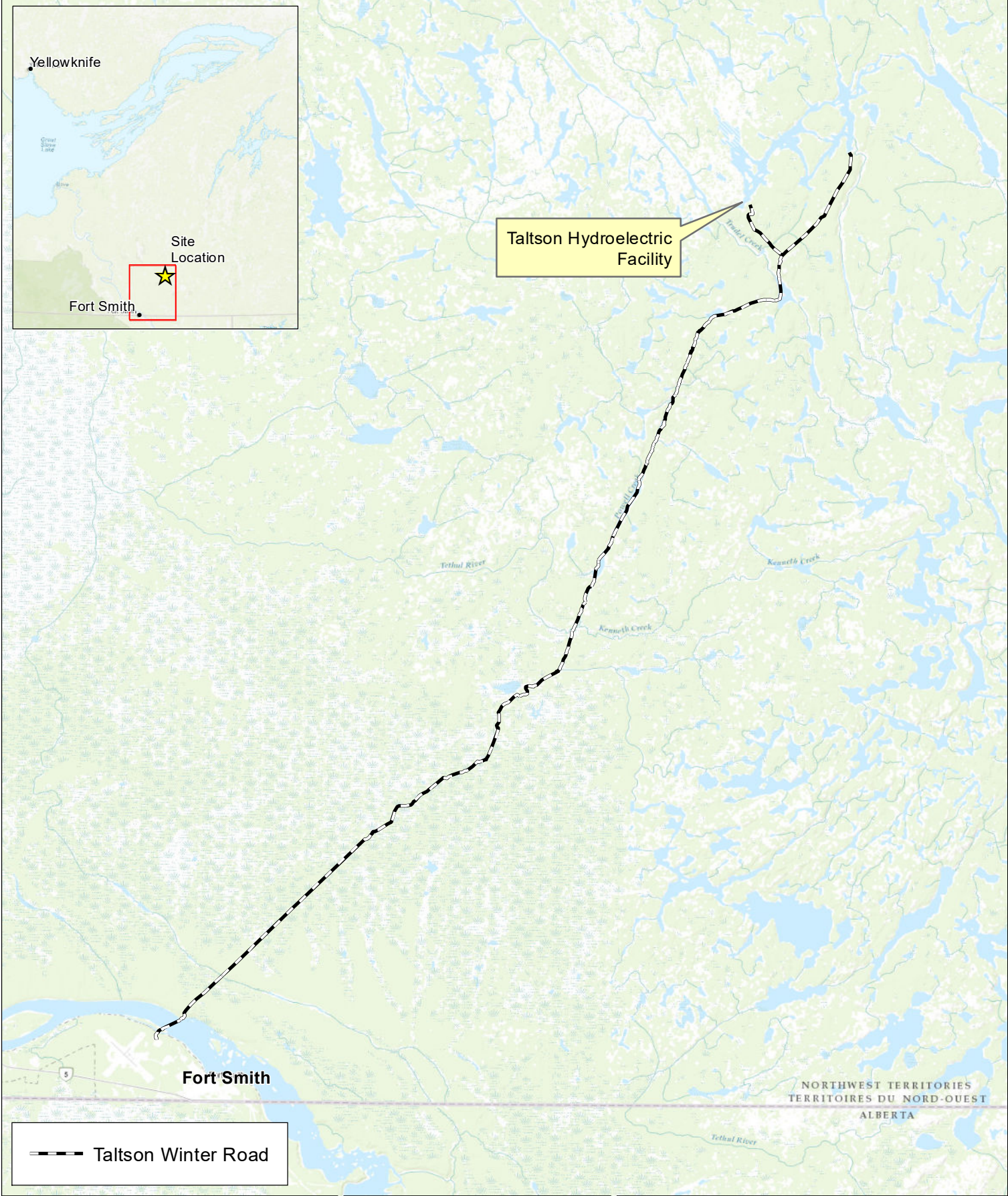
NTPC is committed to preventing, to the greatest extent possible, both inadvertent releases of these substances to the environment and accidents resulting from a mishandling or mishap. NTPC develops programs for employee training, facility inspection, periodic drills to test systems, and procedural review to address deficiencies, accountability, and continuous improvement objectives. NTPC will actively work

towards minimizing the generation of wastes by investigating alternatives to the use of hazardous materials, by recycling products and containers whenever feasible and by treating wastes using state-of-the-art technologies before any release to the environment.

The WMP will form a component of the Environmental Management System (EMS). As such, it is a working document that will be reviewed and updated on a regular basis.



Taltson Hydroelectric Facility



--- Taltson Winter Road

Figure 1 NWT Location map.mxd / 2/17/2021 / 2:54:42 PM



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**FIGURE 2-1: TALTSON
HYDROELECTRIC
FACILITY LOCATION**

The WMP is based on the following principles of best management practice for hazardous materials/waste:

- Identify and prepare materials and waste inventories.
- Characterize potential environmental hazards posed by those materials.
- Allocate clear responsibility for management hazardous materials.
- Describe methods for transport, storage, handling and use.
- Identify means of long-term storage and disposal.
- Prepare contingency and emergency response plans.
- Ensure training for management, workers and contractors whose responsibilities include handling hazardous materials.
- Maintain and review records of hazardous material consumption and incidents in order to anticipate and avoid impacts on personal health and the environment.

1.3 SCOPE

This WMP covers nonhazardous waste, sewage and hazardous materials used and generated at the Taltson Hydroelectric Facility to ensure they will be stored, handled and transported on-site in compliance with all applicable federal and territorial regulations. For the purpose of this WMP, hazardous wastes generated at the Facility are included in the definition of hazardous materials. The WMP is specific to the Facility and is intended to supplement the NTPC Hazardous Waste Management Plan (HWMP) which addresses the specific requirements around disposal of hazardous wastes at NTPC facilities.

The WMP applies to all casual, permanent, part-time, and full-time employees and contractors who conduct work or provide services at the Facility. This WMP covers activities and operations conducted at the Facility.

1.4 ENVIRONMENTAL PROTECTION POLICY

Policy

NTPC is committed to protecting the environment for existing and future generations by meeting, if not exceeding, environmental regulations. Our environmental principles are based on the fundamental values of responsibility, accountability, and open communication. We will strive for continuous improvement in environmental performance and will manage our operations in an environmentally responsible manner.

Guidelines

NTPC will:

- Comply with all applicable environmental legislation and guidelines;
- Maintain an Environmental Management System;
- Incorporate environmental planning in the design phase of projects;
- Reduce waste and use resources as efficiently as possible;

- Take reasonable measures to prevent and reduce pollution to air, water, and soil;
- Manage hazardous waste in a manner that minimizes risk to the environment;
- Report all hazardous materials spills released to water, regardless of size;
- Report all hazardous materials spills greater than 5 L to ground or floor;
- Clean up all hazardous materials spills to meet applicable environmental criteria;
- Promote the efficient use of energy to customers;
- Provide employees with the appropriate training and education to help them fulfill their environmental responsibilities;
- Communicate regularly with indigenous groups, government, regulators, industry, community groups, and the public regarding NTPC activities; and
- Respect the heritages of the people and communities that we serve.

NTPC recognizes that incorporating proper hazardous material management into other environmental management plans and systems leads to risk reduction, improved process control, and cost savings. This WMP will form a component of the Facility's Environmental Management System (EMS). As such, it is a working document that will be reviewed and updated on a regular basis. At a minimum the WMP will be reviewed and updated annually. Training is provided on the following NTPC policies, procedures, and information sources, which are available at the Facility and/or on the NTPC Intranet PowerLine:

- Spill Contingency Plan
- Emergency Response Plan
- Hazardous Waste Management Plan
- Fuel Transfer Safe Work Practice
- Operator Training Manual
- Plant Operating Manual
- Safety Handbook

The WMP is presented to all employees and contractors during their on-site orientation sessions.

1.5 APPLICABLE LEGISLATION

Both federal and territorial legislation regulate the management of hazardous materials and hazardous wastes in the Northwest Territories. Management and safety personnel will provide an overview of the applicable regulations to all employees as part of their orientation and ongoing training. The acts, regulations and guidelines pertinent to hazardous products that will be used at the Taltson Hydroelectric Facility are listed in Appendix B.

The federal Transportation of Dangerous Goods Act classifies hazardous materials into nine main classes according to an internationally recognized system, as follows:

- Class 1 – Explosives
- Class 2 – Compressed Gases
- Class 3 – Flammable or Combustible Liquids
- Class 4 – Flammable Solids
- Class 5 – Oxidizing Substances
- Class 6 – Poisonous and Infectious Substances
- Class 7 – Nuclear Substances
- Class 8 – Corrosives
- Class 9 – Miscellaneous

The materials addressed in this document are also identified by class.

1.6 RESPONSIBILITIES

All employees will be expected to comply with all applicable precautions and handling procedures with regard to hazardous materials. Employees are also expected to report any concerns to their supervisors, the Plant Operator, the Joint Occupational Health and Safety Committee, or site management. Contractor employees working on the site will be expected to report any concerns to the Plant Operator. All staff are encouraged to bring forward suggestions for improvements that can be incorporated into procedure revisions as appropriate.

Onsite NTPC Employees

- Ensure worksite and personnel safety.
- Ensure hazardous materials are stored in their appropriate designated storage area.
- Know the location of designated storage areas, spill response materials, first aid stations, emergency and safety equipment, Safety Data Sheets (SDS), emergency exits, and muster stations.
- Wear appropriate personal protective equipment (PPE).
- Know the handling, storage and spill prevention requirements.
- Comply with all NTPC and Facility policies and procedures when performing duties.

Plant Operator

- Ensure the safety of all personnel and the site.
- Ensure all new site personnel and contractors are oriented and have access to all the required documentation.
- Organize inspections of site hazardous material/waste management practices and storage areas and ensure that appropriate records are maintained.
- Ensure all NTPC employees and contractors adhere to the requirements of the HMMP.

- Participate in annual reviews of the HMMP with the Manager, Health, Safety and Environment.

Project Manager/Monitors

- Ensure the safety of all project personnel and the project areas.
- Ensure all new construction personnel and contractors are oriented and have access to all the required documentation.
- Organize inspections of site hazardous material/waste management practices and storage areas and ensure that appropriate records are maintained.
- Ensure all construction employees, contractors and sub-contractors adhere to the requirements of the WMP.

Stores Person (Logistics Officer or Stock Keeper)

- Ensure that all received hazardous materials/wastes are stored, transported and disposed of according to the requirements of the WMP and HWMP
- Maintain appropriate records.

Manager, Plant Operations

- Ensure that the Plant Operator has the available resources to effectively implement the WMP.

Director, Health, Safety & Environment

- Maintain and complete the annual review of the WMP.
- Ensure that all WMP documentation remains up-to-date and the updated versions are distributed out to the personnel on site, external agencies and organizations.
- Periodically audit hazardous materials management at the Facility to support continuous improvement.
- In coordination with the Plant Operator, prepare and submit any formal reports to regulators and NTPC management regarding the management of hazardous materials.

Third Party Contractors and Suppliers

- Ensure worksite and personnel safety.
- Ensure hazardous materials are stored in their appropriate designated storage area.
- Know the location of the designated storage areas, spill response materials, first aid stations, emergency and safety equipment, Safety Data Sheets (SDS), emergency exits, and Muster Points.
- Wear appropriate personal protective equipment (PPE).
- Know the handling, storage and spill prevention requirements.
- Comply with all NTPC and Facility policies and procedures when performing duties.

1.7 MAINTENANCE OF PLAN

The Director, Health, Safety & Environment will maintain the WMP. The Plan will be reviewed annually, but may also be reviewed more frequently as required (e.g. due to a new or amended legislation or the addition/deletion of a hazardous material or waste to/from Taltson Hydroelectric Facility use).

A record will document all significant changes that have been incorporated in the WMP subsequent to the latest annual review. The record will include the name of the party who made and approved the change, as well as the date of the approval.

1.8 ACCESS TO ADDITIONAL COPIES

Additional copies of the plan can be obtained by contacting the Director, Health, Safety & Environment at (867) 874-5327.

1.9 SAFETY DATA SHEETS (SDS)

NTPC maintains Safety Data Sheets (SDS) for all controlled products that are used, stored, and handled at NTPC work sites

3E Online, a web-based program, is used to maintain and update the SDS for NTPC. All NTPC employees with computer access can view current SDS for NTPC products by visiting the following website:

<https://www.3eonline.com/>

In order to login to the site, the following username and password must be entered:

Username: ntpc

Password: msds

If employees cannot locate SDS on the website for products in use at NTPC sites, or if obsolete products are noted on the site, please advise the Manager, Logistics via phone or email using the following contact information:

Thess Cruzpe, Phone: (867) 874-5222, tcruzpe@ntpc.com

All NTPC thermal and hydro sites also require current SDS binders (paper copy) to be maintained and kept up to date (i.e., updated every three years). It is the responsibility of the employee to request up to

date SDS binders. To acquire an up to date SDS binder please contact the Environmental Analyst at (867) 874-5306.

1.10 GENERAL EMERGENCY RESPONSE

NTPC maintains procedures for responding to emergency situations and accidents, including any specific procedures that are required by environmental legislation. A summary is presented below:

Site Specific Emergency Response Plan

NTPC maintains a Site-Specific Emergency Response Plan that documents how to deal with incidents and emergency situations. The most common emergency situations or accidents that can occur at NTPC are spills and fires. For minor spills and fires that are safe to respond to, spill response materials and fire extinguishers are available in all NTPC buildings.

Spill Contingency Plan

In the NWT, under the *Environmental Protection Act*, the Spill Response Planning and Reporting Regulations set the standard for reporting spills of contaminants and preparing Spill Contingency Plans. A Spill Contingency Plan is required if contaminants are stored above ground in excess of 20,000 kg or 20,000 L, or below ground in excess of 4,000 kg or 4,000 L. A copy of the Spill Contingency Plan must be filed with the Chief Environmental Protection Officer. Although NTPC does not have below ground storage facilities, contaminants (e.g., fuel oil) are stored in excess of 20,000 L and therefore Spill Contingency Plans for all NTPC power plant sites have been established and registered with the Chief Environmental Protection Officer.

Emergency Response Assistance Plan

A person who offers for transport or imports a consignment of dangerous goods must have an approved emergency response assistance plan when the quantity of dangerous goods exceeds the Emergency Response Assistance Plan (ERAP) limit (Transportation of Dangerous Goods (TDG) Regulations sections 7.1, 7.4, and column 7 of Schedule 1). The ERAP is to be filed and approved by the Director General.

Currently no dangerous goods offered for transport or imported by NTPC require an ERAP.

Reporting of Spills

The procedures for reporting spills at the Facility are presented in the Taltson Hydroelectric Facility Spill Contingency Plan.

A summary of reporting and response requirements for spills of dangerous goods during transport (as defined under TDG Regulations) and spills of hazardous materials (as defined in the NWT Environmental Protection Act and associated regulations) is presented in the NTPC HWMP.

NWT Spill Reporting

The minimum quantities for reporting of spills to the environment are specified in the Spill Contingency Planning and Reporting Regulations. NTPC has adopted a policy of reporting all spills of hazardous materials over 5 L, and spills of any size that reach water, to the 24-Hour Spill Report Line at (867) 920-8130 unless the minimum quantity specified in the regulation is more stringent (i.e. less than 5 L).

1.11 DISTRIBUTION LIST

The WMP and the most recent revisions are distributed internally to:

- i. Health, Safety & Environment Department, Taltson Hydroelectric Facility/NTPC (control copy)
- ii. Manager, Plant Operations, Taltson Hydroelectric Facility
- iii. Plant Operator, Taltson Hydroelectric Facility
- iv. Manager, System Control, Hydro Region
- v. Central Control Room, NTPC
- vi. NTPC Intranet PowerLine

The Director Health, Safety, and Environment is responsible for distribution of the WMP to outside third-party stakeholders.

2 OVERVIEW OF HAZARDOUS MATERIALS

2.1 INTRODUCTION

Diesel fuel is the main hazardous material used and stored at the Facility. However, other materials and wastes such as gasoline, propane, acetylene, used oil, jet fuel and glycol are also stored, and used and/or generated on-site. The primary and designated storage locations for hazardous materials, hazardous wastes and fuel are shown on Figure 2.1. Storage areas are identified on the figure according to the nature of material stored as follows:

FS = Fuel Storage Area

HM = Hazardous Material Storage Area

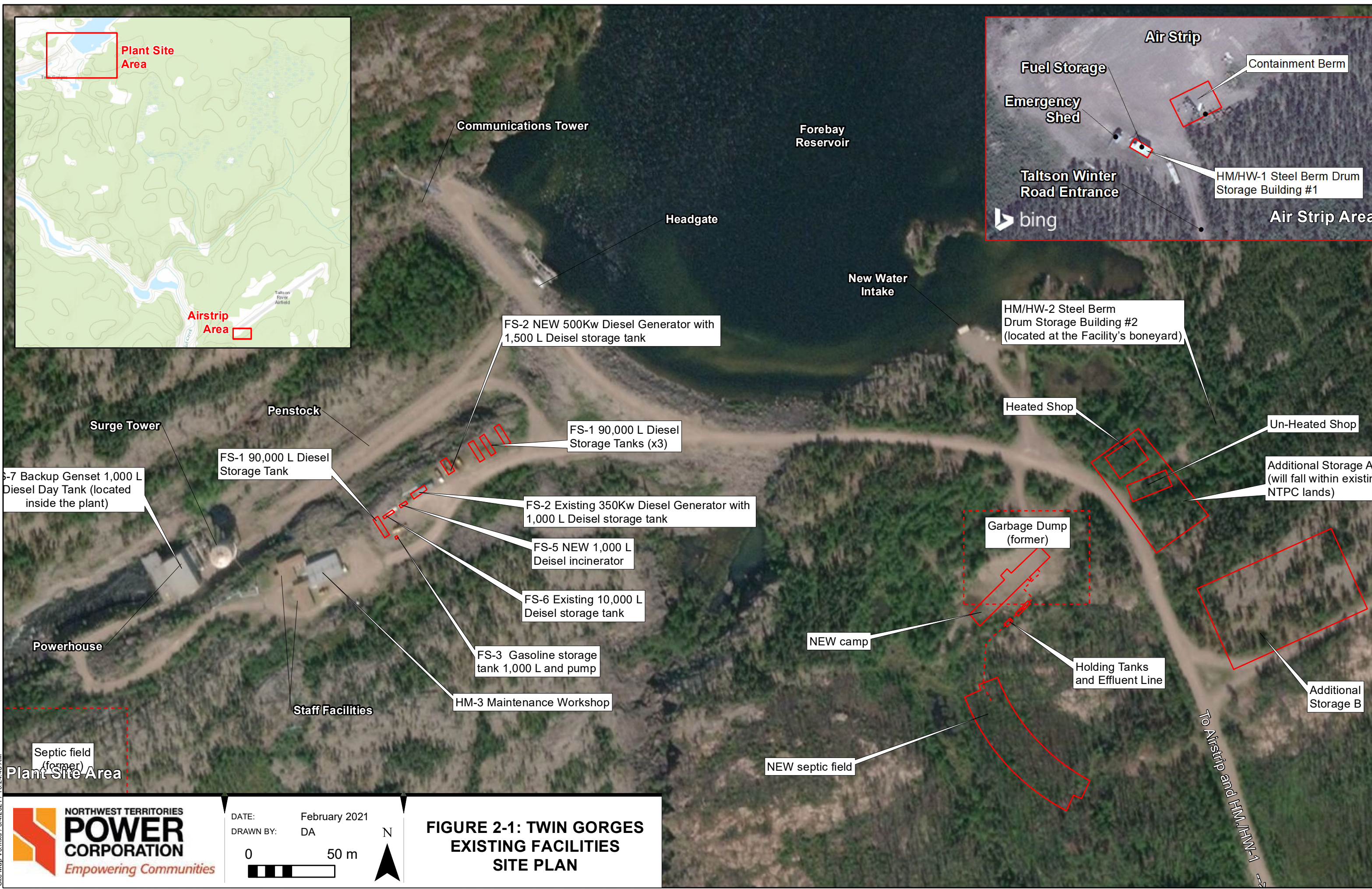
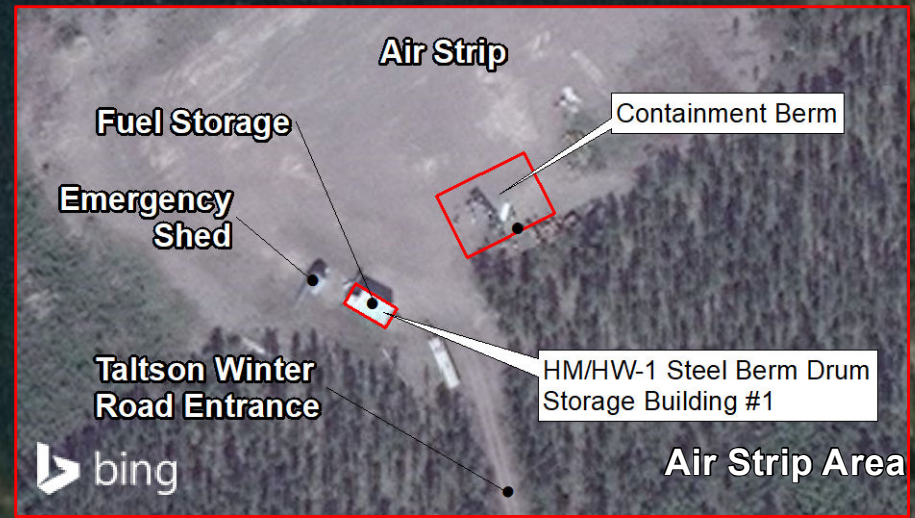
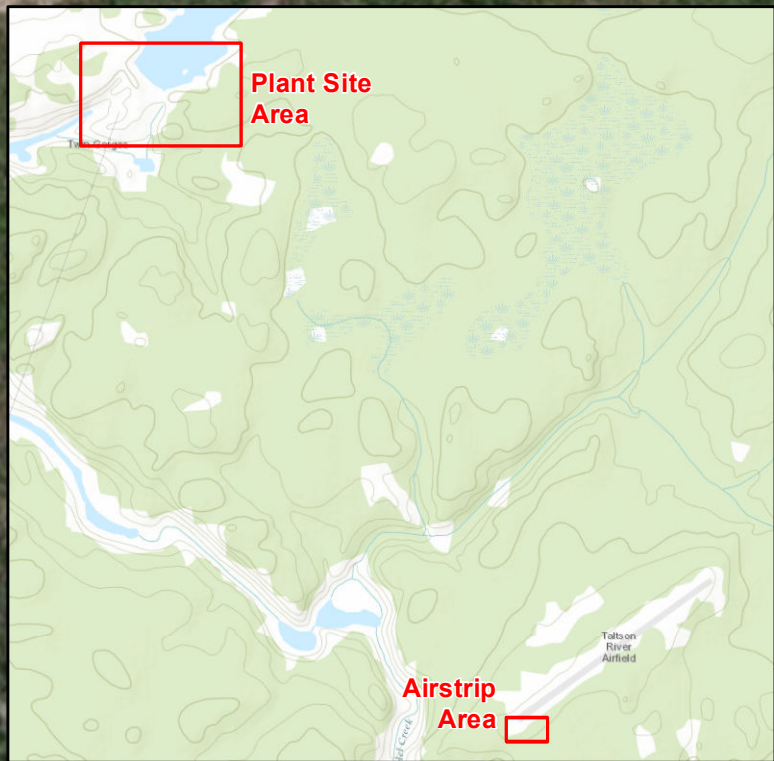
HW = Hazardous Waste Storage Area

Fuel storage areas (FS) include storage areas where diesel is stored. Hazardous materials storage areas (HM) include storage areas containing hazardous materials used to support the hydroelectric operation, other than bulk fuels storage. Hazardous waste storage areas (HW) include locations and facilities at which spent or unwanted hazardous materials are stored pending off-site transportation for recycling, treatment or disposal.

The main hazardous materials storage areas include:

- Temporary 90,000 L Diesel Above Ground Storage Tank (AST) x4 (FS-1)
- Emergency 500kw Generator, 1,500L Day Tank (FS-2)
- Gasoline Tote, 1000 L with pump (AST)(FS-3)
- Existing 350Kw Diesel Generator with 1,000 L diesel storage tank (FS-4)
- Diesel Incinerator, 1000 L (FS-5)
- Diesel Fuel Storage 10,000 L (FS-6)
- Backup Genset 1,000 L Diesel Day Tank (FS-7) (located inside the plant);
- Steel Berm Drum Storage Building #1 (HM/HW-1) (located at the Facility's airstrip);
- Steel Berm Drum Storage Building #2 (HM/HW-2) (located at the Facility's boneyard);
- The Maintenance Garage/Workshop (HM-3)
- Containment Berm (located at the airstrip)

In addition to the above specific storage areas, there is a waste facility storage area, two septic fields (one for the staff facilities and one for the new camp), temporary sewage lagoon and additional storage areas A and B (Shown on Figures 2.1 and 2.2)



Site Map V3.mxd / 3/4/2021 / 10:24:43 AM



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FIGURE 2-1: TWIN GORGES EXISTING FACILITIES SITE PLAN

*It is important to note there is disagreement between the imagery and the GNWT Cadastral mapping. It is assumed that the Cadastra mapping is correct and the positional shift lies with the imagery

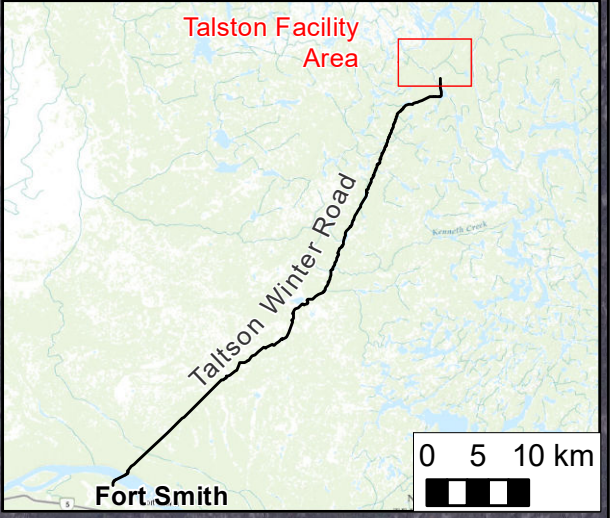
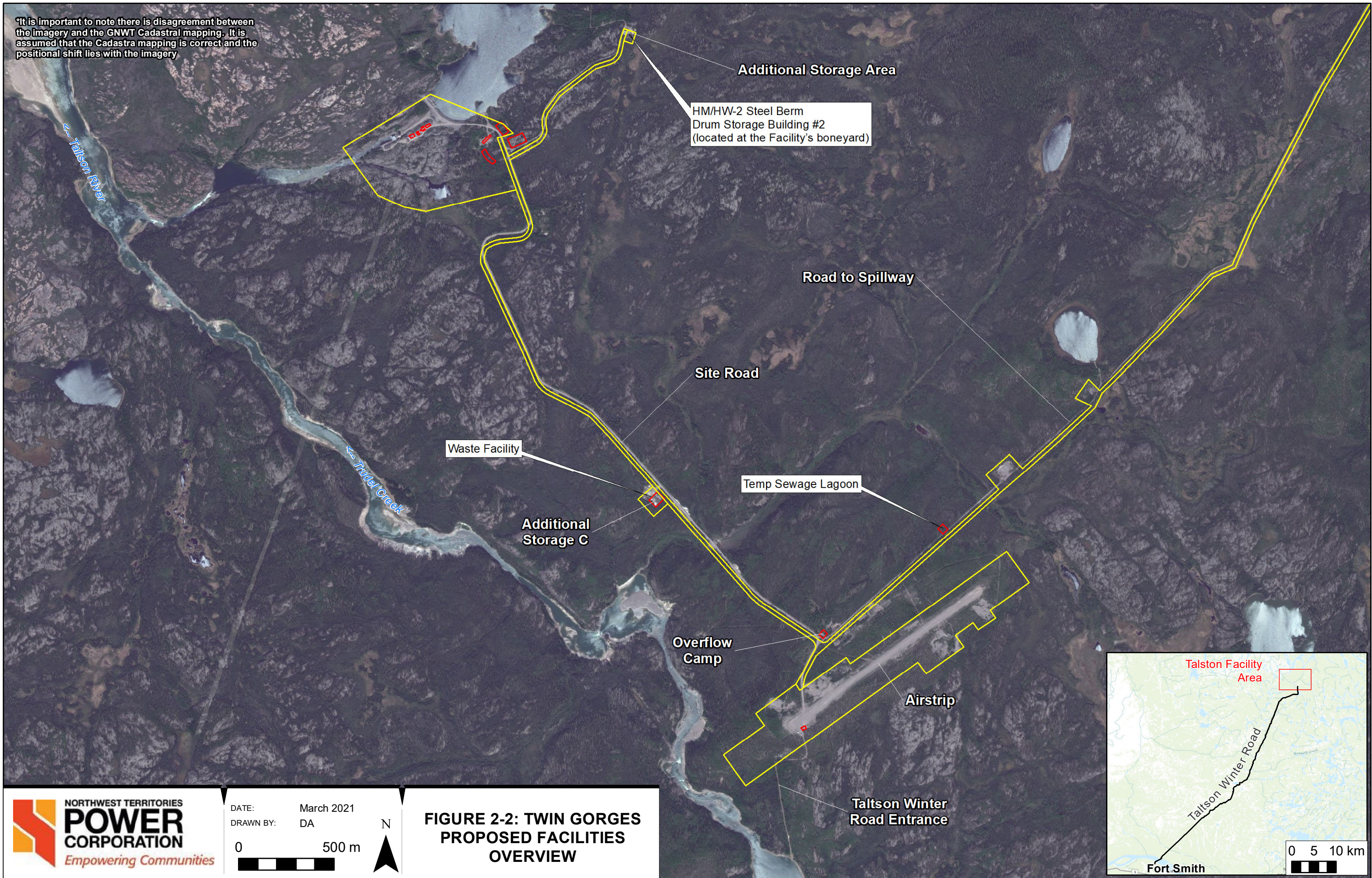


FIGURE 2-2: TWIN GORGES PROPOSED FACILITIES OVERVIEW

Table 2-1 presents general information on the location of the main fuel, hazardous materials and hazardous waste storage areas. Estimated minimum and maximum quantities of hazardous materials are presented in Table 2-2.

Table 2-1: Fuel, Hazardous Material and Hazardous Waste Storage Facilities at the Taltson Hydroelectric Facility

Storage Area	General Description	Location
FS-1 (Diesel Fuel Storage)	Four 90,000 L, double-walled AST containing diesel.	Three located northeast of the plant and one just east of the shop.
FS-2 (Diesel Fuel Storage)	500kw Genset with 1,500 L day tank containing diesel.	Located northeast of the plant near the 90 000 L diesel AST, inside the 500KW Genset Module.
FS-3 (Gasoline Storage)	Gasoline Tote, 1,000 L with pump (AST)	Located just east of the maintenance shop
FS-4 (Diesel Fuel Storage)	Existing 350Kw Diesel Generator with 1,000 L tank containing diesel	Located between the 3 90,000 L storage tanks and the staff accommodations
FS-5 (Diesel Fuel Storage)	Incinerator, 1,000 L day tank containing diesel	Locate between the new 500kw genset and the new incinerator
FS-6 (Diesel Fuel Storage)	Fuel Storage 10,000 L tank (AST) containing diesel	Located between the maintenance shop and the incinerator
FS-7 (Diesel Fuel Storage)	One 1,000 L Day Tank containing diesel.	Located inside the plant.
HM/HW-1 (Steel Bermed Drum Storage Building #1)	205 L drums of waste oil, waste diesel and waste gasoline. Also contains 205 L drums of unused gasoline and jet fuel.	Located next to the Facility's airstrip.
HM/HW-2 (Steel Bermed Drum Storage Building #2)	Mainly 205 L drums of turbine and governor oil. 20 L pails of transmission oil and degreaser. Also contains propane, oxygen and nitrogen cylinders.	Located at the Facility's boneyard.
HM-3 (Maintenance Garage/Workshop)	Minimal hazardous material storage e.g., 205 L drum of diesel, 20 L pail of lube oil, acetylene cylinder, oxygen cylinder.	Located next to crew accommodations, northeast of the plant.
Hazardous waste storage berm (30m x 20m x 0.75m) - to be constructed in 2021	Mainly 205 L drums of hazardous waste stored to be transported offsite for treatment/disposal.	Located are the Facility's airstrip.

Table 2-2: List of Main Hazardous Materials On-Site

Material	Storage Container	Normally On-Site	Maximum On-Site	Storage Location (see Figure 2.1)
Diesel	90,000 L Horizontal AST	4 x 90,000L (4 AST)	360,000 L (4 AST)	Located in the Fuel storage area NE of the Powerhouse within the dam site.
	1,500 L vertical, inside day tank	1,500 L (1 vertical tank)	1,500 L (1 vertical tank)	Located northeast of the beside the new 500Kw Genset Module.
	1,000 L vertical, inside day tank	1,000 L (1 vertical tank)	1,000 L (1 vertical tank)	Located northeast of the beside the new 350Kw Genset Module.
	1,000 L tank	1,000 L (1 AST)	1,000 L (1 AST)	Located on the new incinerator and will be used to run incinerator.
	10,000 L Horizontal AST	10,000 L (1 AST)	10,000 L	Located in the SE corner of the fuel storage area
	1,000 L vertical, inside day tank	1,000 L (1 vertical tank)	1,000 L (1 vertical tank)	Located inside the plant.
	205 L drum	4 x 205L	4x 205L	Located at temporary camp facilities within secondary containment.
Gasoline	1000 L storage tank	1,000 L tank	1,000 L tank	Located in the SW corner of the fuel storage area. Used to dispense fuel
	205 L drum	20 drums	20 drums	Stored in the steel bermed drum storage building next to the Facility's airstrip or two 10' x 10' x1' L-bracket berms or a lined hazardous waste storage berm.
Jet Fuel	205 L drum	20 drums	20 drums	Stored in the steel bermed drum storage building next to the Facility's airstrip.
Lubricating Oil	205 L drum	10 drums	10 drums	Stored in the steel bermed drum storage building next to the Facility's boneyard or two 10' x 10' x1' L-bracket berms or a lined hazardous waste storage berm.
Transformer Oil	4,100 L (4 transformers)	4,100 L (4 transformers)	4,100 L (4 transformers)	Located in the substation.
	8,500 L (1 transformer)	8,500 L (1 transformer)	8,500 L (1 transformer)	Located in the substation
	360 L (1 transformer)	360 L (1 transformer)	360 L (1 transformer)	Located inside the plant.
Propane	80 lb and 20 lb tank	80 lb tank (3) and 20 lb tank (5)	80 lb tank (3) and 20 lb tank (5)	Stored in the steel bermed drum storage building next to the Facility's boneyard or in the Maintenance Garage.

Material	Storage Container	Normally On-Site	Maximum On-Site	Storage Location (see Figure 2.1)
Acetylene	100 lb tank	100 lb tank (1)	100 lb tank (1)	Maintenance Garage.
Oxygen	100 lb tank	100 lb tank (3)	100 lb tank (3)	Stored in the steel bermed drum storage building next to the Facility's boneyard or in the Maintenance Garage.
Nitrogen	100 lb tank	100 lb tank (10)	100 lb tank (10)	Stored in the steel bermed drum storage building next to the Facility's boneyard or in the Plant.

2.2 CAMP WASTE

NTPC maintains two staff houses, with a maximum capacity of 11 people and a new camp accommodation building at the Taltson Hydroelectric Facility. The maximum capacity of the new camp building is 20 people. The new camp consists of a building with 20 individual bedrooms, a galley, rec room, kitchen, fitness room, utility and office space. The kitchen is an industrial kitchen which is capable of handling catering for around 20 people.

Domestic waste from the camp is segregated for disposal using a new on-site diesel incinerator and camp sewage is treated in a new sewage treatment and disposal system with a septic field south of the new camp building (see Appendix I).

2.2.1 Waste Segregation and Storage Methods

Only non-hazardous solid waste materials that meet those in Class I/II and III in accordance with Environment Canada's 2010 Technical Document for Batch Waste Incineration (provided in Appendix G) are incinerated. These materials are segregated at the source and are placed in specifically identified waste containers fitted with transparent bags and located throughout the Facility. These wastes include:

- food waste;
- food packaging, kitchen waste, and other food-contaminated waste;
- paper;
- cardboard; and,
- untreated wood

See Section 2.2.3 for information on operation of the onsite incinerator.

All non-hazardous waste that cannot be incinerated will be sent to the Taltson waste facility area for staging to be shipped offsite, burning or burying. Materials will be sorted into the following categories:

- Untreated Lumber, Brush and Cardboard (burn pile)
- Plastics and Rubber
- Concrete, Bricks, Ceramics
- Pressure Treated Lumber
- Old Boilers and Appliances
- Scrap Metal
- General - Waste that does not fall into another category

See Appendix J for the Taltson Waste Disposal Standard Operating Procedure.

2.2.2 Human Domestic Waste Handling and Disposal

The Facility treats waste sewage and grey water using septic fields. During operation, waste liquid moves into septic tanks and is then pumped into a septic field. For specifics on the Taltson Camp sewage treatment and disposal system design see Appendix I.

2.2.2.1 Temporary Sewage Lagoon

A temporary sewage lagoon will be constructed on the site road to the South Valley Spillway. This lagoon will be used for the sewage from 4 portable toilets that will be placed outside the plant during the overhaul. The temporary sewage lagoon is proposed for the waste from the 4 portable toilets to minimize risk to the septic system for the accommodation buildings during the temporary staffing peaks. It is estimated that 12 people would be using the sewage lagoon. The Residential Water Use (RWU) per capita for facilities where trucked water and sewage services will be used is provided as 90 liters per person per day. Based on this the estimated wastewater generated per day is 90.25 L/d. Allowing for 0.35 liters per day per person sludge volume, the estimated storage volume is 90.6 liters per day per person.

The temporary lagoon will be sized accordingly including a factor of safety for precipitation storage and marked for safety. Sewage from the portable toilets will be collected with a vacuum pump skid and disposed into the temporary sewage lagoon. The lagoon will remain in operation for one season from February 2022 to November 2022, at which time it will be capped and abandoned. Lining of the lagoon will be confirmed after geotechnical testing is completed in the spring of 2021. The lagoon system has been sized to accommodate storage of wastewater, and precipitation for a period of 12-months. Storage calculations have taken into account for sludge and ice accumulation and resulting reduction in storage volume. Temporary sewage lagoon drawings attached as Appendix K. The main features that dictate the design of a wastewater lagoon are:

- A 1 m freeboard
- A generation rate of 0.35 L/person/day of sludge accumulation
- Single treatment stage lagoon i.e., sedimentation/coagulation of solids

- 1 m separation between lagoon and seasonal high groundwater level

The temporary sewage lagoon will be permanently capped and abandoned after 2022 construction activities are completed. At the end of each phase the lagoon will be capped with a 1 m thick clay cap over a layer of lime. A reinforced geomembrane layer will separate the wastewater surface from the clay cap. Abandoning and capping is standard practice and is likely less risky than transporting sewage from Taltson to Fort Smith on the ice roads.

2.2.3 On-site Incinerator

The incinerator at the site is a CY-2050-FA cyclonator incinerator manufactured by Westland Environmental with a maximum batch capacity of 75 kg/hr. The Facility operator has been trained in the use of the incinerator and only authorized personnel are allowed to operate this equipment.

The incinerator is located at Taltson Camp; all non-hazardous solid waste materials meeting the Class I/II and III criteria are transported to this area for incineration. The segregated waste streams that are incinerated include only those wastes identified in Section 2.2.1 Waste Segregation and Storage Methods.

Prior to loading the incinerator, the feed material is inspected by the incinerator operator to ensure it does not contain inappropriate waste materials. General classes of **inappropriate wastes** include, but are not limited to:

- Hazardous Wastes (refer to the NTPC Hazardous Waste Management Plan)
- Mercury containing materials / waste (e.g. fluorescent lamps, thermometers, thermostats, dental amalgam, batteries). Limiting the quantity of mercury placed in the incinerator is the most effective way to limit mercury emissions
- Metal and glass. These materials absorb energy from the furnace and increase the wear and tear on various incinerator components
- Materials / wastes containing heavy metals (e.g. mercury-containing wastes, pressure or chemically treated wood (i.e. Chromated Copper Arsenate [CCA] or creosote), lead painted materials
- Asbestos waste
- Liquid wastes including petroleum hydrocarbons and sewage.
- Uncontaminated plastics, including chlorinated plastics
- Inert materials such as concrete, bricks, ceramics, ash
- Bulky materials such as machinery parts or large metal goods such as appliances
- Radioactive materials such as smoke detectors
- Potentially explosive materials such as propane tanks, other pressurized vessels, unused or ineffective explosives
- Other hazardous materials such as organic chemicals (PCBs, pesticides), other toxics (arsenic, cyanide)

- Electronics
- Batteries
- Drywall
- Fluorescent light bulbs
- Tires
- Oily rags

When identified, inappropriate waste material will be removed from the incinerator feed. If the inappropriate waste is too intermixed with the desired incinerator feed, then the batch will be rejected and not incinerated. Removed inappropriate wastes and rejected batches will be stored and handled in accordance with the NTPC Hazardous Waste Management Plan.

The incinerator is designed with a maximum batch capacity of 1.4 m³ and 75 kg/hr. The incinerator will not be loaded over the maximum capacity. The incinerator is operated in accordance with the Environment Canada (EC) Technical Document for Batch Waste Incineration (2010; Appendix G).

The incinerator will be operated according to the Operation and Maintenance Manual. When the incinerator is loaded with the appropriate mix and quantity of waste, the door is closed and locked and the burn cycle is started. The incinerator operator observes the burn for at least 15 minutes after ignition. When satisfied that the burn is proceeding in a controlled manner, the incinerator operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle will not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste is allowed to be added to the primary chamber while in operation.

When the burn is complete and the unit has cooled, the incinerator operator will open the door only when wearing protective equipment (see Section 4.1).

The incinerator operator removes the ash from the previous burn cycle before reloading the incinerator. Any unburned combustible materials found in the ash will be reloaded into the incinerator after the operator has cleaned the airports, and before putting a fresh charge into the incinerator. Waste ash is disposed of at the Taltson waste facility area.

According to the Canada-wide Standards for Dioxins and Furans (adopted by the Canadian Council of Ministers of Environment [CCME] in 2001), facilities incinerate less than 26 tonnes of waste are not required to confirm stack test concentrations of 80 pg I-TEC / m³ or less through annual testing but must make determined efforts to achieve this stack test concentration. The Taltson Hydroelectric Facility incinerates significantly less than 26 tonnes of waste each year and NTPC does not currently undergo stack testing due to the small amount of waste that is incinerated at the Facility.

2.2.4 Other Waste

Untreated wood and scrap lumber are open burned. Scrap metal will be stockpiled at the waste facility area.

Hazardous materials are not incinerated and are discussed specifically in Sections 2.3 and 3.1.3. All hazardous waste will be stored, handled and disposed of in accordance with NTPC's *Hazardous Waste Management Plan*.

All domestic camp wastes that cannot be incinerated, unburned combustible materials, non-combustible materials (e.g. metal pieces), and residual waste / incinerator ash will be disposed of at the waste facility area.

2.2.5 Waste Container and Storage / Staging Locations

Prior to removal from the site, sealed waste containers are stored at the Taltson Hydroelectric Facility airstrip which is located more than 100 meters (m) from the high-water mark.

To ensure proper capacity for increased amounts of hazardous waste two portable 10' x 10' x 1' L-bracket berms will be sent to the Facility, as well as a lined hazardous waste berm storage area will be constructed at the airstrip. The berm will be approximately 30m x 20m with a 0.75m berm around the storage around with a gate for trucks to drive in/out.

2.2.6 Taltson Overhaul Hazardous Building Materials

Old camp and garage will not be removed until 2027, old turbine and generator will be removed in summer 2022; hazardous materials testing of turbine and generator will be completed in summer of 2021 during the annual shut down. The Taltson Hydro Waste Management Plan will be updated accordingly and submitted in spring of 2022. This will be updated to include turbine oil, transformer oil, as well as any other hazardous waste identified during the summer of 2021.

2.3 GENERAL HAZARDOUS MATERIAL STORAGE GUIDELINES

NTPC is committed to the safe and appropriate storage of fuels, hazardous materials and hazardous wastes. The following sections outline NTPC's general guidelines for storing hazardous materials and hazardous wastes.

2.3.1 General Precautions

General precautions for handling hazardous materials include:

- No person should handle a substance unless that person is familiar with the hazards.
- No person should use a substance unless that person is familiar with the proper use.
- Hazardous materials from different classes should never be mixed in the same container.

2.3.2 General Guidelines for Storage Drums/Containers

Hazardous materials/waste shall be stored in drums/containers according to the following guidelines:

- In the original containers, where possible or in containers manufactured for the purpose of storing the material or use good quality 16 gauge or lower steel or plastic 205 L drums.
- Containers of hazardous materials shall be returned to their designated storage area at the end of each shift or when no longer in use.
- Reused steel or plastic drums must have an internal volume greater than or equal to 150 L to handle, offer for transport or transport dangerous goods that are liquid and are included in Class 3, 4, 5, 6.1, 8 or 9 (Section 5.12(2), TDGR 2001-286)
- Storage containers shall be in good condition, sealable and not damaged or leaking.
- Drums containing hazardous materials/wastes expected to be in storage for more than six months shall be placed on pallets or on a well-drained storage area to prevent rusting.
- Each container shall be clearly labelled to identify the substance being stored according to the requirements of the Workplace Hazardous Materials Information System (WHMIS) or the Safety Act or the relevant Transport Authority, if transport is planned.
- Containers shall be kept secure and closed except when adding or removing product.
- Containers with product shall be kept in the upright position; empty drums can be placed horizontally.
- Containers shall be arranged to prevent damage from falling or dislodging.
- Containers shall be arranged to allow for easy access and inspections.
- Dispensing a container to another shall only be carried out within an area provided with drip / spill containment.

2.3.3 General Guidelines for Storage Areas

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, the following general guidelines for storage areas/facilities will be considered:

- Design of storage areas shall be in compliance with the National Fire Code, where appropriate.
- Drainage into and from storage areas shall be controlled in order to prevent leaks or spills from migrating off-site and to avoid run-off from entering the storage areas.
- Storage areas shall have controlled access. Only authorized and trained personnel shall have access to storage areas.

- Leaking or deteriorated containers shall be removed, and their contents transferred to a sound container.
- Storage areas shall be adequately signed indicating that there is to be no smoking, no sparks or flames and hazardous materials/wastes are stored therein.
- Storage locations shall be clearly defined and marked to prevent damage of storage drums and containers in the event they are covered by snow.
- Incompatible materials shall be segregated by chemical compatibility within the storage area to prevent contact between materials in the event of a release
- Storage areas shall be located at least 30 metres from surface water and on a low-permeability area, where possible.
- Storage areas shall be readily accessible for fire fighting and other emergency procedures.
- Storage areas shall be adequately ventilated to prevent the build up of noxious or toxic vapours.
- Secondary containment or an adequate spill collection system shall be installed to allow for the containment of at least 110% of the largest container or tank volume within the contained area, plus 10% of the aggregate capacity of all other containers or tanks.
- Secondary containment shall be kept free of debris, water accumulation and snow.
- Storage areas and associated secondary containment shall be protected from the elements, where possible. In case this is not feasible, the secondary containment's volume shall be large enough to allow for any precipitation (rain, snow, and storm water run-on) that may enter containment systems located outdoors, in addition to the required containment volume for stored materials. In addition, sufficient capacity to handle sprinkler water and other water from fire protection efforts will be provided.
- Storage areas shall be constructed, or provided with barriers, to protect containers from the environment and physical damage.
- Adequate spill and emergency response equipment shall be installed at each storage area (i.e. spill control, fire protection, etc.). A list of spill control equipment is provided in the Spill Contingency Plan.
- The site shall not be used for long-term storage of hazardous waste.

3 HAZARDOUS WASTE MANAGEMENT PLAN

3.1 LIFE CYCLE MANAGEMENT

“Life cycle management” implies the assessment of a particular product over its entire life – from the time a material is needed to the time the product is fully consumed or disposed of as waste. It covers product supply, transportation, storage, handling, recycling, and waste disposal. NTPC is committed to ensuring proper life cycle management of all products used including hazardous materials. It will be handled in accordance with relevant legislation (e.g. Environmental Protection Act (EPA), Transportation of Dangerous Goods Act and Regulations (TDGA)). NTPC and its contractors will deal only with reputable, certified suppliers, transporters, and expeditors.

3.1.1 Delivery

Hazardous materials will be delivered to the Facility by commercial carriers either by ice road or fixed-wing aircraft with the appropriate transport authority: TDGA or International Civil Aviation Organization (ICAO). Carriers will be licensed and subject to inspections as required by the NWT Department of Transportation. All required permits, licenses, training and certificates of compliance will be obtained.

All shipments must be properly identified and labelled. Shipping papers must be accessible and include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures and emergency response telephone numbers.

Each commercial carrier is required to develop a spill prevention, control, and countermeasures plan to address the materials they are importing. In the event of a release during transport, the commercial transportation company is responsible for first response and cleanup. NTPC will periodically verify the qualifications of commercial carrier, their personnel and the existence of their spill prevention, control and countermeasures plan.

NTPC’s registered waste generator, carrier, and receiver numbers are NTG000008, NTC000002, and NTR000007 respectively. The Taltson Hydroelectric Facility is a generator of hazardous waste; however, it does not act as a carrier (transporter) or receiver of hazardous waste.

3.1.2 On-Site Handling

Once dangerous materials are received at the workplace, additional regulations apply. The federal Workplace Hazardous Materials Information System (WHMIS) calls for the proper labelling of products, the availability of product information in the form of the Safety Data Sheets (SDS), and employee education on how to identify and handle hazardous materials. NTPC will establish procedures for

obtaining SDS with new product deliveries, maintaining the SDS current (i.e. no older than 3 years), and maintaining a system of hardcopy or electronic SDS that are readily accessible by all employees.

All employees with computer access can view the current SDS for NTPC products by visiting the website:

<http://3eonline.com>

In order to login to the site, the following username and password must be entered:

Username: ntpc

Password: msds

Hazardous materials are to be stored in secured areas to prevent access by unauthorized personnel or any tampering. Tanks used for the storage of hazardous materials are double-walled or installed in secondary containment areas sized to hold at least 110% of the volume of the largest tank, plus 10% of the aggregate capacity of all other containers or tanks. Additional guidelines for the storage of hazardous materials are provided in Section 2.

In support of pollution prevention, NTPC will establish procedures for the regular inspection of storage containers/drums, tanks and the storage areas. If deficient conditions are identified, appropriate corrective actions will be taken and documented. Additional details for inspection of storage areas are provided in Section 5.

Emergency response procedures for spilled chemical substances are provided in the Spill Contingency Plan. These procedures outline the response to accidental spills or releases of hazardous materials to minimize health risks and environmental effects. Included are procedures for evacuating personnel, maintaining safety, cleanup activities, emergency contacts, internal and external notifications to regulatory authorities and incident documentation.

3.1.3 Storage and Final Disposal

Prior to removal from the site, sealed waste containers are stored at the Taltson Hydroelectric Facility airstrip which is located more than 100 meters (m) from the high-water mark.

To ensure proper capacity for increased amounts of hazardous waste two portable 10' x 10' x 1' L-bracket berms will be sent to the Facility, as well as a lined hazardous waste berm storage area will be constructed at the airstrip. The berm will be approximately 30m x 20m with a 0.75m berm around the storage around with a gate for trucks to drive in/out.

Hazardous wastes will be shipped offsite either by winter road or fixed-wing aircraft and sent for treatment or disposal, in accordance with NTPC's *Hazardous Waste Management Plan* and Section 5 of the *Taltson Hydro Waste Management Plan*.

3.1.4 Hazardous Wastes

NTPC's *Hazardous Waste Management Plan* (HWMP) presents detailed information with respect to the management of hazardous wastes at all NTPC facilities, including the Taltson Hydroelectric Facility. The reader is directed to the HWMP for specific information relating to the management of hazardous wastes. General information with respect to the management of hazardous waste is provided below.

Hazardous wastes are typically generated through operations involving the use or clean-up of chemicals or other hazardous materials/substances (waste oils, waste fuels, batteries, solvents, etc.). On becoming wastes, hazardous materials will be stored and/or disposed of in accordance with specific government legislation, regulations and guidelines. A hazardous waste inventory is recorded on the Hazardous Waste Storage Inventory Log (Appendix E).

As a waste generator, NTPC is ultimately responsible for ensuring hazardous waste will be properly managed from the time they are generated to final disposal. Waste must be properly identified, labelled, stored, transported, treated and disposed of. Contractors are responsible for handling and disposal of the hazardous wastes they generate through their work, unless alternate arrangements have been made with NTPC in advance.

Hazardous wastes must not be mixed or diluted with any substance or divided into smaller quantities to avoid meeting the definition of a hazardous waste. Incompatible hazardous wastes should be segregated by the TDG class to ensure safety. Open burning of hazardous waste is not acceptable.

It is NTPC practice to remove hazardous waste from all sites at least once per year. No NTPC site should maintain quantities of waste for a period of time sufficient to necessitate registration as a storage facility. If hazardous waste is stored for a period of 180 days or more, and the quantities to be stored exceed the quantities set out in the Guideline for the General Management of Hazardous Waste in the NWT Schedule 1: Registered Volumes for individual waste classes or if the aggregate quantity for all classes of waste stored exceeds 5,000 kg/L, the facility must be registered with the NWT Department of Environment and Natural Resources. The storage facility can be a building, locker, compound, or area used to store hazardous waste.

In cases where hazardous wastes are to be transported off-site for treatment or disposal, NTPC will only use hazardous waste management facilities registered with the appropriate provincial or territorial authorities having jurisdiction. Prior to selecting and engaging such companies, NTPC will verify their "approved" status as a waste facility with the appropriate provincial or territorial authorities having jurisdiction. A review of their "approved" status will be conducted at least annually. NTPC will employ only registered waste carriers to transport waste to registered waste receivers.

The NWT Environmental Protection and Waste Management Division, Department of Environment, Environment and Natural Resources (ENR) monitor the movement of hazardous waste, from the generator to final disposal through use of a tracking document known as a Waste Manifest. Accordingly, a completed Waste Manifest will accompany all movements of hazardous waste from the Taltson Hydroelectric Facility. NTPC is registered with the ENR as a waste generator and our waste generator number is NTG000008.

4 PRIMARY HAZARDOUS MATERIAL

4.1 PRODUCT DESCRIPTION

One particular product –diesel fuel – will be used in relatively large quantities at the Facility. Detailed procedures have been developed to ensure that diesel is handled and used with no adverse effect on people or the environment. The other hazardous materials used on site are present in relatively small quantities. Products such as gasoline, glycol, compressed gases, lubricants, and cutting oils are widely used in the North. These products meet vital needs for power generation, heating and vehicle operation.

The transportation, storage and handling of these petroleum and related products are strictly regulated by both federal and territorial legislation. NTPC will ensure that all such requirements are met. Standard procedures are discussed in Section 2 of this document. NTPC will emphasize the need for regular inspections of all storage and distribution facilities on site to assure mechanical soundness and to prevent leaks or any other uncontained release of fuel products.

Material categories, site handling and storage requirements, and PPE recommended by manufacturers in SDS are summarized in Tables 4.1 to 4.3 (also see the SCP). The primary hazardous material and waste storages areas at the Facility are identified on Figure 2.1 and described in Table 2.1.

Table 4.1 Fuel Products – Hazard Classes & Potential Impacts

Material	TDGA Class	Potential Environmental Impact
Diesel	3	Water & soil contamination
Gasoline	3	Water & soil contamination
Jet Fuel	3	Water & soil contamination
Lube Oil / Motor Oil	Not regulated	Water & soil contamination
Glycol	Not regulated	Toxic by ingestion, could potentially be consumed by wildlife
Propane	2	Fire/explosion
Acetylene	2	Fire/explosion
Oxygen	2	Fire/explosion
Nitrogen	2	Fire/explosion

Table 4.2 Fuel Products – Safe Handling Procedures

Product	Handling Procedures
Diesel	Do not get in eyes, on skin or on clothing. Avoid breathing vapours, mist, fume or dust. Do not swallow. May be aspirated into lungs. Wear PPE and/or garments if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Eliminate all ignition sources. Store in a well-ventilated area. Store in a closed container. Bond and ground during transfer.
Gasoline	See diesel procedures above.
Jet Fuel	See diesel procedures above.
Lube Oil / Motor Oil	Wear protective clothing and impervious gloves when working with used motor oils. To be handled generally consistent with other petroleum hydrocarbons.
Glycol	Ensure adequate ventilation. Wear protective gloves and chemical safety goggles. Keep in tightly closed containers.
Propane	Secure cylinders to a wall, rack or other solid structure in an upright position. Keep valves closed and protective cap in place on cylinder when not in use. Do not handle with oily hands. Protect from heat. Protect against electrostatic charges. Pressurized container: protect from sunlight, store in a cool location and do not expose to temperatures exceeding 50°C. Empty containers may have product residue. Do not pressurize, cut, heat or weld empty containers. Store in a cool, dry and well-ventilated building. Eliminate all ignition sources. Keep product out of direct sunlight and away from incompatible or combustible materials.
Acetylene	See propane procedures above.
Oxygen	See propane procedures above.
Nitrogen	See propane procedures above.

Table 4.3 Fuel Products – Personal Protective Equipment

Product	Personal Protective Equipment		
	Eyes	Skin	Respiration
Diesel	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required.
Gasoline	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required. Ensure adequate ventilation.
Jet Fuel	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required. Ensure adequate ventilation.
Lube Oil / Motor Oil	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Under normal handling, none usually required.
Glycol	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required.
Propane	Chemical goggles	Neoprene or nitrile gloves, protective garments. Insulated gloves suitable for low temperatures where liquid propane is involved.	Under normal handling, none usually required.
Acetylene	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Respirator – see MSDS.
Oxygen	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Respirator – see MSDS.
Nitrogen	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Respirator – see MSDS.

4.2 DELIVERY TO SITE

With the exception of diesel fuel, most petroleum fuel and lubricant products will be delivered to site and stored in the original packaging container from the manufacturer/supplier. These types of containers include a variety of sealed drums (205 L), pails, cans, tubes and boxes. Supplies of diesel are brought primarily by fixed-wing aircraft in 205 L drums.

Upon arriving on site, the fuel is delivered to a designated storage area and then transferred to the diesel aboveground storage tanks by the Plant Operator. The small quantity hazardous materials contained within their original packaging will be delivered directly to their designated storage area by the Plant Operator.

All fuel transfer and storage facilities will be designed and operated in accordance with the National Fire Code, the Canadian Council of Ministers for the Environment (CCME, 2003) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum, and the (CCME, 2008) Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

Appropriate measures will be in place to minimize impacts to surface water, groundwater and soils from potential vehicle accidents when transporting hazardous materials across the site. Details of spill responses are presented in the SCP.

4.3 FUEL TRANSFER PROCEDURES

Bulk transfer of diesel fuel is to follow NTPC's Fuel Transfer Safe Work Practice (Appendix C). General procedures to be followed are listed below.

Before fuel transfers, verify that:

- All employees are wearing personal protective equipment as may be necessary to protect themselves from the hazards involved.
- Emergency equipment including fire extinguishers and spill kits are available and have been inspected.
- All fuel transfer hoses have been connected properly and couplings are tight.
- Transfer hoses are not damaged.
- All fuel transfer personnel are familiar with the general procedures at the site and of the product being transferred.
- Personnel can manually shut off the flow of fuel in the event of a system failure, fault, leak or fire.
- If a high liquid level shutoff device is installed at the delivery tank, verify that the shutoff is operating correctly each time it is used.

In the event that onsite personnel must leave the immediate transfer area, the transfer shall stop, and the transfer point locked. If an employee, while involved with a fuel transfer process, leaves the site during the process, the employee will be dismissed, except in extenuating circumstances.

Transfer points will be kept locked at all times except during the transfer process.

Any accidents or spills must be reported immediately to the Plant Operator and in writing to regulators and NTPC management. Notification and response procedures are detailed in the SCP.

4.4 CONTAMINATED SOILS AND SPILLS

Contaminated soils resulting from the accidental release of hazardous products will be salvaged at the time such impacts are identified, and put into drums, labelled and shipped off-site to an approved disposal facility.

A suitable absorbent will be used to cleanup spillage on impermeable floor surfaces and will be handled similarly to contaminated soil as described above. Internal and external notification requirements, record keeping, and response procedures are detailed in the SCP. If required, the assessment and remediation of contaminated soil will be carried out in accordance with *The Environmental Guideline for Contaminated Site Remediation*.

4.5 USED PETROLEUM AND OTHER WASTE PRODUCTS

Used oil, solvents or glycol that are no longer suitable for their intended use are classified as a hazardous waste and drummed and stored as appropriate. The discharge of used oil, solvents or glycol into the environment, including but not limited to storage areas, septic systems and water bodies is prohibited. Used oil will not be incinerated on site. Used oil will not be applied as a dust suppressant on site. Waste oil and fuel will be shipped to Fort Smith by ice road or fixed-wing aircraft to be burned in a local contractor's waste oil furnace. Other hazardous wastes (e.g., solvents and glycol) are also shipped by ice road or fixed-wing aircraft to Fort Smith and transported via truck to Hay River for disposal.

These materials will be managed in accordance with requirements of the *Used Oil and Waste Fuel Management Regulations*, the *Guideline for the Management of Waste Solvents* and the *Guideline for the Management of Waste Antifreeze*.

5 INVENTORY, INSPECTION & RECORDS

5.1 GENERAL

A contract expediting company will arrange all deliveries from Fort Smith to the Taltson Hydroelectric Facility. This will include the hazardous materials discussed in this plan. The Plant Operator will have ultimate responsibility for supervising the receipt, inspection and recording of all material inventories on site. The Manager, Plant Operations will reconcile total amounts received against amounts ordered.

5.2 FUELS & LUBRICANTS

5.2.1 Inventory Management

Fuels, lubricants and other petroleum products (including wastes) in storage areas will be inventoried monthly. Inventory records will be maintained on site.

5.2.2 Inspection

The Plant Operator will coordinate the inspection of all fuel and lubricant storage sites areas. The inspection schedule and procedure to be followed are summarized in Table 5.1. All inspections will be logged with the date and time of inspection, area inspected and the name of the person making the inspection.

Drum / Container Storage Areas

The condition of hazardous materials storage areas will be checked on a regular basis. Observations on their condition will be logged, dated and kept near the corresponding storage area. Drums/containers will be inspected for the presence and legibility of symbols, words or other marks identifying the contents, signs of deterioration or damage such as corrosion, rust, leaks at seams or signs that the drum/container is under pressure such as bulging and swelling, spillage or discoloration on the top or sides of the drum/container. If leaks or deterioration is encountered, it will be noted and addressed in a timely manner.

The hazardous materials area's secondary containment will be inspected, and the condition of the secondary containment will be noted. Arrangements will be made for repairs if necessary. If precipitation (water or snow) is present within the secondary containment, it will be removed from the secondary containment area in a timely manner to prevent overflow or damage to the containment system due to large ponding.

The availability of suitable and suitable quantity of spill response materials will be verified during the inspections. Additional spill response materials will be provided as required.

Petroleum Storage Tanks and Tank Storage Facilities

Inspection of petroleum storage tanks and petroleum storage tank facilities will be in conformance with the requirements of the *National Fire Code* and the *CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum*.

Visual inspection of storage tank facilities (used for dispensing fuels) to ensure that there has not been a leak or deterioration of the facility that could result in a leak will be conducted and documented each day the facility is in operation.

Visual inspection of a storage tank facility to ensure that there has not been a leak or equipment failure shall be conducted weekly and documented for the following where applicable:

- foundations, tank walls, roof, and tank attachments;
- dyke capacity, condition of the dyke wall and floor, and water removal systems;
- pumps and product-handling equipment;
- tank gauging equipment;
- mechanical and automatic electronic leak detection equipment;
- dispenser sumps and spill containment devices; and
- overfill protection devices.

Inspection and performance testing in conformance with the manufacturer's requirements and procedures to ensure satisfactory equipment performance and operation of a storage tank facility will be conducted annually and documented where applicable for:

- automatic tank gauges and monitoring systems;
- high-technology sensors;
- electronic or mechanical leak detection equipment;
- corrosion protection equipment;
- pressurized piping emergency valves;
- emergency shut-down devices;
- containment sumps including dispenser, turbine and transition containment devices; and
- overfill protection devices.

Vertical tanks will also undergo periodic testing as per API 653 / API 653-01 as required.

Table 5.1 Inspection of Petroleum and Hazardous Materials Storage Sites

90,000 and 10,000 L horizontal, double-walled AST	Schedule: Weekly by the Plant Operator or designate; Procedure: Repair leaks and report promptly. Inspections will be reported annually and filed with the Plant Operator or designate.
1,000 and 1,500 L vertical, inside day tank	Schedule: Weekly by the Plant Operator or designate; Procedure: Repair leaks and report promptly. Inspections will be reported annually and filed with the Plant Operator or designate.
Other Hazardous Material Storage Areas	Schedule: Monthly by Plant Operator or designate when materials are on site. Procedure: Inspections will be reported annually and filed as above.
Spill Kits	Schedule: Weekly/Monthly as part of inspection schedule as per above by Plant Operator or designate.

Any accidental damage to containment structures will be inspected immediately and appropriate repairs undertaken. The extent of damage will be reported in writing to the Plant Operator or alternate. The report will identify any remedial repairs that may be made, the date of any repairs and the need for any follow-up inspection. The Safety Inspection Report, which includes inspection of the Hazardous Materials Storage Area, can be found in Appendix F.

5.2.3 Records

Records pertaining to storage, use, and loss of fuels and lubricants are required by CCME and the Fire Marshal (under the *National Fire Code*). The following records will be prepared and maintained for fuel and hazardous materials storage areas under the supervision of the Plant Operator:

- Receiver registration number
- Carrier registration number
- Waste generator registration number
- Waste manifests
- Waste accumulation log
- Safety Inspection Report (Hazardous Waste Storage)
- Weekly use summaries
- Inspections and maintenance records
- Any alterations to the systems
- Reports of leaks or losses
- Reports of spill responses
- Records of training

Specific to storage tanks, the following records are also required, where applicable:

- Inventory data;
- Inspections and maintenance records;
- Overfill alarm tests
- Cathodic protection monitoring;
- Precision leak detection tests;
- Maintenance and repairs;
- Construction, alterations, or upgrades;
- As-built drawings; and
- Excavation or nearby construction that could affect the integrity of the storage tank system.

The records will be maintained on-site for at least seven years.

6 TRAINING

6.1 GENERAL

As outlined in the NTPC's Health and Safety Management System, all employees and contractors at the Taltson Hydroelectric Facility will receive the following training:

- WHMIS
- Emergency and spill response training (see also the SCP and ERP)
- Operations overview

Employees will receive additional training specific to their area of work and duties, including safe operation practices, safe handling and storage of chemicals, and use of PPE. This training will be the responsibility of NTPC.

Periodically, NTPC staff will carry out fire or other emergency drills. The drills will test emergency response procedures and will be scheduled so as not to disrupt work. The results of the drills will be recorded and forwarded to the Plant Operator, JOHSC and NTPC. The results may indicate that additional or refresher training is required. Safety committee recommendations will be enacted expeditiously.

6.2 FUEL & LUBRICANTS HANDLERS

Personnel who handle fuel and lubricants will be expected to be conversant with relevant SDS information. As well, these personnel will be given training in the following:

- Transportation of Dangerous Goods (TDG)
- NTPC's fuel handling procedures (outlined in Section 4.3)
- Spill response and cleanup procedures for petroleum hydrocarbons (see the SCP)
- Emergency response procedures (see the ERP)

The attendants and persons involved in inspections of fuel storage locations will be trained in fuel inventory and inspection procedures to support leak prevention and early detection.

6.3 PLANT EMPLOYEES

Plant employees may receive TDG training, if appropriate. All plant employees will be trained in spill and emergency response procedures. Emergency response procedures for spilled chemical substances are provided in the SCP.

For more information on employee training and safety guidelines, see NTPC's Health and Safety Management System, SCP and ERP.

6.4 THIRD PARTY CONTRACTORS

It is expected that third party contractors receive adequate and comprehensive training to conduct their work tasks from their employer. NTPC intends to review the general qualifications of third-party contractors prior to having them work at the site. In addition, the contractor companies may also be requested to confirm the qualifications of specific individuals that they may have working at the site.

Third party contractors working on the site will be expected to participate in and complete a site-specific health and safety training session. The training session is valid for a period of one year, after which time the contractor may be required to complete the training again or attend a refresher. The training session will outline site specific hazardous and response procedures that they should be aware of in the course of conducting their work on site. The training session will cover hazardous materials management.

7 PLAN EVALUATION, AUDIT & IMPROVEMENT

7.1 GENERAL

NTPC's goal is to audit all aspects of the WMP for effectiveness. Environmental management procedures will be modified and updated to address changes in policy, regulations and technology advances. The primary purpose will be continued compliance with legislative requirements. The WMP will be reviewed and audited every two years at a minimum but may also be reviewed and audited more frequently as required to identify any components that need to be corrected, adjusted, upgraded, or otherwise modified. Aspects of the plan that affect the safety of employees at the facility and of the general public will be most important.

Formal evaluations of the plan will be documented, deficiencies will be noted, and progress in addressing deficiencies will be tracked in writing. Individual responsibilities and accountabilities will be assigned, and deadlines will be set for addressing the required changes. The Director, Health, Safety and Environmental will assume overall responsibility for the process.

In line with the NTPC's goal of continuous improvement in all health and safety matters, all employees will be encouraged to offer suggestions for more efficient and safer materials handling procedures.

APPENDIX A

GLOSSARY

A

- **Accredited** (accreditation):

A term used by analytical laboratories. Those that have been tested and evaluated by the Standards Council of Canada and Canadian Standards Association, and that have met certain standards, are assigned an accreditation number. Only Accredited Laboratories may be used to obtain analytical results required for legislative compliance.

B

- **None**

C

- **CAEAL:**

Canadian Association of Environmental Analytical Laboratories. In cooperation with the Standards Council of Canada (see below), this Association governs the standards for and admission to the association of laboratories that have met all CAEAL standards to become accredited (see above).

- **Carrier:**

Any person engaged in the transport of hazardous waste whether or not for hire or reward.

- **Commissioner's Lands:**

Lands in the Northwest Territories that have been transferred by Order-Land in-Council to the Government of the Northwest Territories. This includes highways, block land transfers, and most lands within municipalities.

- **Consignee (Receiver):**

A site or facility that is licensed to accept certain subject wastes for disposal.

- **Consignor (Generator):**

A person who offers a consignment of hazardous waste for transport.

- **Contaminant:**

Any noise, heat, vibration or substance including such other substances as the Minister may prescribe that, where discharged into the environment:

- (a) endangers the health, safety or welfare of persons,
- (b) interferes or is likely to interfere with normal enjoyment of life or property,
- (c) endangers the health of animal life, or
- (d) causes or is likely to cause damage to plant life or property.

D

- **Dangerous Goods**

Any product, substance, or organism included by its nature or by the Transportation of Dangerous Goods Regulations (TDGR) in any of the classes listed in the schedule provided in the Transportation of Dangerous Goods Act (TDGA).

E

- **Empty Container**

A container that has been emptied, to the greatest extent possible, using regular handling procedures, the contents of which shall not exceed 1% of the container's original capacity or 2 litres, whichever is less. This does not include containers which previously contained mercury or class 2.3, 5.1, or 6.1 materials of TDGR.

- **Environmental Protection Service (EPS):**

Environmental Protection Service (EPS) of the Department of Environment and Natural Resources (ENR) is the Government of the Northwest Territories' (GNWT) agency responsible for initiatives which control the discharge of contaminants and their impact on the natural environment.

F

- None

G

- **Generator**

The owner or person in charge, management, or control of a hazardous waste at the time it is generated, or a facility that generates hazardous waste.

H

- **Hazardous Waste:**

A contaminant which is a dangerous good that is no longer used for its original purpose and is intended for recycling, treatment, disposal, or storage. A hazardous waste does not include a contaminant that is:

- (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 landfilling that meet the applicable standards set out in schedules I, III, or IV of the Guideline for Industrial Waste Discharges in the NWT.

- **Hazardous Waste Management Facility:**

A facility which is used for the collection, storage, treatment, recycling, or disposal of hazardous waste.

I

- **Incompatible Waste:**

Hazardous wastes which, when in contact with one another or other substances under normal conditions of storage or transportation, could react to produce heat, gas, fire, explosion, corrosive substances, or toxic substances.

J

- None

K

- None

L

- **Landfilling:**

The deposit of waste on land, as described in the GNWT Department of Municipal and Community Affairs' document Guidelines for the Planning, Design, Operation & Maintenance of Solid Waste Modified Landfill Sites in the Northwest Territories.

- **Licensed Waste Disposal Facility:**

A facility or site that is authorized to accept and dispose of predetermined wastes.

- **Long Term Storage:**

The storage of hazardous waste for a period of 180 days or more and in excess of the minimum quantities, not including materials in transit.

M

- **Manifest (Waste Manifest):**

A six-part, colour-coded, and uniquely numbered document issued by the government to licensed waste generators/carriers that must be completed and carried with/filed for shipments of waste (certain exemptions are allowed). The Manifest consists of three Sections (Consignor, Carrier, and Consignee) each of which must be completed by the party in control of the waste at the time the Section is completed.

- **Manage:**

To handle, transport, store, recycle, treat, destroy, or dispose of hazardous waste.

N

- **None**

O

- **None**

P

- **None**

Q

- **None**

R

- **Receiver (Consignee):**

A person to whom a quantity of hazardous waste is being or is intended to be transported to.

S

- **Sewage System:**

A system for the collection, transmission, treatment or disposal of any liquid waste containing animal, vegetable, mineral, human or chemical matter in solution or in suspension.

- **Small Quantity:**

Hazardous waste that is generated in an amount that is less than 5 kilograms per month if a solid or 5 litres per month if a liquid, and where the total quantity accumulated at any one time does not exceed 5 kilograms or 5 litres. This does not apply to wastes that are mercury or in classes 2.3, 5.1, or 6.1 of TDGR. These wastes must be generated in an amount less than 1 kilogram per month if a solid or 1 litre per month if a liquid; and where the total quantity accumulated at any one time does not exceed 1 kilogram or 1 litre.

T

- **Toxicity Characteristic Leaching Procedure (TCLP):**

Laboratory test method developed by the USEPA for determining the leaching potential of contaminants.

- **Transport Authority:**

The regulations controlling the management of hazardous waste under that mode of transport. These include:

- Road and rail - Transportation of Dangerous Goods Act (TDGA) and Regulations (TDGR).
- Air - International Civil Aviation Organization Technical Instructions (ICAO).
- Marine - International Maritime Dangerous Goods Code (IMDG).

- **TDGA/TDGR:**

The Transportation of Dangerous Goods Act and Regulations (Canada).

- **Treatment or Treat:**

The handling or processing of a hazardous waste in such a manner as to change the physical, chemical or biological character or composition of the hazardous waste in order to eliminate or reduce:

- (a) one or more environmental hazards of the waste; and/or
- (b) the volume.

U

- **None**

V

- **None**

W

- **Waste:**

Any material that is to be disposed of by any individual/company that is not considered to be inert.

- **Waste Dangerous Goods:**

Subject wastes that are also regulated by the terms and conditions contained in the Transportation of Dangerous Goods Regulations under the Transportation of Dangerous Goods Act (federal).

- **Waste Data Sheets:**

The pages in Tab 5 of this manual that describe the legislated requirements for managing the various wastes in accordance with the Transportation of Dangerous Goods Regulations, if applicable.

X

- **None**

Y

- **None**

Z

- **None**

APPENDIX B
LEGISLATIVE REQUIREMENTS

Federal Legislation

A summary of the relevant federal legislation and applicable sections that cover the collection, handling, transportation, and disposal of hazardous wastes in Canada is presented in Table B1.

Table B1 – Summary of Federal Legislation

FEDERAL LEGISLATION		
Legislation	Hazardous Waste	Relevant Details in Legislation
Federal Transportation of Dangerous Goods Act	Waste Dangerous Goods	<ul style="list-style-type: none"> - Section 3 - Application of Act The Act applies to the Transportation of all dangerous goods in Canada. Dangerous goods are the following: <ul style="list-style-type: none"> Class 1 - Explosives Class 2 - Compressed gases Class 3 - Flammable or combustible liquids Class 4 - Flammable solids Class 5 - Oxidizing substances Class 6 - Poisonous and infectious substances Class 7 - Nuclear substances Class 8 - Corrosives Class 9 - Miscellaneous - Section 5 - Safety Requirements, Standards and Marks No person shall handle, offer for transport, transport, or import dangerous goods unless they comply with all safety requirements, have the means of containment and transport for the material, and can display the prescribed safety marks. - Section 7 - Emergency Response Assistance Plans The person offering for transport or importing certain dangerous goods must have a Minister-approved ERAP prior to transport. - Section 8 - Means of Containment Containment must display all the necessary safety marks prior to being sold, delivered, distributed, imported, or otherwise transported. - Section 15 - Monitoring Compliance An inspector can inspect any vehicle transporting dangerous goods to ensure compliance to this Act. - Section 18 - Duty to Respond If there is an accidental release of a dangerous good in excess of the prescribed amount as outlined in the TDG Regulations, the person in charge of the material at the time of discharge has the responsibility to immediately report the incident to the 24-Hour Spill Report Line at (867) 920-8130. The person responsible for making the report shall take all reasonable emergency measures to reduce or eliminate any danger to public safety that may occur as a result of the release.

Table B1 – Summary of Federal Legislation (continued)

FEDERAL LEGISLATION		
Legislation	Hazardous Waste	Relevant Details in Legislation
Federal Transportation of Dangerous Goods Regulations SOR/DORS/2001-286	Waste Dangerous Goods	<ul style="list-style-type: none"> - Part 2 – Classification The consignor is responsible for determining the classification of dangerous goods. Classification includes, as applicable, the shipping name, primary class, compatibility group, subsidiary class, UN number, packing group and risk group of dangerous goods. - Part 3 – Documentation Before allowing a carrier to take possession of dangerous goods for transport, the consignor must prepare and give to that carrier a shipping document or, if the carrier agrees, an electronic copy of the shipping document. The information required on a shipping document must be easy to identify and legible. Information that must be included on a shipping document is outlined in Part 3.5 of the Regulations. - Part 4 – Dangerous Goods Safety Marks A person must not offer for transport, transport or import a means of containment that contains dangerous goods unless each dangerous goods safety mark required by this Part is displayed in accordance with this section. - Part 5 – Containment A person must not handle, offer for transport, transport or import dangerous goods in a means of containment unless the means of containment is required or permitted by this Part to be used for the transportation of the dangerous goods. - Part 6 – Training A person who handles, offers for transport or transports dangerous goods must either be adequately trained and hold a training certificate in accordance with this Part or perform those activities in the presence and under the direct supervision of a person who is adequately trained and who holds a training certificate in accordance with this Part. Adequate training is described in Part 6.2 of the Regulation. - Part 7 – Emergency Response Assistance Plan It is the responsibility of the person offering for transport or importing dangerous goods for which an emergency response assistance plan (ERAP) is required to establish such a plan and to have that plan approved by Transport Canada. - Part 8 – Accidental Release and Imminent Accidental Release Report Requirements In the event of an accidental release of dangerous goods from a means of containment, a person who has possession of the dangerous goods at the time of the accidental release must make an immediate report if the accidental release consists of a quantity of dangerous goods or an emission of radiation that is greater than a determined quantity or emission level. If an immediate report was required to be made for an accidental release, a follow-up report must be made by the employer of the

Table B1 – Summary of Federal Legislation (continued)

FEDERAL LEGISLATION		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<p>person who had possession of the dangerous goods at the time of the accidental release within 30 days of the initial report.</p> <ul style="list-style-type: none"> - Schedule 1 – Classes 1 to 9 Schedule 1 is a chart of all dangerous goods indicating UN numbers, Shipping Names and descriptions and other important information that must be addressed when handling or shipping dangerous goods. - Schedule 2 – Special Provisions This schedule provides extra requirements for certain dangerous goods that are not provided in Schedule 1. - Schedule 3 – Alphabetical Index This schedule is provided to quickly determine the UN number and class of a dangerous good using an alphabetized list.
National Fire Code	Waste Oily Rags	<ul style="list-style-type: none"> - Waste oily rags are to be kept in non-combustible receptacles with a melting point of no less than 650oC without openings on the sides or bottom. The container must have a self-closing tightly fitting cover.
Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations	Waste diesel fuel and waste lube oil	<p>The owner or operator of the storage tank system must ensure that:</p> <ul style="list-style-type: none"> - all liquids and sludge are removed and disposed of; - if a tank is being withdrawn from service, the tank is purged of vapours to less than 10% of the lower flammability limit and the presence of vapours is checked with a combustible gas meter; and - the withdrawal is done in such a way that there will be no immediate or long-term harmful effect on the environment, and it will not constitute a danger to human life or health.
Canadian Environmental Protection Act – National Strategy for the Management of Post-Use Preservative Treated Industrial Wood	Preservative treated wood (e.g., creosote treated power poles)	<p>The preferable option for treated wood poles is reuse as posts, braces, stubs or anchors.</p> <p>The following uses of treated wood are prohibited:</p> <ul style="list-style-type: none"> - Fuel (e.g., open-burning, furnace, etc.) - Construction material in water (e.g., docks, walls, etc.) - Construction material with which people come into direct and frequent contact (e.g., playgrounds, garden, etc.) <p>Post-use treated wood is not classified as a hazardous waste and can be sent to Class I or II landfills for disposal. The landfill Operator shall be made aware of the waste type so that the treated wood is buried and not open burned.</p>

Table B1 – Summary of Federal Legislation (continued)

Northwest Territories Legislation/Guidelines

A summary of the relevant legislation and guidelines and applicable sections that cover the collection, handling, transportation and disposal of wastes in the Northwest Territories (NWT) enacted under the NWT Environmental Protection Act is presented in Table B2.

The Department of Environment and Natural Resources (ENR) is the NWT government agency responsible for initiatives which control the discharge of contaminants and their impact on the natural environment, including the disposal of hazardous wastes.

Table B2 – Summary of Northwest Territories Legislation/Guidelines

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
Environmental Protection Act (EPA)	All hazardous wastes (i.e. contaminants that can enter the environment)	<ul style="list-style-type: none"> - Section 4 - Environmental Protection 4 (1) The chief Environmental Protection Officer may require that the storage facility have on hand at all times the equipment and the material necessary to alleviate the effect of any discharge of contaminants that may be specified in the order. - Section 5 - Discharge of Contaminants 5 (1) - No person shall discharge or permit the discharge of a contaminant into the natural environment without a permit. If there is a discharge to the environment, the person in charge of the contaminant prior to the discharge must: Report the discharge to the 24-Hour Spill Line (867) 920-8130; Stop the discharge if possible; and Make a reasonable effort to notify everyone who may be adversely affected by the discharge. - Section 9 - Unsightly Land If the inspector believes that the land is unsightly when compared to lands used for a similar purpose, the Chief Environmental Protection Officer may issue a written order to improve condition of the land.
Guideline for Industrial Waste Discharges in the NWT	Various Wastes	<ul style="list-style-type: none"> - Addresses discharge of effluent and process residuals from industrial operations. - Covers only waste for which there is not already a guideline or regulation in place. - Provides standards for discharge to municipal landfills and sewage systems.
Guideline for Ozone Depleting Substances (ODSs)	CFCs, HCFCs and Halons (used in heat pumps, air conditioning equipment, refrigeration equipment, motor vehicle air conditioners, and portable fire extinguishers)	<ul style="list-style-type: none"> - ODSs are found in certain air conditioners, refrigeration devices, and fire extinguishers. - A waste manifest must accompany waste ODS if moved for storage, recycling or disposal. - ODS should be removed from equipment by a certified technician prior to equipment disposal. - Any release of ODS from a compressed gas vessel (Class 2, TDG) with a capacity greater than 100 L must be reported to the 24-Hour Spill Report Line (867) 920-8130. - A release of 5 L or more of an ODS classified as a poisonous substance (Class 6, TDG) must be reported to the 24-Hour Spill Report Line (867) 920-8130. - Any ODS-containing equipment that requires disposal should be serviced by a technician to remove the CFCs or HCFCs and marked with the date of service, the certified technician and company name, and an indication that the equipment no longer contains refrigerant. After servicing the equipment can be recycled or landfilled. - If it is a remote community and a technician is not available, contact ENR for a plan to manage ODS equipment in remote areas at (867) 873-7654.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
Guideline for the General Management of Hazardous Waste in the NWT	All hazardous wastes	<ul style="list-style-type: none"> - Complements existing acts and regulations regarding hazardous wastes. - Should be consulted in conjunction with applicable specific hazardous waste guidelines - The generator is responsible for the identification, labelling, and storage of the hazardous waste from the time of generation to the time of disposal (from the “cradle to the grave”). - Generators, carriers, and receivers must all be registered with ENR. The office of the Fire Marshal has authority over the storage of flammable, combustible, and hazardous materials under the National Fire Code. - Storage of Hazardous Waste: <ul style="list-style-type: none"> a) Stored in original containers or other containers manufactured for the purpose of storing hazardous waste. Containers must be sound, sealable and not damaged or leaking. b) Clearly labelled according to WHMIS if transport is planned. c) Bulked into 16 gauge or equivalent metal or plastic drums, as appropriate. d) Containers should be sealed or closed at all times unless in use. - Requirements for storage facilities: <ul style="list-style-type: none"> a) Drainage into and from the site is controlled to prevent spills from leaving the site. b) Incompatible wastes are segregated by chemical compatibility to ensure safety. c) A secure area with controlled access to trained persons only. d) Regular inspections of containers are performed and recorded. e) A record is maintained of the type and amount of waste being stored. f) Emergency response equipment is available on site. g) If the site stores over 1,000 L/kg of any one waste class or a total of over 5,000 L/kg of all waste classes combined for over 180 days, the site must be registered with ENR. <ul style="list-style-type: none"> - The company name, address, phone number and contact person including position, the location and description of the facility, the expected types, quantities, and method of hazardous waste storage, and the required approvals to occupy the land for the purpose of hazardous waste storage must be provided to the EPA and the local fire chief for emergency planning purposes. h) Storage site must meet local zoning and by-law requirements. - A completed Waste Manifest must accompany all shipments of hazardous waste. Waste Manifests are available from ENR. - Transportation is regulated by TDGR by road, International Civil Aviation Organization (ICAO) by air, and International Maritime Dangerous Goods Code (IMDG) by water. - Treated hazardous waste may be directed to a landfill or to a municipal sewage system if it meets the <u>Guideline for Industrial Waste Discharges in the NWT</u> and the municipal authority and facility water license are consulted.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - Hazardous waste containers must be triple rinsed and punctured so they are rendered unusable or returned to distributor for recycling. <p><i>* Waste oil being transported from generator to receiver in the NWT does not require manifesting (e.g., by waste oil burners under the NTPC Waste Oil Agreement).</i></p>
Guideline for the Management of Waste Antifreeze	Antifreeze (ethylene glycol, propylene glycol)	<ul style="list-style-type: none"> - Waste Antifreeze is a contaminant under the NWT EPA and must be managed as a hazardous waste. - It shall not be landfilled or poured down any drain as it is toxic by ingestion and can easily contaminate the environment. - Both ethylene glycol (used in cooling systems) and propylene glycol (used in heating systems) are considered hazardous despite toxicity differences. - Waste Antifreeze has the potential to contain heavy metals, which are toxic in the natural environment. - Waste antifreeze can be recycled by registered companies or on-site using special equipment. Additives and filters can also be used to extend the life of antifreeze. - Store waste antifreeze as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT</u>. - When transporting waste antifreeze use the following shipping information: <ul style="list-style-type: none"> WASTE TOXIC LIQUID, ORGANIC, N.O.S. (Waste Propylene/Ethylene Glycol) Class: 6.1 PIN: UN2810 Packing Group: I, II or III Special Provisions: 16 for I, 16 or 23 for II and III - The type of glycol must also be added to the shipping name (propylene or ethylene). - Transport the containers to a registered recycling or disposal facility. Do not landfill antifreeze, especially in landfills, which employ a permafrost protective barrier. Do not pour antifreeze into sewers or drains because it can destroy the bacteria that treat sewage.
Guideline for the Management of Waste Asbestos	Fibrous asbestos	<ul style="list-style-type: none"> - Waste asbestos is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Store waste asbestos as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT</u>. - When transporting waste asbestos use the following shipping information: <ul style="list-style-type: none"> ASBESTOS WHITE / BLUE / BROWN PIN: UN2590 / UN2212 / UN2212 Classification: 9 Packing Group: III / II / II

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - The removal of asbestos materials requires a thorough understanding of potential hazards and measures available to prevent worker, public and environmental exposure to asbestos fibres. - The <u>Asbestos Safety Regulations</u> require that employers conducting an asbestos removal project provide proper training to workers likely to come in contact with asbestos. - Asbestos can be landfilled if 0.5 m of cover is placed on the waste immediately. It must be buried where it will not be disturbed and mapped for future reference. - An asbestos abatement expert can be contracted to remove the material.
Guideline for the Management of Waste Batteries	<p>Batteries (lead acid, potassium hydroxide, nickel cadmium)</p> <p>*Does not include dry cell batteries</p>	<ul style="list-style-type: none"> - Waste batteries are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Store waste batteries as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT</u>. - Transport of waste batteries (ensure no leakage): <ul style="list-style-type: none"> - in sealed, upright drums with adsorbent material, cardboard, or plywood between battery layers, or - on a good, solid pallet lined with a large piece of polyethylene plastic (if pallet is rough or has protruding nails cover it with plywood first to protect the plastic); place cardboard or plywood between battery layers, fold the poly over top of the package to seal it, and secure with banding. - When transporting waste batteries use the applicable shipping information as follows: <p style="margin-left: 20px;">WASTE BATTERIES, DRY, CONTAINING POTASSIUM HYDROXIDE SOLID, electric storage PIN: UN3028 Classification: 8 Packing Group: III</p> <p style="margin-left: 20px;">WASTE BATTERIES, WET, FILLED WITH ACID, electric storage PIN: UN2794 Classification: 8 Packing Group: III Explosive Limit: 5</p> <p style="margin-left: 20px;">WASTE BATTERIES, WET, FILLED WITH ALKALI, electric storage PIN: UN2795 Classification: 8 Packing Group: III Explosive Limit: 5</p> <p style="margin-left: 20px;">WASTE BATTERIES, WET, NON-SPILLABLE, electric storage PIN: UN2800 Classification: 8 Packing Group: III Special Provisions: 39 Explosive Limit: 5</p>

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - Batteries should be shipped to a registered recycler or disposal facility.
Guideline for the Management of Waste Lead and Lead Paint	Lead paint	<ul style="list-style-type: none"> - Leaded paint is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Products containing lead in excess of 600 ppm (0.06%) are considered hazardous waste. - Painted steel structures should be sampled for confirmation of lead amended paint and lead concentration prior to sandblasting or other maintenance activities. - Regardless of removal method, total containment of the leaded paint and abrasive debris or paint strippers is required under the EPA. - Store lead compounds in leak proof containers to prevent release into the environment. - When transporting waste lead paint use the following shipping information: WASTE LEAD COMPOUND, SOLUBLE, N.O.S. (Waste Lead Paint) or (Sandblasting Residue) PIN: UN2291 Classification: 6.1 Packing Group: III Special Provisions: 24 Explosive Limit: 5 - Leaded paint and sandblast residue should be transported to a registered hazardous waste disposal facility or a lead or metals foundry.
Guideline for the Management of Waste Paint	<p>Alkyd paint (oil-based paint)</p> <p>Latex paint (water-based paint)</p>	<ul style="list-style-type: none"> - Waste paint is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Paint: includes lacquer, enamel, stain, shellac, varnish, polish, liquid filler, and liquid lacquer base. - Paint related material includes paint thinning or reducing compounds. - Latex paint wastes are not a hazardous waste and can be disposed of into most sewage systems and landfills – municipal approval may be required. - Specialty paints are a mix between a base and a hardener (e.g. epoxy coatings). Consult individual MSDS for disposal instructions. - Store waste latex and alkyd paint separately as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT.</u> - When transporting most waste paint (flammable liquids) use the following shipping information: WASTE PAINT (or Waste Paint Related Materials) PIN: UN1263 Classification: 3 Packing Group I, II or III Special Provision 59 for I, 59 or 83 for II and III

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - When transporting certain specialty paints (corrosive) use the following shipping information: WASTE PAINT (or Waste Paint Related Materials) PIN: UN3066 Classification: 8 Packing Group II or III Special Provision 59 - Less than 5 L of alkyd paint can be allowed to fully dry and be taken to landfill. - Fully dried latex paint may be taken to landfill in any quantity. - Liquid paint should be shipped to a registered recycling or disposal facility.
Guideline for the Management of Waste Solvents	Alcohol or petroleum-based liquids capable of dissolving another substance (e.g. Varsol, paint thinner)	<ul style="list-style-type: none"> - Waste solvents are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Store waste solvents separately as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT</u>. - Bulk drums must be grounded to avoid sparks. - When transporting waste solvents use the following shipping information (with Varsol as an example): WASTE PETROLEUM DISTILLATES, N.O.S. (Waste Varsol) PIN: UN1268 Classification: 3 Packing Group: I, II, III Special Provisions: 16 - Bulk containers should be shipped to a registered recycling or disposal facility.
Used Oil and Waste Fuel Management Regulations	Fuel (diesel fuel, gasoline, aviation fuel, kerosene, naphtha) Oil (transmission fluid, hydraulic fluid, crankcase oil, gear lube oil, lube oil) Grease	<ul style="list-style-type: none"> - Used oil and waste fuel are contaminants under the NWT EPA and must be managed as hazardous waste. - Used oil has the potential to contain heavy metals that are toxic in the natural environment. - Used oil and waste fuel should be bulked in containers as described in the <u>Guideline for the General Management of Hazardous Waste in the NWT</u>. - Used oil and waste fuel should be shipped to a registered recycler. - Waste oil can be burned in a CSA approved oil heating furnace and can be shipped without a waste manifest in the NWT in this special case. - When transporting waste fuel use the following shipping information: WASTE FLAMMABLE LIQUID, N.O.S. (Waste Fuel Oil) PIN: UN1993 Classification: 3 Packing Group: I, II, III Special Provisions: 16

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - When transporting waste oil use the following shipping information: WASTE OIL (Waste Lube Oil) PIN: NA Classification: NA Packing Group: NA
	Used oil filters	<ul style="list-style-type: none"> - Used oil filters must be punctured/crushed and drained of their contents for 24 hours prior to disposal. - Used oil filters do not have to be managed as hazardous waste if properly drained. - All used oil in filters must be drained for 24-hrs into bulk used oil containers. The filters can then be recycled by a registered facility or sent to landfill. - Used oil filters can be crushed using a filter crusher, where available, and then recycled or sent to landfill. - When transporting waste oil filters use the following shipping information: WASTE FILTERS (Fuel Oil or Lube Oil) PIN: NA Classification: NA Packing Group: NA
	Oily Rags	<ul style="list-style-type: none"> - Oily rags or sorbents must be drummed and disposed of at a registered facility. - Some landfarms accept oily rags. - When transporting waste oily rags/sorbents use the following shipping information: WASTE OILY RAGS PIN: NA Classification: NA Packing Group: NA
Environmental Guideline for Contaminated Site Remediation	Contaminated Soil	<ul style="list-style-type: none"> - When transporting hydrocarbon impacted soil with a flashpoint that is unknown or below 610C use the following shipping information: WASTE SOLIDS CONTAINING FLAMMABLE LIQUID, N.O.S. (Gasoline or Diesel, as appropriate) PIN: UN3175 Classification: 4.1 Packing Group: II Special Provisions: 16, 56 - When transporting glycol impacted soil or hydrocarbon impacted soil with a flashpoint higher than 610C use the following shipping information: WASTE SOIL (Gasoline, glycol, diesel or oil) PIN: NA Classification: NA Packing Group: NA Special Provisions: NA

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<ul style="list-style-type: none"> - All contaminated soil should be analyzed for flashpoint prior to transport so that it can be transported as waste soil rather than Class 4.1.
NWT Disposal Guideline for Fluorescent Lamp Tubes	Waste fluorescent tubes	<ul style="list-style-type: none"> - Fluorescent tubes are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Fluorescent tubes contain mercury phosphor powder and traces of lead and cadmium. Compliance with the <u>Canada Wide Standards for Mercury</u> is necessary. - Waste fluorescent tubes should be shipped to a registered recycling/disposal service. - If tubes are not broken and are packaged in their original shipping box, transport as a hazardous waste is not necessary. It is recommended to obtain boxes from the manufacturer if not already on hand. - If tubes are broken compliance with the <u>Guideline for the General Management of Hazardous Waste in the NWT</u> and TDG Regulations is required. - As an alternative to shipping waste bulbs for disposal the ENR Environmental Protection Service (EPS) owns a fluorescent bulb crusher which crushes the bulbs and separates the glass from the contaminants. Contact the EPS for more information.
	Waste mercury vapour bulbs	<ul style="list-style-type: none"> - Mercury vapour lights are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Mercury vapour bulbs contain mercury. Compliance with the <u>Canada Wide Standards for Mercury</u> is necessary. - Waste mercury vapour lights should be shipped to a registered recycling/disposal facility. - If bulbs are not broken and are packaged in their original shipping box, transport as a hazardous waste is not necessary. It is recommended to obtain boxes from the manufacturer if not already on hand. - If tubes are broken compliance with the <u>Guideline for the General Management of Hazardous Waste in the NWT</u> and TDG Regulations is required.
Spill Contingency and Reporting Regulations (under EPA)	All spills	<ul style="list-style-type: none"> - Section 3 - Spill Contingency Plan A spill contingency plan must be implemented and filed with the Chief Environmental Protection Officer for facilities with above ground storage of 20,000 L or 20,000 kg or with a below ground storage of 4,000 L or 4,000 kg. If the facility has less than the above storage, a spill contingency plan should be in place, but does not have to be filed with the Officer. - Section 4 The owner or operator of the facility is responsible for the spill contingency plan. It must include: <ol style="list-style-type: none"> a) the name, address and job title of the person in charge of the facility b) the name, job titles and 24-hour phone number of the person in charge of activating the spill contingency plan c) a description of the facility including location, size and storage capacity d) a description of the type and amount of contaminants stored at the facility

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	Hazardous Waste	Relevant Details in Legislation
		<p>e) a site map of the location described in (c) f) the steps to be taken to report, contain, cleanup and dispose of contaminants in case of spill g) inventory and location of available response and cleanup equipment h) the date the plan was prepared. When a review is completed the plan shall be updated and the Officer shall be alerted.</p> <p>- Section 9 Spills shall be reported when the amount spilled is equal to or exceeds that described in schedule B. Report spills to the 24-Hour Spill Report Line at (867) 920-8130. The following details should be provided regarding the spill: date and time of spill, spill location, direction spill is moving, name and number of contact person close to spill, type and amount of contaminant spilled, cause of spill, whether spill is continuing or has been stopped, description of existing containment, action taken to contain, recover, cleanup and dispose of spilled material, name, address and phone number of person reporting spill, and name of person in charge of contaminants at time of spill.</p>
<p>Consolidation of Pesticide Act</p> <p>Chapter P-2 Pesticide Regulations</p>	Pesticides	<p>- Section 4 - Consolidation of Pesticide Act 1988 No person shall dispose of a pesticide or a container that contained a pesticide in any way except at a site or in the manner that is prescribed in regulations.</p> <p>- Pesticide Regulations: report spills to the 24-Hour Spill Report Line (867) 920-8130.</p>
<p>Guideline for Industrial Waste Discharge in the NWT</p>	Ash	<p>- Each 205L drum of ash collected from an incinerator must be sampled independently and sent to a registered laboratory for analysis before it can be discarded at a sanitary landfill or registered disposal facility.</p> <p>- Residues of incinerator ash must pass the leachate extraction test described in the Guideline for Industrial Waste Discharges in the NWT, Schedule IV before it can be sent to a sanitary landfill.</p> <p>- Ash residues that fail the leachate extraction test must be handled as a Hazardous Waste accordingly and sent to a registered disposal facility.</p>
<p>PCB Regulations under the Canadian Environmental Protection Act, 1999</p>	<p>Streetlight ballasts (capacitors) manufactured before 1979</p>	<p>- Many capacitors found inside fluorescent streetlight ballasts manufactured before 1979 contain high levels of PCB (Polychlorinated Biphenyls).</p> <p>- Check the date code on the ballasts to determine the year it was manufactured.</p> <p>- If the ballast was manufactured before 1979 the ballast must be shipped as a hazardous waste to a registered treatment facility for disposal.</p> <p>POLYCHLORINATED BIPHENYLS (PCB) PIN: UN2315 Classification: 9 Packing Group: III</p>

APPENDIX C

SAFE WORK PRACTICE 2.04 – FUEL AND BULK PRODUCT TRANSFER

1 Purpose	To outline the safety requirements for conducting fuel transfers.
2 Application	Applies to all NTPC employees and contractors involved in transferring fuel between tanks, trucks, and/or barges.
3 Definitions	<p>Static Electricity</p> <p>Static is the electricity produced on dissimilar materials through physical contact and separation. A spark generated by it can ignite flammable vapour. A static electrical charge can build up during refuelling when the fuel moves through a pipe.</p>
4 References	<ul style="list-style-type: none"> • SWP 4.06: Skin Protection
5 Equipment	<ul style="list-style-type: none"> • Spill Kit • Fire Extinguisher • Approved grounding devices • Hoses and hardware
6 PPE	<ul style="list-style-type: none"> • High-visibility vest • Work gloves • Coveralls or long-sleeve shirt and pants • CSA-approved safety glasses • CSA-approved foot protection
7 Training	<ul style="list-style-type: none"> • On-the-job training • Spill Response Training
8 Work Practice	<ul style="list-style-type: none"> • Before the start of any work a Tailboard Meeting shall be conducted with all individuals involved in the transfer process and documented on <i>Form 2.3: Tailboard Meeting</i>. • The worker responsible for the transfer process shall notify the person in charge of the site (e.g., Plant Operator, Plant Superintendent, Manager, etc.) to receive approval to begin the transfer. The worker shall also notify the person in charge of the site after the transfer is complete. The date, start time and end time of the transfer shall be recorded in the Plant Log Book. • Workers conducting the transfer shall wear the appropriate personal protective equipment, including coveralls or long-sleeve shirt and pants, high-visibility vest, work gloves, CSA-approved safety glasses, and CSA-approved foot protection. • To prevent overfilling, before the start of the transfer the amount of fuel in the tank must be determined (e.g., tank

	<p>dip).</p> <ul style="list-style-type: none"> • The worker responsible for the transfer process shall remain onsite throughout the process. • While a fuel transfer is in process all sources of ignition including smoking shall be kept a minimum of 6 meters (20 feet) away from the fuel truck and the fuel transfer point. • The worker shall immediately shut down the transfer process in the event of a system failure, fault, leak, spill or fire. • In the event that the worker responsible for the transfer process must leave the immediate transfer area, the transfer process shall be stopped and the transfer point shall be locked. • If the worker responsible for the transfer process leaves the site during a transfer without stopping the transfer and locking the transfer point, the worker shall be subject to discipline up to and including dismissal. • Transfer points shall be locked at all times except during the transfer process. • Prior to refuelling the refuelling system must be inspected to ensure it is properly grounded and bonded. Grounding devices shall be installed to safeguard against the build-up of static electricity. • Emergency equipment including fire extinguishers and spill kits shall be available throughout the transfer process and shall be inspected prior to each transfer. • The local transfer procedure specific to the site and product shall be followed. This includes: <ul style="list-style-type: none"> ○ Properly calculating the amount of fuel to be transferred and documenting the volume on <i>Form 2.3: Tailboard Meeting</i> ○ Flow rates ○ Emergency shutdown procedures ○ Emergency and spill response procedures • After completion of the fuel transfer all hoses shall be disconnected, drained into an appropriate container, and securely blanked.
9 Documentation	<ul style="list-style-type: none"> • Plant Log Book • <i>Form 2.3: Tailboard Meeting</i>

Development

Name	Position	Date
Prepared by: P. Pascoe	Pozniak Safety Associates	Jul. 15, 2014
Reviewed by: J. Clark	Environmental Analyst	Jul. 30, 2014
Approved by: E. Smith	Director, Health, Safety & Environment	Aug 15, 2014

Revision History

#	Revised Sections	Description of Revisions	Revised by (name, position)	Approved by (name, position)	Issue Date
01					
02					
03					
04					
05					
06					
07					

APPENDIX D
WASTE ACCUMULATION LOG

APPENDIX E

HAZARDOUS MATERIALS / WASTE STORAGE INVENTORY LOG



WASTE STORAGE INVENTORY

Year		Drum ID (plant - unique drum # - year, e.g., 120-01-10)			# of Drums		
Plant					Full	Empty	Initials
Month	Oil	Shipped					
		Stored					
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
	Oil	Shipped					
		Stored					
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
	Oil	Shipped					
		Stored					
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
	Oil	Shipped					
		Stored					
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				

APPENDIX F
SAFETY INSPECTION REPORT



Health & Safety Management System Form:
Safety Inspection Report

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Monitor:
Director, Health, Safety & Environment

Form #:
9.2

Inspection Details

Location:	Plant:
Inspected by:	Date:

#	Inspection Item	Y	N	NA	Notes
1.0	Housekeeping				
1.1	Are all buildings clean & organized inside?				
1.2	Are all walkways and doorways clear and free of debris?				
1.3	Is the yard clean & organized with no vegetation control required?				
1.4	Is the transformer storage platform solid and well-organized?				
1.5	Is the pole storage rack solid and well-organized?				
1.6	Are garbage cans fire resistant with self-closing lids? Emptied at the end of each day?				
1.7	Are all spills and leaks cleaned up?				
1.8	Are floors clean and tidy and free of slippery substances (e.g., water, oil, grease)?				
1.9	Are windows clean, both inside and outside, and kept obstruction free?				
2.0	Storage				
2.1	Are tools and materials properly stored in racks, shelves, and bins wherever possible?				
2.2	Are commonly used and heavy items stored between mid-thigh and shoulder height?				
2.3	Are floors around racks, shelves, pallets, etc. clear?				
2.4	Are racks, shelves, pallets, etc. kept in good condition?				
2.5	Are storage areas safe from falling objects?				
2.6	Are storage racks, shelves, etc. free of sharp edges?				

#	Inspection Item	Y	N	NA	Notes
2.7	Is there a safe means of accessing high shelves?				
3.0	Tools & Equipment				
3.1	Are tools & equipment maintained in good condition, clean, suitable for intended use?				
3.2	Are all necessary machine guards in place?				
3.3	Are spill pads, drip trays, and crankcase vent containers emptied or replaced as required?				
3.4	Are batteries free of leaks with terminals clean and protective covers in place?				
3.5	Are line & electrical tools available, properly stored, certified, and in good condition?				
3.6	Is rigging & lifting equipment available, properly stored, certified, in good condition?				
3.7	Are compressed gas cylinders undamaged, stored upright, and secured?				
3.8	Are pipes (outdoor & indoor, connections, valves) leak-free, colour coded, and properly painted?				
3.9	Are flex connections in alignment?				
3.10	Are valves and piping tight, plugged, blanked, and/or locked where applicable?				
4.0	Personal Protective Equipment (PPE)				
4.1	Is all PPE available onsite (hard hats, safety glasses, rubber gloves, hearing protection)?				
4.2	Is all PPE properly stored?				
4.3	Is all PPE clean?				
4.4	Is all PPE in good condition?				
4.5	Is all PPE correctly used?				
5.0	Emergency Equipment				
5.1	Is the Emergency Response Plan available onsite and current?				

#	Inspection Item	Y	N	NA	Notes
5.2	Is the Spill Response Plan available onsite and current?				
5.3	Is the Hazardous Waste Management Plan available onsite and current?				
5.4	Are the NWT Safety Act & NWT Occupational Health & Safety Regulations available onsite?				
5.5	Are emergency phone numbers posted and up-to-date?				
5.6	Are emergency lights functional for a 30 second test?				
5.7	Are eyewash stations available and functional with the solution changed every 6 months?				
5.8	Are fire extinguishers available, charged, and inspected monthly?				
5.9	Are fire extinguishers secured on the wall and not free standing?				
5.10	Are 1 st aid kits available, inspected monthly, fully stocked, with outdated items replaced?				
5.11	Are AED (automated external defibrillator) pads, batteries checked monthly for expiry?				
5.12	Is access to extinguishers, eyewash, 1 st aid kits, and AEDs free and unobstructed?				
5.13	Are exits clearly marked with functional exit signs?				
5.14	Are exits functional and free from obstructions?				
6.0	Chemicals				
6.1	Are Safety Data Sheets (SDS) available and up-to-date within the last 3 years?				
6.2	Are all chemicals properly labelled and stored in proper containers (as per WHMIS)?				
6.3	Are all flammable products stored in proper containers and kept in a flammable cabinet?				
6.4	Are unused or unnecessary substances disposed of in a safe manner?				
6.5	Are all chemical containers and drums leak free?				



Health & Safety Management System Form:
Safety Inspection Report

Monitor:
Director, Health, Safety & Environment

Form #:
9.2

#	Inspection Item	Y	N	NA	Notes
7.0	Building				
7.1	Are buildings in good condition on the inside with no repairs required?				
7.2	Are buildings in good condition on the outside with no repairs required?				
7.3	Are floors level and well maintained with no projecting surfaces and no tripping hazards?				
7.4	Is ventilation equipment clean, obstruction free, well maintained, and fully functional?				
7.5	Is the air temperature comfortable?				
7.6	Are all inside & outside lights functional?				
7.7	Do existing lights provide adequate lighting?				
7.8	Are all necessary warning signs in place with no new or additional signs required?				
7.9	Are all signs and notices in good condition?				
7.10	Are employee facilities (e.g., washrooms, lockers, crew trailers) clean, tidy, maintained, and adequate?				
8.0	Security				
8.1	Are all fences in good condition with barbwire intact?				
8.2	Are all gates and doors kept locked when unattended?				
8.3	Are all doors and locks in working order?				
9.0	Electrical				
9.1	Are ground connections present and in good working condition?				
9.2	Are electrical boxes & breakers properly covered?				
9.3	Are all electrical plugs and switches in good condition?				
9.4	Are all electrical cords in good condition?				
9.5	Are all power tools in good condition?				



Health & Safety Management System Form:
Safety Inspection Report

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Monitor:
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Form #:
9.2

#	Inspection Item	Y	N	NA	Notes
9.6	Is all temporary wiring properly routed?				
10.0	Work Protection				
10.1	Are sufficient Work Protection tags and forms available onsite?				
10.2	Is the Work Protection Log book available and up-to-date?				
10.3	Are all Single Line Diagrams posted and up-to-date?				
11.0	Hazardous Waste Storage Area				
11.1	Are all wastes properly separated to ensure no mixing of wastes?				
11.2	Are all waste storage containers in good condition, lids securely in place, no leaks?				
11.3	Are all waste containers labelled clearly and accurately?				
11.4	Are spill response materials available onsite (e.g., spill kits, sorbents, hand tools, PPE)?				
11.5	Are all sources of ignition kept away from the waste storage area?				
11.6	Is a fire extinguisher kept close to the waste storage area, inspected monthly, charged?				
11.7	Does the storage area have proper drainage to prevent leaks/spills from leaving the site?				
11.8	Is the <i>Waste Accumulation Log</i> up-to-date?				
11.9	Is the <i>Waste Storage Inventory Log</i> up-to-date?				

Provide completed form to manager.



Health & Safety Management System Form:
Safety Inspection Report

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Monitor:
Director, Health, Safety & Environment

Form #:
9.2

Corrective Actions (to be assigned by manager and followed up until completed)

Manager:

Signature:

Date:

#	Corrective Action	CMMS #	Resp. Party	Due Date	Completed
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

APPENDIX G

ENVIRONMENT CANADA TECHNICAL DOCUMENT FOR BATCH WASTE INCINERATION



Environment
Canada

Environnement
Canada



Technical Document for Batch Waste Incineration

January 2010

Canada

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Aussi disponible en français.

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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.

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

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.

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.

1.0 Introduction

1.1 Purpose

This *Technical Document for Batch Waste Incineration* was developed to provide guidance for owners and operators of batch waste incinerators regarding proper system selection, operation, maintenance and record keeping, with the goals of assisting them in achieving the intent of the Canada-wide Standards (CWS) for dioxins/furans and mercury, and reducing releases of other toxic substances. This technical document focuses on batch waste incinerators ranging in size from 50 to 3,000 kg of waste/batch. 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 revealed that, when properly operated and maintained, these systems are capable of meeting the CWS for dioxins/furans (80 pg I-TEQ/Rm³ @ 11% O₂) and mercury. Stack testing can be carried out as required by the regulatory authorities in order to verify that these standards are met.

The document includes:

- A discussion on 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 waste incinerators to meet the intent of the CWS for dioxins/furans and mercury, and to reduce the release of other toxic substances; and
- Recommendations on record keeping and reporting.

Owners and operators are advised to undertake a full review of relevant local legislation and consult with the appropriate regulators before proceeding with any waste management operation.

1.2 Background

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.

This section provides background information on batch waste incineration, including: substances of concern; international and national initiatives; and provincial/territorial initiatives.

1.2.1 Substances of Concern

There are some important potential environmental concerns associated with waste incineration that can be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F), which are persistent organic pollutants (POPs), and mercury.

Dioxins and Furans

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F), commonly known as dioxins/furans (D/F), are toxic, persistent, bioaccumulative, and result predominantly from human activity.

Data from the measurement of dioxins/furans in the North shows that these chemicals are frequently found at concentrations far in excess of those that might be explained by local production. With the increased social and economic development in Canada's North, it is important to control these persistent chemicals.

Dioxins and furans can be generated from incomplete combustion resulting from the use of inadequate technology and/or operating the incinerator improperly.

Mercury

Another possible contaminant released from incinerators is mercury. Mercury bio-accumulates in the environment and, like POPs, is found in polar regions at higher concentrations than can be explained by local anthropogenic releases.

Mercury is not emitted from the incinerator unless items containing mercury are placed into the incinerator. The best method to control mercury releases is therefore to limit the amount of mercury in the waste fed to the incinerator.

1.2.2 International and National Initiatives

Over the years, Canada has participated in numerous initiatives to reduce dioxins and furans as well as mercury releases such as:

- Stockholm Convention on Persistent Organic Pollutants;
- CCME Policy for Management of Toxic Substances;
- Federal Toxics Substances Management Policy (TSMP),
- Canada Wide Standards for Dioxins and Furans;
- Canada Wide Standards for Mercury; and,
- Chemicals Management Plan.

Stockholm Convention on Persistent Organic Pollutants

Canada is a Party to the Stockholm Convention on Persistent Organic Pollutants (POPs), which entered into force in May 2004. The Stockholm Convention sets out a range of measures to reduce and, where feasible, eliminate POP releases².

Incineration was identified as a potential source of the POPs listed in Article 5 of the Stockholm Convention. Article 5 of the Convention requires Parties to take measures to reduce, and where feasible, eliminate releases of unintentionally produced POPs, including dioxins, furans, hexachlorobenzene (HCB) and dioxin-like polychlorinated biphenyls (PCBs) which are “*unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions*”.

Article 5 also requires that Best Available Techniques (BAT) and Best Environmental Practices (BEP) be applied for both new and substantially modified sources. “Best Available Techniques” are defined as using the most effective and advanced techniques that can be practically adopted to:

- *prevent or minimize* harmful emissions of by-product POPs and other environmental impacts; or,
- *reduce* by-product POPs releases to acceptable limits.

“Best Available Techniques” techniques can be applied by an operator to a specific facility since they have been developed to a state that they are economical and technically viable. Similarly, “best environmental practices” implies the application of the most appropriate combination of environmental control measures and strategies. Annex C states that for the purposes of the Convention there are a series of measures that are appropriate:

“Improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste.”

CCME Policy for Management of Toxic Substances and the Federal Toxics Substances Management Policy

Canada took steps to improve the management of POPs even before the Stockholm Convention was adopted. Polychlorinated dioxins-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were designated as Track 1 substances and scheduled for virtual elimination from the Canadian environment under the 1995 federal *Toxic Substances Management Policy*³ and the 1998 CCME *Policy for the Management of Toxic Substances*⁴.

² At the Conference of Plenipotentiaries on the Stockholm Convention on Persistent Organic Pollutants, held May 22 to 23 2001 in Stockholm, Sweden, the Convention was adopted and opened for Signature. It remained open for signature at the United Nations Headquarters, Treaty Section, in New York, until May 22, 2002. Available on-line at: <http://chm.pops.int/>

³ Environment Canada, Toxic Substances Management Policy. 1995. Available at <http://www.ec.gc.ca/toxics/TSMP/en/tsmp.pdf>

⁴ CCME, 1998. CCME Policy for the Management of Toxics Substances. January 29, 1998. Available at http://www.ccme.ca/assets/pdf/toxics_policy_e.pdf

PCDD/F are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999*⁵.

Under the federal 1995 *Toxic Substances Management Policy* and the 1998 *CCME Policy for Management of Toxic Substances*, mercury was designated as a Track 2 substance. As such, mercury must be managed through its life cycle to minimize releases. Mercury is on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act* (CEPA 1999).

Canada-wide Standards for Dioxins and Furans

The Canadian Council of Ministers of the Environment (CCME) examined the incidental release of dioxins and furans in emissions from various combustion systems. This led to the development of the *Canada-wide Standards for Dioxins and Furans*, which were adopted by the CCME in 2001. The standards identify incineration for action to reduce emissions, and include specific air emission standards.

In a 2007 review of the Dioxins and Furans Canada-wide Standards for waste incineration⁶, a series of recommendations were made by the Dioxins and Furans Incineration Canada-wide Standards Review Group regarding batch incinerators in remote locations. These recommendations suggest that:

- The company/department should take appropriate measures to ensure good operation and provide adequate records of such operation;
- The company/department should only use incinerators that are equipped with monitoring equipment (temperature probes, differential pressure meters and auxiliary fuel flow) to ensure that proper operation is maintained. The monitoring equipment should be connected to a computer which will continuously log the data recorded;
- All installations should install weigh scales to record the weight of each load charged to the incinerator;
- All data from these systems should be available to inspectors;
- The computerized data acquisition equipment should be integrated with all the operating controls of the incinerator in a manner that would facilitate remote access to the data to enable the manufacturer to assist the operator with trouble shooting the operation;
- Operators should be trained, either through an appropriate site specific training program or through a certification program provided by a qualified body;
- Operators should be instructed to distinguish between broad categories of waste, in terms of their calorific value, and be given clear instructions on how much from each category is suitable for charging to the primary chamber for a given batch;
- All facilities should be required to file, with the appropriate regulatory authority, their annual waste throughput data. This filing should include details on the quantity and disposition of residues discharged from the facility.

⁵ CEPA, 1999. Canadian Environmental Protection Act, 1999. 1999, c. 33 (Assented to September 14, 1999). Available at http://www.ccme.ca/assets/pdf/mercury_emis_std_e1.pdf

⁶ Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review: A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf

Canada-wide Standards for Mercury

The Canada Wide Standards for Mercury Emissions were adopted in 2000 in order to reduce atmospheric emissions derived from both deliberate use of mercury and from incidental releases of mercury⁷. The standards include limits for mercury emissions from waste incinerators.

The Mercury Containing Product Stewardship: Manual for Federal Facilities⁸ provides useful information on how to develop an inventory of mercury within a facility, reducing mercury through life-cycle management practices, and monitoring and reporting on mercury stewardship activities.

Chemicals Management Plan

Canada's efforts to improve the environment have also led to new measures under the Chemicals Management Plan (CMP)⁹, which was first brought forward in 2006. The CMP develops measures to better protect human health and the environment from the risks posed by chemical substances. Since CEPA was adopted, all new chemicals have received rigorous pre-market assessments; however, approximately 23,000 "legacy" chemicals were in use in Canada before CEPA came into effect. The CMP identified a list of 193 substances as priority for action. Industry is required to provide Environment Canada and Health Canada with information regarding these substances on a quarterly basis within the next three years. The information that is received, along with that gathered from other sources, will be assessed and used to decide, if necessary, the appropriate actions required to protect the health of Canadians and the environment.

The Waste Sector has been identified as a sector under the CMP due to potential releases to the environment from incinerators and landfills.

1.2.3 Provincial / Territorial Initiatives

The CWS for both dioxins/furans and mercury have been incorporated into regulations related to new incinerators in various provinces. One example is the Ontario Guideline A-7¹⁰ which incorporated the CWS emission values for new incinerators shortly after they were adopted and Guideline A-7¹¹ which clarified the approach for existing facilities in 2004. In many cases, the adoption of the CWS by provincial regulators has resulted in the closure of older incineration facilities. Some facilities have been upgraded to meet the new standards.

⁷ Canadian Council of Ministers of the Environment (CCME). Canada-wide Standard for Mercury Emissions, 2000. Available at: http://www.ccme.ca/ourwork/air.html?category_id=87

⁸ Mercury-containing Product Stewardship: Manual for Federal Facilities. (2004). Environment Canada. Available at <http://www.ec.gc.ca/Mercury/ffmis-simif/Manual/index.aspx?lang=E>

⁹ Chemicals Management Plan (CMP), 2006 Notice of intent to develop and implement measures to assess and manage the risks posed by certain substances to the health of Canadians and their environment. Under the *Canadian Environmental Protection Act*, 1999. <http://www.chemicalsubstanceschimiques.gc.ca/en/index.html>

¹⁰ Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9. Last revision February, 2004. Available at: <http://www.ene.gov.on.ca/envision/gp/1746e.pdf>

¹¹ Ontario Ministry of the Environment, 2004. GUIDELINE A-8 Guideline for the Implementation of Canada-wide Standards for Emissions of Mercury and of Dioxins and Furans and Monitoring and Reporting Requirements for Municipal Waste Incinerators Biomedical Waste Incinerators Sewage Sludge Incinerators Hazardous Waste Incinerators Steel Manufacturing Electric Arc Furnaces Iron Sintering Plants. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9, August 19, 2004. Available at: <http://www.ene.gov.on.ca/envision/gp/4450e.pdf>

2.0 The Waste Incineration Process

This section provides background information on the waste incineration process in order to provide a basis for understanding the recommendations contained later in the report. This chapter discusses: controlling combustion and emissions; waste incineration technologies; and, general design and operation considerations.

2.1 Controlling Combustion

2.1.1 Overview of the Waste Incineration Process

Gases, liquids and solids containing carbon and hydrogen can be burned. The way each state of matter burns is different. In the context of this document, waste being incinerated is mostly in solid form as opposed to a liquid or a gas.

Most solid fuels contain both volatile materials and fixed carbon. During combustion, two different processes occur: the gaseous volatile materials are released and oxidised; and, the fixed carbon is oxidised.

In the first process, the volatile materials are released by pyrolysis reactions that convert the waste into gases consisting of hydrogen, carbon monoxide (CO), light hydrocarbons and tars. Once released in the high temperature environment, the hydrogen reacts instantaneously with oxygen to form water vapour. The CO oxidises to form carbon dioxide (CO₂) at a slightly slower rate. The hydrocarbons and tars react to form hydrogen and carbon, which in turn are oxidised. The gaseous reactions require oxygen and an elevated temperature. If the gases and the air are not well mixed some of the reactions do not go to completion and tars and other products of incomplete combustion, such as dioxins/furans, can also be released to the flue. Under these circumstances, the stack gases will be cooler and tars and other products of incomplete combustion will condense on the flue walls as soot or tar deposits.

In the second process, the remaining fixed carbon oxidizes and releases CO. This reaction takes longer than the release of the volatile materials because oxygen must diffuse to the material's surface where it can react. The rate of this reaction is proportional to the exposed surface area available.

Throughout the combustion process, the oxidation of CO to CO₂ occurs through reactions with hydroxyl (OH) radicals. If excessive air is present in the combustion zone, the combustion temperature and the concentration of hydroxyl radicals will be reduced and the CO oxidation reaction will be inhibited. This results in elevated concentrations of CO in the exhaust gases. Insufficient air can also lead to high CO concentration because there will be insufficient oxygen to oxidise the CO.

The burning of waste in an incinerator is essentially a rapid oxidation process that generates heat and converts the waste to the gaseous products of combustion, namely carbon dioxide and water vapour, which are released to the atmosphere. At the end of the burning process, there may be residual materials and ash that cannot burn.

2.1.2 Controlling Combustion

Controlling combustion during the waste incineration process is very important for in order to minimize the formation and release of products of incomplete combustion such as dioxins and furans. The intent is to ensure that the combustion process is as complete as possible, yielding residues with little carbon, and stack gases containing only carbon dioxide and water vapour.

Solid waste is generally characterized as heterogeneous, with materials that burn at different rates. The rate of burning is determined by the amount of air added to the waste. When burning waste in a well designed incinerator, air flows are controlled to ensure high temperatures and a clean burn.

Burning is an oxidation reaction that requires a precise amount of oxygen to mix with the material being burned. This is termed the stoichiometric oxygen requirement. There must be just enough oxygen molecules to combine with the carbon and hydrogen from the waste to create carbon dioxide and water. If the quantity of oxygen available is just enough, the temperature generated by the reactions will reach its maximum. If too little or too much oxygen is present, the temperature achieved in the system will be lower.

In batch incinerators, the waste sits stationary on a solid surface referred to as the hearth. The heterogeneous mix of waste on the hearth changes as the waste is reduced to ash through gasification and oxidation reactions. The initial heat required to ignite the waste is supplied by a burner that uses propane, natural gas or oil. Since the fuel supply to the burner is continuous, the burner can stay on indefinitely during the burn cycle. However, this would increase operating costs, and so the incinerator controls shut off the burner once the waste on the hearth has generated sufficient heat to allow the reactions to become self sustaining.

Air must be provided to sustain the combustion process. In batch incinerators, the air is supplied through holes in the incinerator walls. These holes are positioned so that the air is directed to the base of the hearth. In larger continuously operated incinerators, these air ports are under the fuel bed. In either case the air introduced in this manner is termed “under fired” air to denote where it is injected. Air must also be added above the hearth to burn the gases generated. This air also enters through air ports, and is referred to as “over fired” air. In dual chamber incinerators the over fired air is added in the secondary chamber. It is not sufficient just to add the over fired air, it must be well mixed with the volatile gases to ensure good combustion. This mixing is typically accomplished by passing the volatile gases through a “flame port” that is smaller than the primary chamber dimensions. Air can be added in the flame port or immediately after it. The flame port increases the gas velocity and introduces turbulence into the gas stream to promote mixing.

The oxidation reactions require a finite amount of time for completion, meaning that the duration of exposure at elevated temperatures must be controlled. Since batch incinerators typically lack any mechanism for agitating the waste, the temperature in the system must be maintained by re-igniting the primary burner. The combustion cycle for a batch waste incinerator is thus set to ensure maximum carbon reduction of the waste on the hearth.

The type of waste incinerated can have significant implications for the control of combustion. Paper and plastics have a higher energy value and require more air to complete the combustion process. Food wastes, with lower energy levels, require less air to complete the burning process. However, the moisture in food waste has to be evaporated before the carbon can sustain combustion. Thus, food wastes must be heated for longer periods before the combustion process commences and the primary burner can be shut off.

Combustion in the secondary chamber of a dual chamber incinerator will respond to the quantity of volatile gases present. As the volatile gas release rate drops, the temperature in the secondary chamber will also drop. To address this issue, most batch waste incinerators are equipped with secondary chamber auxiliary fuel burners. These burners maintain the desired temperature in the secondary chamber and assist with heating the incinerator during start up. The secondary chamber is typically sized to provide the gases with a one second residence time at 1000°C.

2.1.3 Reducing Dioxin and Furan Emissions

Emissions of air contaminants from batch waste incinerators are a function of the design and operation of the equipment, and the nature of the materials being processed. Heavy metals present in the waste will be released with the exhaust gases. If there is mercury in the waste, mercury will be found in the emissions. If no mercury enters the incinerator, it cannot exit the stack. However, the same approach cannot be used to reduce the emissions of POPs, and in particular, dioxins and furans (PCDD/F).

It is known that at temperatures in excess of 600°C, any PCDD/F will be destroyed. However, even in incinerators with good combustion there is a potential for PCDD/F formation due to *de novo* synthesis reactions. *De novo* reactions occur at temperatures in the 250 - 450°C range when stack gases and fly ash are in contact for periods exceeding a few seconds. It has been postulated that residual carbon in the fly ash reacts with components in the exhaust gases to form PCDD/F. Given this behaviour, it should not be surprising that facilities with low temperatures have been identified as those having higher PCDD/F emissions.

Chemical reactions are driven by concentration gradients, so the higher the concentrations of carbon and fly ash the more likely the reaction will produce high emissions. Similarly, incinerators with higher concentrations of fly ash in zones with lower temperatures are anticipated to produce significantly more *de novo* reactions.

Carbon monoxide (CO) concentrations in the exhaust gases are a good indicator of combustion efficiency. Most incinerators can be adjusted to give a minimum CO concentration. For batch waste incinerators, CO concentrations should be below 50ppm. If the incinerator is not operated appropriately (for instance, if the waste has a high calorific value and insufficient air is provided to complete the combustion process), CO levels will rise and black smoke will be released. Such smoke will contain large quantities of carbon that can react to produce higher PCDD/F emissions. Conversely, if the waste cannot create enough heat in the primary chamber to achieve the target temperatures, perhaps because too much air is leaking into the incinerator, there will be zones in the incinerator where temperatures could be in the *de novo* reaction range. The extra air can also entrain particulate matter from the hearth raising fly ash levels in the gas stream. The result will be higher PCDD/F concentrations than might be found in a properly operating system.

2.2 Waste Incineration Technologies

A waste incinerator is a system constructed to thermally treat (i.e. combust or pyrolyze) a waste for the purpose of reducing its volume, destroying a hazardous substances or pathogens present in the waste. There are two main types of waste incinerators: batch and continuous. Batch waste incinerators are loaded with waste through an open door which is then closed

before the waste is ignited. The door remains closed until the ash residues remaining on the hearth have cooled and can be safely removed. The duration of a batch waste incinerator cycle is measured in hours. In comparison, continuously operated incinerators receive fresh waste and discharge ash residues periodically throughout their operation, which can last from weeks to months. This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 to 3,000 kg of waste/batch.

For facilities incinerating more than 26 tonnes of waste per year (tpy), the preferred incinerator for new installations is the dual chamber controlled air incinerator. The dual chamber controlled air incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. They are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and particularly dioxins/furans. Figures 2.2 and 2.3 illustrate the design of a typical dual chamber controlled air incinerator.

Batch waste incinerators have a zone where the waste is ignited and mixed with air to promote combustion, and a second zone where additional air is added to complete the combustion process. In large continuously operated incinerators, the energy available in the hot exhaust gas stream may be recovered in a heat recovery steam generator (HRSG) or hot water boiler. The steam generated can be used to produce electricity or it can be used for process or space heating. Heat recovery is not recommended for batch waste incinerators, as it lowers the gas temperatures in the system and can lead to *de novo* synthesis formation of PCDD/Fs.

Large continuously operated incinerators are equipped with air pollution control (APC) systems to treat the hot gases leaving the heat recovery system. The gases leaving the heat recovery system are cooled by a fine water mist to reduce the size of the required air pollution control equipment and to protect the incinerator from high gas temperatures. If a large continuously operated incinerator is not equipped with a heat recovery system, a rapid water quench system is used to achieve the desired gas temperatures. Such quenching will limit the potential for *de novo* synthesis of PCDD/Fs because the gases do not remain in the critical temperature range for sufficient time to allow the *de novo* reactions to proceed.

APC 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 in excess of 700°C to reduce the chances of inadvertent formation of PCDD/F through the *de novo* synthesis process.

After the waste has been oxidized in the primary chamber, residues, generally referred to as bottom ash, must be removed. Bottom ash from well-operated incinerators has been shown to contain low PCDD/F concentrations (<20 pg TEQ/g of bottom ash). Solid residues deposited in the heat recovery system of large continuously operated incinerators typically have <50 pg TEQ/g of PCDD/F whereas residues from air pollution control systems typically have <300 pg TEQ/g of PCDD/F. The deposits from heat recovery systems and air pollution control systems are generally referred to as fly ash because the ash has travelled suspended in the exhaust gases. Because of low gas velocities, batch waste incinerators create much less fly ash than large continuously operated incinerators.



Figure 2.2 Typical Controlled Air Dual Chamber Incinerator

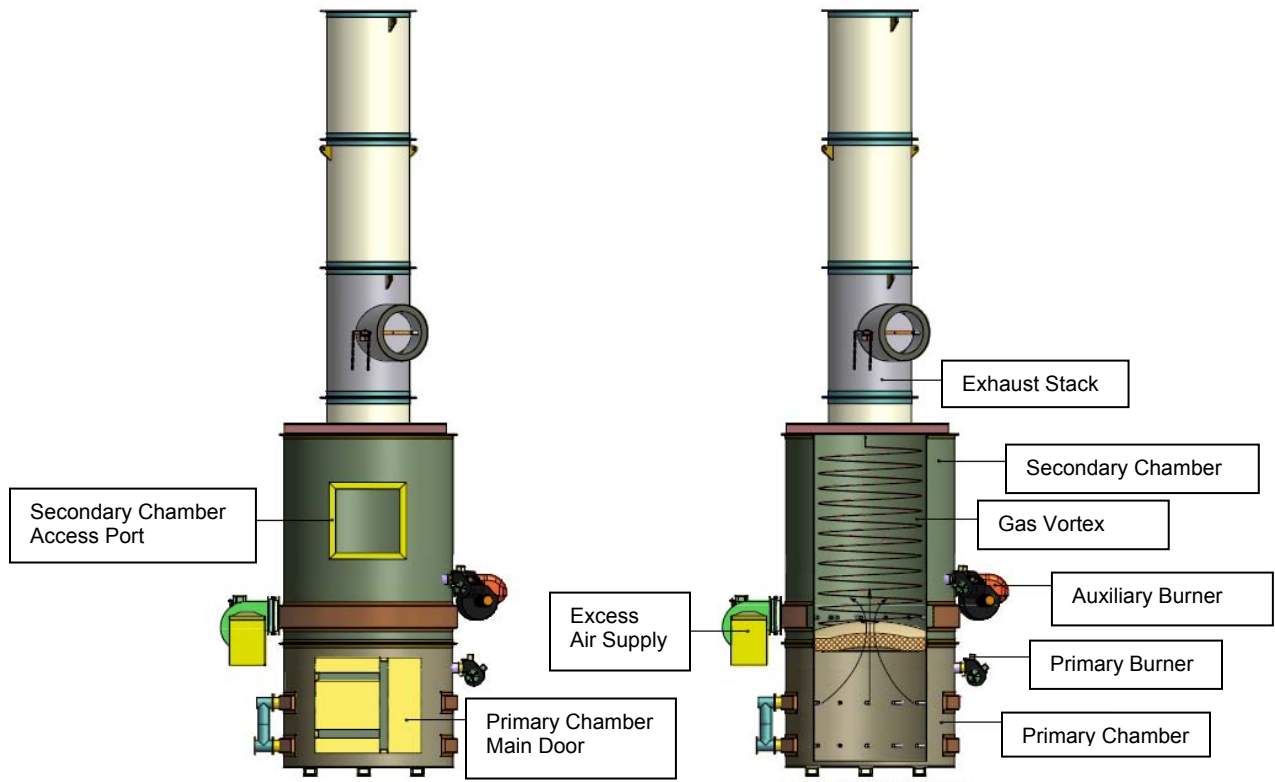


Figure 2.3 Schematic of Typical Controlled Air Dual Chamber Incinerator

2.3 General Design and Operation Considerations

2.3.1 Design and Operation

The design features addressed below are deemed to be most important for those contemplating buying a dual chamber controlled air batch incineration system. As mentioned previously, the emphasis is on batch waste incinerators that are capable of disposing of up to 3,000 kg of waste per batch.

The degree to which the combustion process is completed is a function of:

- the temperature the combusting gases reach;
- the length of time the gases remain at elevated temperatures;
- how well the air and the gases are mixed; and
- whether there is adequate oxygen to permit complete combustion.

Combustion temperatures downstream of the primary chamber and the residence time for gases at this temperature are frequently specified in regulations. In Ontario, for example, waste incinerators must provide a 1 second residence time for gases at 1,000°C¹². In the European Union, the requirements are two seconds at 850°C¹³. These values reflect operating conditions in incinerators with low emissions.

The incinerator designer has more discretion in defining the temperatures in the primary chamber. Primary chambers are designed with consideration of the wastes that will be destroyed. Materials that are harder to burn require higher operating temperatures. The design temperature is governed by the rate at which heat is released in the primary chamber, which is known as the target volumetric heat release rate and expressed in MJ/m³/hour. This value is based upon the calorific value of the waste in MJ/kg, the quantity of waste to be charged to the incinerator in kg/batch, and the volume of the primary chamber in cubic metres. The operating temperature in a system provides a limit for the volumetric heat release rate. For the typical dual chamber incinerator, the primary chamber should operate in the 500 – 800°C range.

Since the temperatures achieved in a specific primary chamber are a function of the heat release rate and the waste mass, it is important that the incinerator be loaded with waste that matches its particular design characteristics. It should be remembered that by design, incinerators are heat release limited devices. Too little heat and the material will not burn properly; too much heat will lead to damage to the incinerator. When the appropriate amount of energy is introduced into the primary chamber, the primary chamber temperature in a batch waste incinerator can be controlled principally through adjusting the air to fuel ratio.

Air addition to the primary and secondary chambers of batch waste incinerators will result in exhaust oxygen concentrations in the range of 6 – 12%. Operation in this zone will minimize the release of CO and thus also minimize trace organic releases. This range can be reduced based upon testing of a given system to produce minimum CO levels. Maintaining oxygen

¹² Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Solid Waste Incinerators.

¹³ Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste. 2000.

concentrations within the manufacturer's recommended range will ensure that the system is operating at in the most efficient manner.

As noted, temperature control involves regulating the air to fuel ratio. To lower the temperature, more air is added, up to the maximum flow. Alternatively the auxiliary fuel flow rate can be reduced. The primary chamber of a batch waste incinerator is designed for a waste mass of a certain calorific value. The air supply system is sized to provide the appropriate level of excess air to control the temperature to the desired level, even if the heat input varies from design.

It is considered poor practice to introduce wastes at either extreme of the calorific value range if good combustion is the objective. In order to prevent any situation where the temperature might be damaging to the primary chamber, the quantity of high calorific waste in any charge must be limited. Wastes should be mixed to achieve a relatively uniform heating value close to the design point of the unit. If the operator controls the quality of the waste mix, any variability in the rate that the waste burns can usually be managed by the control systems of the incinerator.

2.3.2 Heat Recovery

In most cases, batch waste incinerators should not be equipped with heat recovery because this can lower temperatures and lead to *de novo* synthesis formation of PCDD/Fs.

2.3.3 Air Pollution Control Systems

Air Pollution Control (APC) systems with evaporative cooling towers and dry scrubbers are seldom recommended for small batch fed incinerators for two main reasons:

- Due to the non-continuous nature of batch waste incineration, gas temperatures will vary from ambient to operating levels as high as 1,200°C each time the system is operated. When not at high temperature, condensation can occur and cause corrosion in the system. Furthermore, deposits remaining in the duct work during the cool down phase pass through the *de novo* synthesis temperature and can increase the production of PCDD/Fs.
- Since the non-continuous nature of batch waste incinerator operation generally makes it impractical to install a heat recovery system, there will be no initial cooling of the gas stream and higher temperatures will enter the APC system. To prevent equipment damage, some means of rapid gas cooling would need to be installed. This would require large volumes of water, some of which will collect hydrochloric acid and other acidic gases, and would require treatment or at the least re-circulation in the system. In certain areas of the country, obtaining the water and treating it could present significant challenges.

Adding an APC system to a batch waste incinerator will also increase the pressure drop across the system. This will result in the need for induced draft fans to exhaust the combustion gases. The induced draft fan and the air pollution control system will increase the energy requirements of the incinerator.

In most cases, APC systems are not recommended for batch incineration systems to control

PCDD/F emissions. By ensuring good combustion control and exhaust gas temperatures in excess of 700°C, there should be little opportunity for the formation of PCDD/F through *de novo* synthesis

However, in certain jurisdictions and/or operating conditions it may be necessary to employ an APC system. Owners and operators should consult with manufacturers and local regulatory authorities regarding any such requirements.

3.0 The Six-Step Process for Batch Waste Incineration

The recommended Six-Step Process for Batch Waste Incineration includes:

- 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

The Six-Step Process will assist owners and operators of batch waste incinerators, ranging from 50 to 3,000 kg/batch, in achieving the intent of the CWS for dioxins/furans and mercury, and reducing the potential for releases of other toxic substances to the environment.

3.1 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.

3.1.1 Conducting a Waste Audit or Estimating Waste Characteristics

A waste audit is the best way to define the waste stream at a given location. Ideally, an audit should account for seasonal variations in the waste generation rates, so it might have to be conducted in each season.

Performing a waste audit will provide an estimate of the total quantity of waste that could be generated, and allow the user to develop diversion activities that will reduce the amount of material requiring disposal. The residual waste remaining after diversion activities represents the waste requiring disposal. After other disposal options have been investigated, the characteristics of the remaining waste can be used to estimate the energy of the waste that will be charged to an incinerator. This information will be required to select an incinerator.

If the facility is only in the design stage a waste audit cannot be conducted. Even if a facility is operating, the cost of a waste audit could be seen as prohibitive. 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 finalized. Owners should investigate waste generation and diversion data from similar operations / facilities in order to develop an estimate of the waste types and quantities that will be generated at their facility. Sources of such information may include: industry associations; waste industry consultants; provincial / territorial authorities; and, other regulatory bodies.

3.1.2 Choosing Appropriate Waste Management Options

In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option. Facilities should have a Waste Management Plan that outlines waste generation data and defines the acceptable recycling and disposal options. Hazardous waste and hazardous recyclable materials should be handled appropriately in accordance with local, provincial/territorial, and federal legislation.

3.2 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 furans¹⁴ 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.

The results of the waste audit conducted for the site should be provided to incinerator suppliers. Suppliers will be able to use these data to provide the appropriate type of incinerator. However, the owner should consider a number of issues when preparing the request for proposals. These include the type of incinerator that should be installed and the size of the incinerator. These issues are discussed in the following sections.

3.2.1 Classification of Batch Waste Incinerators

The emphasis in this report is on batch waste incinerators having a capacity of 50 to 3000 kg/batch. Even with this restriction there are various configurations of incinerators that could be used as noted in Table 3.2.

¹⁴ Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

Table 3.2 Batch Waste Incinerator Types and Features

FEATURE	TYPE
A. Number of chambers	1. Single-chamber (with afterburner)
	2. Dual-chamber
	a. Excess air in primary chamber
	b. Starved air in primary chamber, excess in secondary chamber
B. Waste feeding mode	1. Batch (one load per cycle)
	2. Intermittent (with ram feeder)
C. Ash removal mode	1. Batch
D. Air Pollution Control	1. No
	2. Yes (variety of technologies)
E. Use of blowers and fans	1. Forced air (blower(s) to supply air to combustion chamber(s))
	2. Combination (blower(s) AND an induced draft fan, necessary for APC systems)
F. Heat Recovery System	1. No
	2. Yes

3.2.2 Incinerator Selection Considerations

New Incinerators

For facilities incinerating **more than 26 tonnes of waste per year (tpy)**, the preferred incinerator for new installations is the dual chamber controlled air incinerator. This type of incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. These incinerators are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and in particular dioxins and furans.

As noted in Table 3.2 there are single chamber incinerators on the market. Suppliers may offer single chamber units equipped with afterburners, but they are not desirable. They are unlikely to provide the low emissions levels achievable by properly sized dual chamber incinerators. A properly sized secondary chamber is required to accommodate the volatile gases that are released from the primary chamber. Small secondary chambers are unlikely to provide sufficient time at elevated temperatures to ensure destruction of volatile compounds.

Another important factor to consider is the frequency of operation of the incinerator. While operating procedures should minimize the release of unwanted contaminants to the atmosphere, even during start-up and shut-down, there is a higher probability of emissions during these transition conditions than during the normal steady-state operation.

Incinerators sized in a way that allow them to operate only on alternate days, or even only 2 or 3 times per week, will generate lower annual emissions than those operated frequently each day. For this reason, a larger incinerator which can be operated less frequently is preferred.

The designer undertakes detailed calculations to size the incinerator and the control systems. Manufacturers recognize that wastes will not be consistent day after day and provide a margin

of safety in their instructions. While the manufacturers would prefer tighter control on the feed rate, it is not unusual to see instructions state that the primary chamber should only be half filled. Based on the waste audit data, the manufacturer assumes a density and heat value for the waste and specifies a safe quantity of material that can be burned in a given cycle.

Existing Incinerators

If an existing incinerator is still being used as originally intended (i.e. the nature of the waste has not changed over the intervening years, and the unit has been properly maintained), consideration could be given to the unit's continued operation. Stack testing of the emissions can determine the incinerator's emission performance and allow the status of the emissions to be compared to the Dioxins and Furans Canada-wide Standards for incinerators.

Annual Throughput Considerations

The Canada-wide Standards for Dioxins and Furans¹⁵ distinguishes incinerators by their capacity and use, setting an annual throughput threshold of 26 tonnes.

Any system capable of handling greater than 26 tonnes per year should have a primary chamber and a large secondary chamber sized to match the nature of the waste characteristics developed from the waste audit.

If the unit is unlikely to process 26 tonnes of waste per year, and a smaller secondary chamber is chosen to facilitate transport, additional care must be taken in ensuring the correct types of wastes and volume of material are charged to the primary chamber. This will reduce the possibility of high PCDD/F emissions.

Special Waste

Special wastes such as liquid waste (e.g. waste oil), wet waste (e.g. kitchen wastes, sludges), and animal carcasses require special consideration when selecting an incinerator. Liquid and wet waste in small quantities can usually be mixed with other wastes, but large quantities of either material will require special provisions.

For instance, waste oil can be used as an auxiliary fuel in an incinerator. Should its use be contemplated to offset virgin oils in the incinerator, this strategy should be made known to the manufacturer. They will recommend appropriate systems to separate sludge and moisture from the used oils, and the installation of two burners in each chamber (one for waste oil and one for virgin oil). These are necessary steps to ensure that temperatures in the chambers can be maintained should operating problems arise with the waste oil burner. In the context of the batch waste incinerators addressed in this report, liquid hazardous wastes, other than oil, should not be injected into the incinerator.

The incinerator hearth should be designed to contain any free liquid anticipated in the waste stream. Free liquids can drain into air ports if they are situated below the liquid level in the incinerator. Liquid may also leak through the doors of a standard flat hearth incinerator and damage their seals. Leaks in other areas can lead to poor combustion performance.

¹⁵

Available at: http://www.ccme.ca/assets/pdf/d_and_f_standard_e.pdf

Wet waste is challenging to handle unless the incinerator is properly designed. For example, it is strongly recommended that batch incinerators not be used to treat sewage waste, unless they have been designed specifically for this type of waste. If it is anticipated that the waste to be incinerated on a routine basis will contain wet wastes, the auxiliary burner may need to be larger to dry the waste in a reasonable amount of time.

Unlike sludges and liquids, animal carcasses should not cause liquid leaks from the primary chamber even though they contain high levels of moisture. They must be handled in incinerators that can accept this type of waste. Animal wastes should only be charged to an incinerator that is capable of completely calcining the bones in order to ensure that all pathogens are destroyed in the incinerator. Those anticipating the need to destroy animal carcasses should discuss their needs with regulators and the manufacturers of waste incinerators.

3.3 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.

3.3.1 Building Considerations

The recommendation from the previous section that incinerators be over-sized so they can be operated on a less frequent basis implies that the facility will need to store waste between incinerator operation periods. The incinerator should be installed in a building with sufficient space for waste storage. Operating the unit in a building will ensure that the operators are more comfortable and thus spend more time ensuring proper operation and conducting the necessary maintenance on the system. Furthermore, it will protect the unit from weather conditions, extend its life, and make operation more reliable.

Care must be taken to avoid the exposure of combustible building material to the high temperatures on the surfaces of the incinerator and the stack. Suitable fire proof insulation and air gaps must be provided to avoid igniting the building structure.

Since combustion reactions require air, provisions should be made to ensure that sufficient fresh air is available in the vicinity of the incinerator. The air flow should be unimpeded by louvers or doors in the building. At the very least, if louvers are required to isolate the incinerator room during power outages, their status should be interlocked to the incinerator controls so the incinerator does not operate when the dampers are closed. The manufacturer's advice should be sought on the fresh air supply requirements for the incinerator. It should be remembered that in extremely cold climates, fresh air impinging upon fuel lines or other parts of the operating system can create operating problems so the air should be properly tempered to minimize equipment freezing and/or staff discomfort.

3.3.2 Equipment Considerations

The operation of the incinerator should be monitored at all times and this data should be recorded to provide a record of such operation. A list of monitoring equipment recommended for all installations follows:

- **Weigh Scale:** Every incinerator operation should have a weigh scale so that every load can be weighed and the results recorded.
- **Continuous Monitoring:** In order to confirm the status of the incinerator at all times, it is recommended that measurements of the parameters described below be continuous regardless of the operational status of the incinerator. Gaps in the readings could be interpreted as periods where the incinerator was not operating in an appropriate manner. Thus, continuous readings, once per minute, are the best way of proving that the system is operating in compliance with the various approvals and guidelines. The measurements should be captured in a computerized data acquisition system that logs the date and time of the readings as well as the readings themselves.
 - **Temperature:** The most basic of all measurements associated with incinerator operation is temperature. Temperature should be monitored in both the primary and secondary chamber and the stack at all times. The sampling location for the stack measurement should be above the barometric damper if one is installed. Such measurements will ensure that the system has achieved the desired temperature levels. Temperatures outside the normal range can serve to warn the operator that the system is not working as intended.
 - **Differential Pressure in the Primary Chamber:** A second operating parameter that is important is the differential pressures in the primary chamber. The

primary chamber should operate at negative pressure. Should the differential pressure track towards the positive, it is an indication that insufficient draft is present in the system and combustion fumes could be building in the system. The operator should be able to adjust this parameter either by changing the inlet flows or adjusting the barometric damper. If the pressure goes too negative, the combustion air fans may have failed, or the damper needs adjustment. The data acquisition system can be programmed to warn the operator of potential draft limitations in the system.

- **Auxiliary burner operation:** The auxiliary fuel burners in some incinerators are not reliable. This type of failure will likely be reflected in lower than desired temperatures in the incinerator. A combination of no fuel flow in the auxiliary burners and low temperatures in either chamber could indicate an auxiliary burner failure. The operator should be able to monitor the auxiliary burner operation.
- **Fan Amperage:** Failure of the combustion air fans will lead to inappropriate operating conditions. Recording the fan amperage will provide some indication that the fans are operating at their design loads.
- **Interlocks:** The data acquisition system should monitor the state of all interlocks on the system. Loading doors and other components of the system are frequently connected to the incinerator control system. Recording the status of sensors on various doors or dampers will assist in confirming the system is operating in the desired manner.

The type of data acquisition system described above can store data and can also be used as a means of allowing the manufacturer to look at operational data remotely to assist with trouble shooting the operation. In this manner, the operator can quickly obtain the assistance of the manufacturer. Owners should request that the manufacturer provide recommendations for the data acquisition system. This will likely open up a line of communication concerning what they can do to help operational staff adjust the incinerator if it is not operating correctly.

Other Considerations

Most batch incinerator systems are factory fabricated and shipped to the site where they are to be used. Larger systems may be shipped in sections to be assembled on the site. Typically the stack will be installed on the incinerator as one of the final steps. Stacks should be properly designed to ensure that emissions can freely disperse in the atmosphere and not be re-entrained into fresh air intakes on nearby buildings.

3.4 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.

3.4.1 Operation

3.4.1.1 General Batch Waste Incinerator Operation Considerations

Effect of Waste Characteristics

The characteristics of the waste loaded to the incinerator will affect the temperature profile in the various sections of the incinerator during the burn cycle. These variations will also influence the duration of auxiliary burner operation.

Wastes with a high percentage of volatile matter (e.g. paper >75%, plastics >85%) will release more volatile gases from the primary chamber than wastes with low percentage of volatile matter (e.g. vegetable wastes <20%). When mixed with additional air in the secondary chamber, the combustion of the volatile gases maintains the secondary chamber operating temperatures and limits the need for auxiliary fuel. At this point in the burn cycle, the temperature in the secondary chamber will be higher than that in the primary chamber. However, as the release of volatile gases from the primary chamber decreases, combustion in the primary shifts and begins to consume the fixed carbon. This results in a drop in temperature in the secondary chamber and an increase in temperature in the primary chamber. The secondary temperature can drop to the point where the secondary chamber auxiliary burner must come on to maintain the temperature at or above the required setpoint, typically 1000°C.

Higher moisture levels in the waste require more auxiliary fuel to evaporate the moisture and allow the waste to burn. The moisture released in this way passes through the secondary chamber taking heat from that chamber as well. This could mean that the secondary burner must operate for longer periods during the early phases of the cycle.

The ash percentage in the waste can also influence auxiliary fuel consumption and overall cycle time. The ash must be heated to sufficient temperatures to drive off volatile gases and the fixed carbon. The ash remaining in the primary chamber retains heat and lengthens the time required for the incinerator to cool so it can be handled safely.

Incinerator Loading

To properly load the incinerator, the following steps need to be followed:

- Determine the source of the waste – kitchen, vehicle shop, bunkhouse area, etc.;
- Weigh the waste to determine how much must be disposed; and,
- Proportion the waste fed to the incinerator on the basis of the anticipated heating value.

The wastes from different operations in the facility would need to be designated, either by colour codes or in different waste containers. Each source would be assumed to produce waste that was similar in composition on a daily basis.

For batch waste incinerators with charge sizes between 50 kg and 200 kg, individual bags of waste can be weighed before they are put into the incinerator.

For larger batch incinerators it would likely be onerous to have to weigh each bag in a 1,000 kg charge and alternative approaches could be adopted. The incinerator building should have a tipping floor sized to allow segregation of the various types of waste streams. All waste arriving at the facility should be weighed before being placed in the appropriate area. Knowing the mass of waste in each pile, the incinerator could be loaded with the appropriate volume of a specific type of waste to create a mixed load that has an appropriate calorific input for the incinerator. Possible mixes could be developed from the waste characteristics so the operator has clear guidance on loading the incinerator. For instance adding some higher calorific value plastic waste to the kitchen waste could reduce the amount of auxiliary fuel needed to evaporate the moisture. It is important to segregate known high calorific value materials so that the quantity of these materials in a batch can be limited.

Controlling Air

Ideal combustion is achieved when the exact amount of air needed to oxidize the carbon and hydrogen in the waste is supplied to the incinerator. This stoichiometric air addition rate will result in the highest temperatures from burning a given batch of waste. If too little or too much air is supplied, the temperatures in the primary chamber will change. Indeed, controlling air is the basis of many batch waste incinerators.

The typical starved air incinerator operates by controlling the primary chamber air injection so that the primary chamber operates under sub-stoichiometric or pyrolytic conditions. The air added to the system is only sufficient for the primary chamber to reach pyrolysis temperatures. This is typically between 70% and 80% of the ideal amount of air needed to burn the waste.

The volatile gases from the primary chamber can be burned in the secondary chamber after being mixed with extra air. The amount of air in the secondary chamber is typically 140% to 200% of the amount required to complete the reaction in the secondary chamber. Part of this excess air is added to control temperatures in the secondary chamber as explained below.

If too little air is supplied to the primary chamber the temperature will drop because the waste cannot burn sufficiently to increase the temperature. The operating ideal is to allow the waste to burn at a rate that generates sufficient volatile gases to maintain the desired temperature in the secondary chamber. If too much air is added in the primary chamber the combustion rate is accelerated and much of the volatile gases will be consumed before they get to the secondary chamber. This will lead to higher temperatures in the primary chamber, premature failure of

refractory and potentially other damage to the incinerator. In turn, because insufficient volatile gases will pass to the secondary chamber, the temperature in the secondary chamber will be lower and the auxiliary burner will need to operate to maintain temperature. Adding additional air to the secondary chamber will decrease the temperature in the secondary chamber, while limiting air addition will raise the temperature. This is opposite to the temperature response to additional air in the primary.

Controlling the amount of air added to the incinerator can be done in a number of ways:

- Manually by the operator;
- Automatically based upon the temperatures in the primary and secondary chambers; and,
- Automatically based upon changes in the oxygen level in the gas stream.

The control methods represent an increasing level of complexity so oxygen sensors are usually found only on larger systems. The operator must understand the cause and effect when making changes to the system and should be present for the duration of the cycle if manually controlling the operation. For this reason, automatic temperature sensing controls are preferred for batch incinerators.

Controlling Temperature

The primary chamber should be operated in the appropriate temperature range (typically 500°C to 800°C) specified by the manufacturer.

During operation, the secondary chamber temperature is controlled by varying the amount of air introduced to the secondary chamber and by operating the secondary chamber burner. As discussed earlier, regulators usually specify the secondary chamber temperature set point in the range of 850 °C – 1000 °C. The secondary chamber temperature set point may vary by jurisdiction and according to the residence time in the secondary chamber. As noted above, adding air to the secondary chamber decreases its temperature, while decreasing the amount of air raises its temperature. A secondary chamber temperature sensor controls the operation of the secondary burner. This sensor has low and high temperature set points that govern burner operation on pre-heating of the secondary. If the temperature drops below the selected set point the burner comes back on to increase the temperature. To avoid having the air and burner control compete with each other, the set point for the air control system is usually set at least 40°C above the burner's high temperature set point.

Typical Problems

Temperatures indicate how the combustion system is performing. Another way to judge the operation of the incinerator is to observe the colour of the flame in the two chambers. Hotter temperatures will drive the flame colour from dull red, through orange to yellow. In the primary chamber any colour brighter than dull red would suggest that too much air is being introduced into the system. In the secondary chamber, red flames indicate a temperature around 760°C, which is generally considered to be too low. An orange flame will be seen in the 1,100°C temperature range whereas at 1,200°C yellow flames are an indication that the temperature is too high for normal waste destruction.

Typical operating problems with batch waste incinerators are:

- **High fuel consumption**

High fuel consumption occurs when the operator is trying to burn extremely moist waste, or when too much air is added to the system.

As noted earlier, water must be evaporated from the wet waste before volatilization can occur. Since heat is not released from the waste until it starts to volatilize, the auxiliary burner must supply the extra energy needed. To reduce energy consumption, one must limit high moisture waste in any particular load.

If the combustion chambers have leaks, excess air will be introduced to the incinerator. Air could enter the incinerator through doors that have become warped due to over heating, or through deformed seals or holes in the incinerator due to corrosion. If excess air is introduced in the primary chamber, the volatile gases will be partially burned in the primary chamber and will not be available to heat the secondary chamber. If excess air enters the secondary chamber, temperatures will drop and the burner will operate for longer periods.

- **The formation of fused ash, or clinker, in the primary chamber**

Clinkers form when localized temperatures of the ash bed lead to melting of the ash and fusing of the melted material. With municipal solid waste, this occurs at temperatures above 1,200°C. While this should be far above the operating gas temperature of the primary chamber (typically 500°C to 800°C), localized bed temperatures can be higher than the gas temperature. Wherever air is introduced into the primary chamber, there will be zones where the stoichiometric amount of air is present for complete combustion. This air addition rate will result in the highest combustion temperatures possible (in excess of 1,500°C). This condition is more likely to occur if a harsh jet of air is introduced into the primary chamber due to blocked air ports. If this occurs, the flames near the bed would be bright yellow. The operator needs to check the air ports and ensure that the air is evenly distributed throughout the primary chamber each time he removes ash from the incinerator. Cleaning the air injection ports will limit clinker formation.

- **Visible stack emissions**

The appearance of the stack plume can also provide some indication of the adequacy of the combustion process. Typically stack emissions increase when there is one or a combination of the following situations occurring:

- The high set point temperature in the secondary chamber is too low;
- Excessive air infiltration;
- Excessive negative draft;
- Excessive primary air addition;
- Excessive secondary air addition; or,
- Waste characteristics that prevent the unit achieving design settings.

Plume Characteristics

Figure 3.2 shows different conditions that may be observed with malfunctioning dual chamber controlled air incinerators.

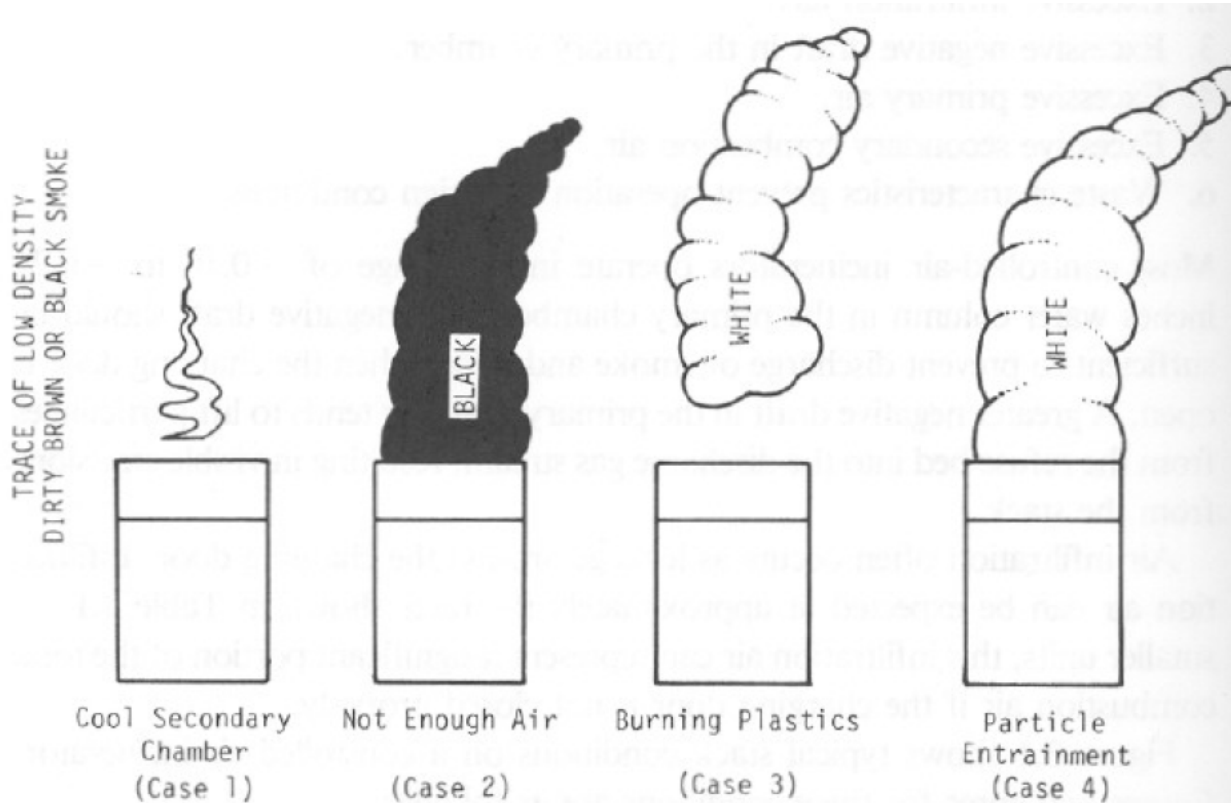


Figure 3.2 Plume Characteristics related to Operating Conditions ¹⁶

Case 1, with traces of dirty brown or black smoke in a wispy plume, generally occurs when the secondary chamber set point temperature is too low. Raising the temperature in the secondary chamber should improve the situation. Secondary chamber temperatures could also be low due to burner failure. Incinerators should not be operated without functioning secondary chamber burners.

Case 2 is the classic “not enough air for the waste being burned” situation as black smoke indicates incomplete combustion. There are a series of steps that the operator should go through to rectify this situation:

- increase the air flow to the secondary chamber to the maximum;
- reduce the air flow to the primary chamber to reduce the rate of volatilisation; and/or
- temporarily increase the set point of the auxiliary burner to 1,200°C to overcome the burning of a very high calorific waste charge.

If the situation persists after these steps have been taken, check the charging capacity for the

¹⁶ Cross, F.R, and H.E. Hesketh, 1985. Controlled Air Incineration. Publishing by Technomic Publishing Company Inc. ISBN No. 87762-396-1

incinerator and the characteristics of the wastes being burned. If the energy content of the waste is very high, the amount of that waste charged to the incinerator will need to be reduced in the future.

Case 3 is a detached white plume that could be the result of burning chlorinated wastes. Hydrogen chloride can cause this type of plume in high concentrations. To rectify this situation, ensure that chlorinated plastics are segregated from the waste stream.

Case 4 is a white plume that persists for long distances downwind. It is indicative of high quantities of fine particulate matter in the stack gases. This can be caused by high rates of air addition to the primary chamber, or by the particular components in the waste stream. If reducing the primary air flow does not rectify this situation, the operator needs to determine the types of materials being burned and take steps to reduce or eliminate their introduction to the system.

High moisture levels in a plume, particularly when exhausting into cold air, will also appear to be white. Water vapour forms a mist as it comes out of the stack and takes on the appearance of a white plume. This plume dissipates rapidly as the plume travel downwind and as the saturated air mixes in the atmosphere reducing moisture levels. The difference between Case 3, Case 4 and a high moisture plume is that typically the moisture plume will only exist for a short distance downstream of the stack. Moreover, the high moisture plume will typically not be visible as the plume exits the stack, but rather appears to form some distance above the stack tip as the vapour condenses in the cold atmosphere.

3.4.1.2 DOs and DON'Ts of Incinerator Operation

It is important to ensure that the incinerator is operating properly according to its design purpose. The following figure provides some significant DOs and DON'Ts to consider when operating a batch waste incinerator.

Some Significant DOs and DON'Ts of Batch Waste Incineration

DO:

- Use specially designed incinerators to dispose of animal carcasses, sewage, liquid wastes, or hazardous waste materials.
- Develop a waste collection and handling program that will allow the operators to mix the waste to provide a uniform heat input to the incinerator;
- Use waste oil and waste fuel for other heating purposes where practical, rather than disposal through incineration;
- Limit the quantity of waste oil or waste fuel in any specific charge to the incinerator to ensure the energy contained in the waste charge is within the limits specified by the manufacturer;

DO NOT:

- Overload the incinerator.
- Put mercury containing waste (e.g. fluorescent lamps, thermometers, thermostats, dental amalgam, batteries) into the incinerator. Limiting the quantity of mercury placed in the incinerator is the most effective way to limit mercury emissions.
- Introduce metal and glass into the incinerator when alternative options exist (e.g. recycling, landfilling). These materials absorb energy from the furnace and increase the wear and tear on various incinerator components.
- Incinerate wastes containing heavy metals (e.g. mercury-containing wastes, wood treated with Chromated Copper Arsenate (CCA), lead paint).
- Incinerate asbestos waste.
- Introduce large quantities of plastics or high calorific wastes into incinerators designed for low calorific value wastes such as animal carcasses and food waste. Incinerators capable of disposing of low calorific value waste are not suited to burning large quantities of high calorific wastes.

3.4.1.3 Standard Operating Procedures

To ensure good operation of the incinerator, there are certain standard operating procedures that should be followed. The list below should serve as a starting point for building the site specific procedures. These procedures must be tailored to the individual facility, and all operators should be trained to follow the site specific version of these procedures.

Cleaning and Loading

- The primary chamber should be cleaned of all ash before any new charge is introduced. Operators should check to ensure that the previous cycle is complete and that the primary chamber has cooled to room temperature before commencing clean out.
- Turn OFF all power to the incinerator before opening the primary chamber door.
- Wear personal protective equipment (gloves, face shield, dust mask) and use appropriate equipment to remove the ash. Rake and shovel the ash from the hearth and place it in a metal container for transport to an approved disposal site.
- Material that was not completely reduced to ash should be placed into the primary chamber for the next burn cycle. If it is necessary to remove this material for inspection and maintenance of the chamber it should be placed in a metal container until it can be reloaded to the incinerator. If this material is still smouldering, it should be sprayed with water when in the metal container.
- Inspect the interior of the primary chamber for wear, or damage to refractory. Refractory that has failed should be replaced before using the incinerator for the next cycle.
- Clean all the air pipes into the primary chamber. Vacuum the pipes to remove fine materials and carefully chip away any slag around the tip of the air pipes, so as not to damage the air pipes.
- Inspect all the door seals to ensure that the door will maintain a tight seal upon closure. Clean any deposits from the seals. Replace seals that are damaged, worn or crushed.
- Clean the inspection view ports.
- Measure and record the weight of the materials to be combusted on the next burn cycle. Fill the primary chamber with the material to be combusted on the next burn cycle. Ensure waste loaded to the primary chamber does not block the burner. Follow the manufacturer's instructions concerning the mass or volume of waste that can be loaded.

Pre-Start Check

- Close and lock the primary chamber door. Ensure that all the latches are properly engaged and that the PRIMARY DOOR CLOSED safety switch is energized.
- Check that no alarms are displayed on the operating panel.
- Ensure that all the temperature set points are at the correct settings.
- Ensure that the cycle times are appropriate for the nature of the waste (volume, energy content, moisture, density, etc.). Typically the burn cycle will be 2 to 6 hours in duration with the cool down cycle being approximately 2 to 3 hours.
- If the incinerator is equipped with an EMERGENCY STOP BUTTON ensure that it is properly armed and that it is unlocked and pulled out.

- Ensure that primary and secondary manual air dampers are 100% open. Set all fuel valves to the open position.

Starting the Burn

Typically the operator will push the start button for the burn cycle and the control system will take over the operation of the incinerator. The operator should observe the operation during start-up to ensure that the following steps are completed.

- Starting the cycle will initiate an air purge of the chambers. This is followed by a purging of the secondary chamber burner prior to igniting. As the secondary burner operates, the temperature in that chamber will rise. When the temperature reaches the appropriate set point, the primary chamber burner will purge and ignite.
- If the secondary burner does not raise the temperature to the manufacturer's recommended set point, the operator should not override the controls and continue the burn. Any failures during the start-up should result in the incinerator shutting down. At this time the operator will need to commence fault identification procedures to overcome the deficiencies.
- The incinerator control system should maintain proper operating conditions throughout the timed burn cycle. Following the burn cycle, the system will go into a cool down mode. During this period air is introduced into the primary chamber to speed the cool down.
- Under no circumstances should the operator attempt to open the primary chamber doors when the system is operating. This practice can cause flashbacks that can injure personnel. The extra air entering the primary chamber will disrupt the combustion process, possibly leading to increased emissions.

3.4.1.4 Preventative Maintenance

All mechanical equipment requires routine preventative maintenance to operate efficiently. The operating conditions for the equipment dictate how frequently maintenance should be carried out. Incinerators have a service cycle that involves repeated heating to high temperatures followed by cooling. This can lead to refractory failures. Furthermore, moving waste and ash into and out of the incinerator creates wear on surfaces. Surfaces need to be refurbished on a routine basis and the seals around the openings require regular inspection and replacement as necessary.

Incinerators are waste disposal devices and should be managed in a manner similar to other disposal options. Incinerator owners need to recognize that money will be required to maintain the facility and to mitigate any unexpected events.

In addition, money should be set aside for routine maintenance. The cost of maintenance will be proportioned between labour, maintenance supplies, and equipment replacement. At least 3-5% of the capital cost of the unit should be set aside for annual maintenance and capital equipment replacement.

The maintenance budget should also include a capital reserve fund to cover repair and upgrades necessitated by unbudgeted circumstances. A suggested allowance for this would be 20% of the annual maintenance costs, labour and supplies, or about 1% of the capital cost.

The owner should consider establishing a service contract with the manufacturer (or a manufacturer-trained/ qualified local technician). These people should visit the site annually, and preferably quarterly if the incinerator is used daily. The owner should discuss the costs of such a program with the manufacturer and inquire about assistance the manufacturer can provide if the incinerator control and operating system can be accessed remotely.

Thus annual maintenance and capital reserve fund costs should be on the order of 4 - 6% of the original cost of the incinerator system.

3.4.2 Training

The cornerstone of ensuring good operation of any incinerator is that the staff understands how the system operates and takes appropriate steps to ensure the continued good operation of the equipment¹⁷.

Every incinerator manufacturer has its own unique approach to designing incinerators. The control systems, while following the general logic of the previous section, are likely to differ as well. Any person who will be operating an incinerator should be trained by the manufacturer before being asked to operate it. It is not good practice to have operators train operators. The manufacturer and its agents are the people most familiar with good operating procedures that will ensure minimal emissions.

Management staff should be involved in the training sessions wherever possible. Management are likely to provide long-term continuity at most sites. They can assist operators with their tasks, and ensure that substitutes or replacements are suitably trained.

¹⁷ Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review. A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf August 18, 2008.

3.5 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.

3.5.1 Residue Handling Practices

The quantity of ash (residues) generated by the facility should be documented, and the facility's weigh scale should be used to determine the mass of ash that is shipped from the facility to the disposal site.

For every 1000 kg of waste burned, approximately 300 kg of bottom ash is generated¹⁸. If the quantity of ash exceeds this amount, the material should be examined to determine whether the increased mass is due to the presence of non-combustible materials, or because there is a high quantity of unburnt carbon in the ash. If the latter situation is the case, operation of the incinerator should be adjusted to enhance the oxidation of carbon.

Representative samples of the bottom ash should be collected and forwarded to a laboratory for leachate toxicity testing. The International Ash Working Group provides guidance on sampling and analysis of ash¹⁹. At least 10 samples of ash are required to adequately characterise the material, and as a precaution it is recommended that testing on each sample be completed in triplicate. The results of the tests should be forwarded to the appropriate regulatory agency.

¹⁸ International Ash Working Group, 1997. Municipal Solid Waste Incinerator Residues. Published by Elsevier, ISBN 0-444-82563-0.

¹⁹ Ibid

3.6 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.

Recording:

One of the most important records that should be available for review by the regulators is the maintenance log. This should record routine maintenance activities, date completed, by whom, and any problems encountered. This routine maintenance should correspond to the preventative maintenance recommendations provided by the manufacturer. A record should be kept of any upsets or equipment failures that necessitated special maintenance activities. The data for special maintenance activities should include the description of the issue being addressed, the date the work was completed, and who was responsible for that work. Most importantly, the operators/maintenance personnel should analyse the cause of the failure and ascertain if there are operating procedures that can avoid a repeat of the failure.

Continuous monitoring (once per minute) of incinerator operation should be recorded regardless of whether or not the incinerator is in use. To prevent any uncertainty about the waste disposal data, the information on the quantity of waste incinerated should be cross referenced by date and start time to the incinerator operating data. While some might question the usefulness of collecting operating data when the incinerator is not operating, a complete record for all 8760 hours of the year will validate the production data.

Reporting:

Licenses issued to waste disposal operators in all parts of Canada require some degree of reporting on operations to the appropriate authorities. There is some basic information that should be included in any report:

- **Quantity of Waste Incinerated:** Since the CWS for PCDD/F and Mercury both set limits

on the amount of waste that can be burned before different levels of proof of compliance are required, the basic measurement for every incinerator site must be the quantity of waste charged to the incinerator during the year. Because the incinerator is limited to a fixed quantity of waste on every charge, each load should be recorded separately, and the quantities totaled for the year, and preferably weekly and monthly. Such data will also assist the owner in determining waste generation rates at the facility, and in turn, provide data on the effectiveness of diversion and reduction programs.

- **Operating Data:** Operating data that is important are temperatures, carbon monoxide, and oxygen levels, along with other data such as differential pressures and auxiliary burner operating times. If the auxiliary burners are of fixed output, it would be satisfactory to record the signal controlling its operation. If the input is variable, motor amperage from the pump would provide some indication of the rate of fuel use. Raw one minute monitoring data should be preserved in electronic format for analysis.
- **Ash shipment weights:** The report should include ash shipment weights and the name of the operator for any particular load along with notes on observations or problems experienced with the load.
- **Auxiliary fuel receipt data:** Auxiliary oil receipt data should be recorded in the log book and receipts for the shipments should be kept for verification by regulators.
- **Training:** The report should contain records of the training received by the staff, who conducted the training and when.
- **Changes in Operation:** Any major changes to the operation should be noted in the annual report, as should the results of any testing undertaken on the stack emissions or ash.

It is important to note that waste any incinerators incinerating: ≥ 26 tonnes of non-hazardous solid waste per year, ≥ 26 tonnes of biomedical or hospital waste per year, hazardous waste, or sewage sludge must report emissions of PCDDF, hexachlorobenzene, and mercury under the National Pollution Release Inventory (NPRI). For more information, please see www.ec.gc.ca/inrp-npri/.

APPENDIX H
TALTSON WINTER ROAD

INTRODUCTION

The Northwest Territories Power Corporation (NTPC) has prepared this appendix to the Taltson Facility Spill Contingency Plan (SCP) for the Taltson Winter Road (WR) between Fort Smith and the Taltson Facility located on the Taltson River, Northwest Territories. The Taltson WR is required to support upgrade and maintenance activities at the Taltson Facility and is tentatively scheduled for construction and operation for three to five seasons, beginning in January 2020.

This appendix outlines the spill response procedures and guidelines for contractors and companies operating on the Taltson WR and complements the spill response procedures, guidelines, and information provided in the SCP. For the purposes of spill contingency planning and the scope of this appendix, the Taltson WR comprises the marshalling/laydown area in Fort Smith and the WR corridor between Fort Smith and the Taltson Facility. This corridor includes the WR plus any pullouts, turnaround areas, rest areas, parking areas and other support areas that are constructed and maintained as part of the Taltson WR.

This appendix demonstrates that NTPC has appropriate response capabilities and measures in place to effectively address potential spills on the Taltson WR. This appendix documents NTPC's local and regional spill response capabilities, presenting information specific to the Taltson WR. This appendix is not a standalone document and it must be read in conjunction with the Facility SCP. Copies of the SCP with this appendix should be provided to all third-party contractors and suppliers operating on the WR so that their personnel (e.g. equipment operators and drivers) are familiar with its contents and understand their responsibilities in the event of a spill on the WR.

PURPOSE

The purpose of this appendix is to expand the scope of the Facility SCP to include response actions for potential spills of hazardous materials of any quantity on the Taltson WR.

SCOPE

This appendix applies to the accidental and/or uncontrolled release of a contaminant into the environment that has the potential for adverse impact. This appendix applies to all casual, permanent, part-time, full-time employees, and contractors who conduct work or provide services on the Taltson WR. This appendix covers activities and operations conducted on the WR.

GENERAL RESPONSIBILITIES

Same as described in Section 1.5 with the following additions.

Contractors and Sub-contractors

- All contractor and sub-contractor equipment and vehicles operating or travelling on the Taltson WR must be equipped with a 205L (45 Gal) Drum Spill Kit.
- All contractor and sub-contractor personnel travelling on the WR must be prepared to act as the First Responder in the event that they are the first to arrive at the scene of a spill.

NTPC Employees

- All NTPC equipment and vehicles operating or travelling on the Taltson WR must be equipped with a 45-Gallon Drum Spill Kit.
- All NTPC personnel travelling on the WR must be prepared to act as the First Responder in the event that they are the first to arrive at the scene of a spill.

Third Party Contractors and Suppliers

- All equipment and vehicles from third party contractors and suppliers operating or travelling on the Taltson WR must be equipped with a 45-Gallon Drum Spill Kit.
- All third party contractor and supplier personnel travelling on the WR must be prepared to act as the First Responder in the event that they are the first to arrive at the scene of a spill.

Plant Operator

- The Plant Operator remains the On-Scene Coordinator for spills at the Taltson Facility as per the SCP.

Project Manager, Engineering / On Scene Coordinator

- Project Manager, Engineering responsible for the Taltson Facility Upgrade Project is also responsible for the Taltson WR. Project Manager, Engineering (or designate) is the On Scene Coordinator for spills on the Taltson WR and is responsible for all actions described in Section 1.5.4 of the Facility SCP.
- Project Manager, Engineering (or designate) will coordinate all spill response activities with the Manager, Operations – South Slave.

Manager, Operations – South Slave / On Scene Coordinator

- Ensure that spill response initiated at the Facility by the Plant Operator is immediate, effective, and sustained.

- Support the Project Manager, Engineering (or designate) in coordinating spill response activities on the Taltson WR.

Director, Health, Safety & Environment

- Liaise with the Project Manager, Engineering and the appropriate environmental regulatory body to ensure that the response to a spill on the WR is completed in accordance with existing environmental laws and regulations.
- In coordination with the Project Manager, Engineering, prepare and submit any formal reports (within the required timeframe) to regulators and NTPC management regarding the management of hazardous materials and spill response.

PLAN TESTING AND TRAINING

Pre-incident training on the SCP is required for it to be an effective tool for the NTPC. The first time it is to be consulted should not be when an incident of emergency event has occurred. Companies operating on the Taltson WR must train all personnel involved with the WR on the contents of the SCP and their specific roles within it.

The SCP and this appendix will be tested to ensure that it is current, comprehensive, and effective. Appropriate communication drills and notification tests will be conducted under the direction of the Project Manager, Engineering..

The techniques for spill response outlined in the SCP are meant to act as a guideline or reference only. They are not intended to be a substitute for proper training. It is important that all employers ensure that any personnel with a designated safety role be suitably trained in how to perform their responsibilities.

ADDITIONAL PLANS AND RESOURCES

This appendix is to be used in conjunction with the following references:

- Taltson Hydroelectric Facility Spill Contingency Plan
- Taltson Hydroelectric Facility Operations and Maintenance Plan
- Taltson Winter Road Waste Management Plan

PROJECT DETAILS

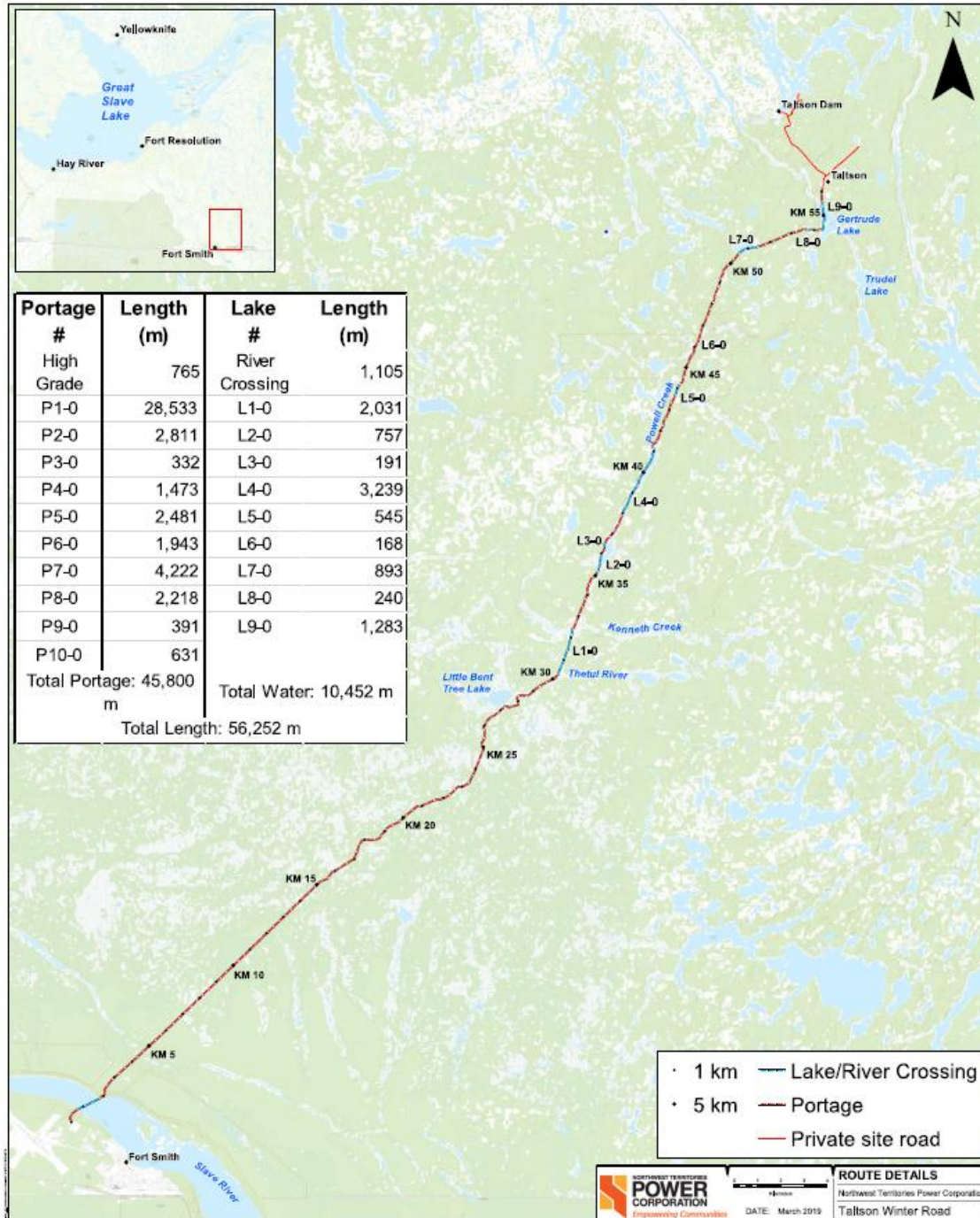
The Taltson WR is approximately 56 km long, the start point is a temporary laydown/marshalling area at the northeast corner of the Fort Smith airport. The end point is a temporary laydown area at the southern end of the airfield at the Taltson Facility. The Taltson WR consists of 11 over land

portions (portages) and 10 over ice portions (lakes/ivers). The total length of portages is approximately 45.3 km (81%) and the total length of lakes/ivers is 10.7 km (19%). The WR alignment is show in Figure J-1.

LOCATION AND LIST OF HAZARDOUS MATERIALS ON THE WINTER ROAD

There will be no hazardous material stored on the Taltson WR. There will be no fuel storage or cross-loading on the WR. Any vehicles transporting hazardous materials will arrive loaded at the marshalling area near the start point of the WR. All fuel offloading (bulk or drums) will occur at the Taltson Facility. Any spills caused by third party contractors and suppliers prior to arrival at the WR marshalling area are the responsibility of the third party and are outside the scope of this appendix.

Figure J-1: Taltson Winter Road Map



SPILLS

MATERIALS AND REPORTABLE SPILLS ON THE WINTER ROAD

The Project Manager, Engineering (or designate) is responsible for reporting spills on the Taltson WR. The Project Manager, Engineering, must be notified immediately of any spill regardless of quantity to land or water within the WR corridor (see Table 3-1 for Immediately Reportable Quantities).

SPILL PREVENTION MEASURES

In addition to the measures described in Section 3.3, the following additional general preventative measures are in place to minimize the risk and impact of a potential spill or release:

- Prior to starting to work or travel on the Taltson WR, all employees and contractors (including third party contractors and suppliers) are required, as a minimum, to go through an orientation session to familiarize themselves with this SCP, the hazardous materials that will be transported on the WR, and the WR spill response procedures.
- All vehicles and equipment travelling or operating on the winter road will be equipped with spill kits. The spill kits and their contents are to be regularly inspected to ensure that adequate supplies are available.
- Regularly inspect the WR marshalling and laydown area in Fort Smith and any pullout or parking areas along the WR for minor spills or leaks from parked vehicles

RESPONSIBLE PARTY

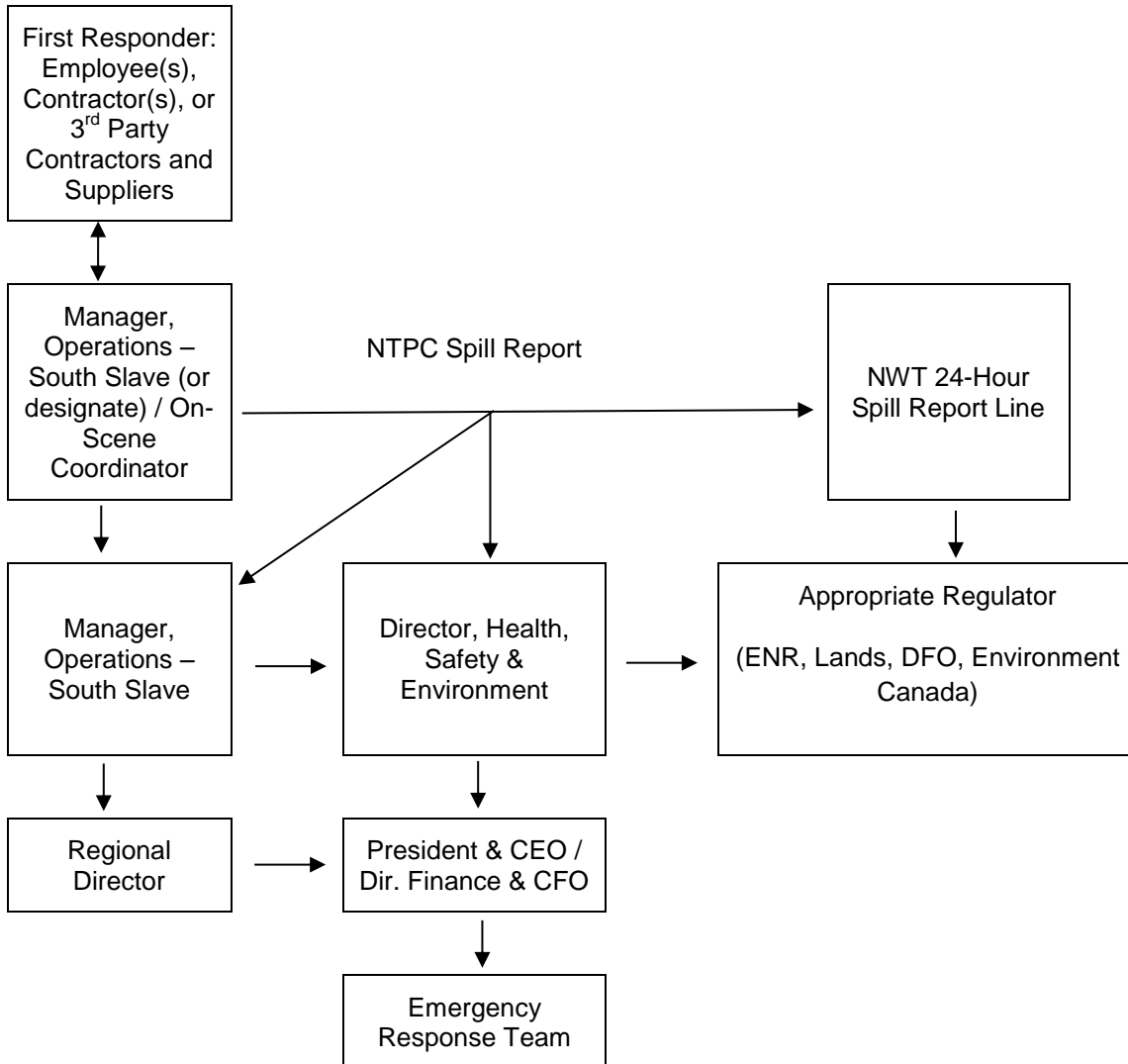
The Responsible Party is the organization or individual whose equipment or personnel are directly involved with, or the cause of, the spill. This could be a third-party contractor or supplier, NTPC staff, of any other WR user. The responsibility for any incident or accident lies with the Responsible Party and they will be held accountable for any emergency response or clean-up costs associated with the incident.

RESPONSE ORGANIZATION

The spill response organization, communication flowchart, response team roles and responsibilities, and organizational communication plan described in Section 4 remains in effect for incidents involving spills on the Taltson WR with two important exceptions. First, Fort Smith will be the nexus for coordinating spill responses on the WR. Where the Plant Operator is the On-Scene Coordinator for spills at the Taltson Facility, the Manager, Operations – South Slave (or designate) based in Fort Smith will be the On-Scene Coordinator for spills on the Taltson WR. When a spill of any size is discovered, the Manager, Operations – South Slave and the 24-Hr

Spill Report Line must be notified. Second, first responder to incidents on the WR as described in Section 4.2.1 includes NTPC employees and contractors as well as third party contractors and suppliers working or travelling on the Taltson WR (see Figure J-2).

Figure J-2: Taltson WR Spill Response Organizational Communication Flowchart



The flow chart depicted in Figure J-2 identifies the response organization and the chain of command for responding to a spill. In accordance with the action plan described in Section 5 of the SCP, the response organization details the roles and responsibilities of each party involved in the spill and their contact information, including the 24-hr phone numbers for the responsible person.

Emergency Response Team (ERT): For spills into water on the WR, **Senior Leadership** will form the ERT immediately (Table 4-2). Senior Leadership may opt to form this team for lesser

emergency levels on a case-by-case basis. Should assistance from regulators or government be required, agencies with some ability to support are provided in Table 4-3.

ACTION PLAN

POTENTIAL DISCHARGE EVENT – WORST CASE SCENARIOS

In Table J-1, a list of potential discharge events, with associated discharge volumes and directions is presented for the primary hazardous materials that will be transported on the Taltson WR. The most likely discharge volume is indicated, and the spill clean-up procedures will focus on the spills of this quantity. A worst-case scenario is also presented. Specific discharge rates are not indicated for each fuel type as these would vary from a few minutes to several hours, based on the source of leak or puncture.

Spills may occur on land, snow, ice or water, or in combination, depending on the conditions at the time of the spill. Any product or material recovered during spill response should be disposed of as per the Taltson WR Waste Management Plan.

Table J-1: List of Hazardous Materials, Potential Discharge Events, Potential Discharge Volumes (Worst Case Scenario in Brackets) and Direction of Potential Discharge

Material (sources)	Potential Discharge Event	Discharge Volume (worst case)	Direction of Potential Discharge
Diesel Fuel (Fuel tanker, vehicles, and heavy equipment)	Leak from fuel tank on vehicles and equipment due to collision / accident on WR Fuel tanker rollover Re-fueling spill from equipment located along the WR Leak from fuel tank on a vehicle that breaks through an ice crossing	Likely < 10 L (max 43,000 L if catastrophic failure of Super B train)	Spills associated with vehicle accidents or re-fuelling on the WR will generally be contained on top of the ice, snow, or frozen ground.
Gasoline (Vehicles and 205L drums being transported via WR to Taltson Facility)	Large puncture, fast leaking container due to due to collision / accident during transport on WR Re-fueling spill from equipment located along the WR Leak from fuel tanks on vehicles and equipment due to collision / accident on WR	Likely < 205 L (max 205 L if a full drum is ruptured)	The contaminated snow/ice/snow can be shovelled up and place in drums for offsite disposal. Larger spills, including those on ice can be cleaned up with heavy equipment.
Jet Fuel (205L drums being transported to Taltson Facility via WR)	Large puncture, fast leaking container due to due to collision / accident during transport on WR	Likely < 205 L (max 205 L if a full drum is ruptured) (Care must be taken not to spread contaminated snow during transport by heavy equipment.
New and Used Lubricating Oil (Vehicles and	Large puncture, fast leaking container due to due to collision / accident during	Likely < 205 L (max 205 L if a full drum is ruptured)	

Material (sources)	Potential Discharge Event	Discharge Volume (worst case)	Direction of Potential Discharge
equipment operating on WR, 205L drums being transported to Taltson Facility via WR)	transport on WR Leak from engine on vehicles and equipment due to collision / accident on WR Small leak from vehicle parked/stopped on WR for an extended period of time		
<p>Every precaution must be taken to ensure that spills do not enter a waterway. If there is any possibility of contamination, a stream or river should be protected by diversion of the spill from the watercourse. This could be done with trenches and/or berms, or the use of absorbent berms (see Appendix E).</p>			

POTENTIAL IMPACTS OF SPILL

Refer to Section 5.2.1.

SPILL PROCEDURES

Refer to Section 5.3.

DECONTAMINATION

Refer to Section 5.4.

CONTAINMENT

Refer to Section 5.5.

RECOVERY / CLEAN-UP

Refer to Section 5.6.

STORAGE

Refer to Section 5.7.

DISPOSAL

Refer to Section 5.8.

SITE RESTORATION

Refer to Section 5.9.

RESOURCE INVENTORY

Refer to Section 6. In addition, all vehicles and equipment will have a 205 L (45 Gal) Drum Spill Kit when travelling or operating on the WR.

TRAINING PROGRAM

NTPC conducts site orientations that include SCP and spill response equipment awareness. Employees, contractors, and third-party contractors and suppliers must complete the NTPC Taltson WR Orientation before travelling the Taltson WR for the first time and prior to conducting work. The Project Manager, Engineering (or designate) provides the WR orientation, which provides an overview of the SCP and this appendix, the locations of spill response equipment, and the procedures to report and respond to a spill incident. Records of site orientations are maintained.

For key NTPC employees responsible to coordinate a response to spill events, NTPC provides an SCP awareness course. In addition to the information provided during the site orientation, spill responders are given a detailed review of this SCP; introduced to step-by-step methods to identify, assess, and respond to spill situations; participate in a review of hazardous materials located on-site and the associated risks; learn how to use absorbent and other spill response equipment; and learn how to properly dispose of contaminated spill response equipment. A mock spill exercise may be performed to familiarize potential first responders with the equipment available and the steps to take during typical spills situations that may occur along the WR.

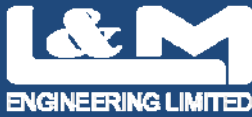
All NTPC contractors and third-party contractors and suppliers (are required to have basic first aid and WHMIS training before being allowed to work or travel on the Taltson WR). All NTPC employees and supervisors are also required to have WHMIS and first aid training. Persons involved in the handling and shipping of hazardous materials are required to be trained in the Transportation of Dangerous Goods Regulation (TDG) requirements and must have a valid TDG certificate.

An up-to-date training matrix is kept by the NTPC Training Coordinator and contains records of all environmental, health, and safety (HSE) training completed by employees. Third-party contractors and suppliers are required to maintain records of all WR-related HSE training completed by their personnel. On request by the NTPC Training Coordinator, third-party contractors and suppliers must provide proof of the WR-related HSE training and/or qualifications of any personnel that will work or travel on the Taltson WR.

PUBLIC RELATIONS

Refer to Section 8.

APPENDIX I
ONSITE SEWAGE AND RAW WATER SYSTEM



April 17, 2020

NTPC TALTSON RIVER WORK CAMP

**ONSITE SEWAGE SYSTEM & RAW WATER SYSTEM SUPPLY
DESIGN REPORT**

**BLOCK 75 D/6, LOT 1003,
NORTHWEST TERRITORIES**

**Client: Northwest Territories Power Corporation
L&M Project No.: 1702-01**

L&M ENGINEERING LIMITED

1210 Fourth Avenue, Prince George, BC V2L 3J4
Phone: (250) 562-1977

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1.0 INTRODUCTION

L&M Engineering Limited (L&M) has been engaged to complete the design for the civil works associated with a new 25 person work camp including domestic water servicing, onsite sewerage system and related earthwork and site grading. The camp is intended to be used to its full capacity for the operating season (approximately 8 months) for the first couple of years and moves to significantly reduced occupancy outside of scheduled shutdowns for the remainder of its operation.

1.1. Project Site Description

The property owned by Northwest Territories Power Corporation (NTPC) is located on the south-end of Taltson River, Northwest Territories. The property has existing infrastructure including accommodation, workshop, and generation plant. The proposed work camp site is proposed to be located near the existing active site off of access road from Taltson Airport. Much of the topography surrounding the project site has exposed rock with significant or vertical slopes with soils conditions consisting of either silty and clay over bedrock or peat over bedrock. This poses significant constraints for onsite sewage disposal from an environmental and public health perspective.

The closest permanent flowing body of water is the Taltson River/Reservoir, approximately 80m north from the proposed work camp. The general topography of the site slopes at 1-2% from east to the west with significant slopes at the west and south boundaries of the site development area.

The existing infrastructure is serviced by an existing septic treatment tank and subsurface disposal system and raw water intake for the domestic water supply off of the existing penstock servicing the generation facility.

1.2. Regulatory Requirements

Land development in the Northwest Territories is regulated by The Mackenzie Valley Land and Water Boards (MVLWB) through the issuance of land use permits (LUPs) in accordance with the Mackenzie Valley Resource Management Act (MVRMA), the Mackenzie Valley Land Use Regulations (MVLUR), and various Territorial Acts. This report addresses the method of onsite sewage management and raw water supply for the proposed 25 person work camp. This report and design will be included in an application for a land-use permit from the MVLWB that will regulate the construction of the camp and other replacement facilities.

1.2.1. Design Standards and Resources

The design methodology, principles, and standards for the water supply and onsite sewage treatment and disposal system are based on the following resources and our extensive experience with remote work camp infrastructure:

- Waters Act – S.N.W.T. 2014
- Public Health Act – General Sanitation Regulations – R.R.N.W.T. 1990
- Northern Land Use Guidelines – Camp and Support Facilities
- Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in fresh water – Fisheries and Oceans Canada
- Alberta Private Sewage Systems Standard of Practice 2015 – Edition 3
- B.C. Sewerage System Standard Practice Manual - Version 3
- Municipal Wastewater Regulation of B.C. – 2012
- Wastewater Engineering Fifth Edition – Metcalf & Eddy

2.0 SITE INVESTIGATION

L&M completed a limited topographic survey and onsite soil assessment of the property on November 19, 2019. A total of two test pits were excavated at the proposed work camp location to a depth of approximately 1.5m below the existing ground. Two permeameter tests were also completed at varying depth to establish the hydraulic conductivity of the native soil. Refer to Drawing C001 in Appendix A for the location of the test pits and permeameter tests. After completing the onsite investigation and moving through design options, the client has decided to relocate the field further from the camp to establish more distance between the active facilities and sewage disposal. Further evaluation of the soils in the new proposed disposal area will be required before moving to construction to verify the suitability and rate for disposal.

2.1. Soil Profile Characteristics

Each of the test pits and drill holes performed onsite demonstrated a similar soil profile, structure, and consistence. The soil observed is primarily silty clay with a moist/friable structure. The top 0.4m of both test pits was comprised of silty clay with a fair structure. A massive layer of clay was noted from both test pits at depths below 0.4m. No groundwater seepage or indication of mottles was present in any of the test pits, suggesting that the water table would not rise to within 1.5m of the surface. Table 2 demonstrates the soil profile observed onsite in further detail and Figure 1 and Figure 2 provide visual representations.

Table 2 – Soil Profile Summary						
Test Pit Number	Total Depth (m)	Soil Profile (m)				Groundwater Conditions
		0-0.4	0.4-1.5m	Below 1.5m	-	
1	1.5	Blocky Silty Clay	Massive Clay	Massive Clay	-	none
2	1.5	Blocky Silty Clay	Massive Clay	Massive Clay	-	none
The soil at the proposed infiltrative surface is blocky with moderate structure and in friable consistence						



Figure 1_Test Pit #1



Figure 2_Test Pit #2

2.2. Soil Permeability

Permeability testing was performed on the site at depths ranging from 0.3m to 0.6m using 7.5cm diameter Edelman auger to assess the hydraulic capacity of the soil for sewage disposal. The infiltration rates selected based on the permeameter tests resulted in an average field saturated of 148 mm/day.

Table 3 – Soil Permeability Summary				
Permeameter Test Number	Depth of Auger Hole (m)	Stable Rate of Fall (mm/min)	Soil Factor	KFS Value (mm/day)
1	0.3	4.8	34.9	167
2	0.6	3.7	34.9	129

2.3. Set Backs

The minimum setbacks for onsite sewerage systems vary between sewerage regulations. Most regulations are similar and require that all sewage collection, treatment, and disposal systems maintain minimum setbacks from various constraints. Applicable setbacks are summarized in Table 4 based on the SPM V3.

Table 4– Set Back Requirements (m)				
Constraint	Requirement		Provision	
	Tanks	Field	Tanks	Field
Water Supply Source	15	30	>300	>300
Water Well	30	30	n/a	n/a
Pressurized Water Main	3	3	>3	>3
Water Body	10	30	>100	>100
Intermittent Water Body	10	15	>15	>15
Water Cistern (Above Ground)	1	1	>15	>15
Structure or Dwelling	1	1	>5	>30
Another Disposal Field	3	6	n/a	n/a
Slope Breakout Point	-	7.5	>7.5	>7.5
Buried utility Services	1	1	>1	>1
Property Lines	1	3	n/a	n/a

2.4 Site Investigation Summary

Table 5 provides a summary of the site constraints identified and evaluated in the field along with a classification indicating the severity of the constraint.

Table 5– Site Investigation Summary		
Constraint	Description	Classification
Soil Structure/Consistency	Blocky/Firm	Slight
Soil Texture	Silty Clay	Severe
Field Saturated Soil Permeability (kfs)	<75 to <150 mm/day	Severe
Depth of Native Soil Above Restrictive Layer or High Water Table	<0.3m	Severe
Land Slope	1 – 2%	Slight
Setback Requirements	Breakout Slope	Moderate
Coarse Gavel Content	< 10%	Slight

3.0 SEWAGE SYSTEM DESIGN CRITERIA

Based on the identified constraints and the operational requirements provided for the work camp, a Type 1 wastewater treatment system with disposal to a sand mound pressure distribution with timed micro-dosing is recommended. This method of treatment will minimize the field area required for in-ground disposal and the application of timed micro-dosing will take better advantage of soil conditions for in-ground treatment and infiltration capacity. A minimum of 600 mm of approved mound sand will provide a higher quality of treatment prior to effluent contact with the native silt and clay soils. A sand mantel will be installed as part of each mound section to mitigate potential breakout and seasonal ground saturation conditions which may be prevalent in this region.

The recommended treatment and disposal system is supported by the Standard Practice Manual Version 3 (SPM.V3) as indicated in Table II-7 on page II-17. This sewage system has been designed to collect, treat, and dispose of sewage waste for up to 7,600 L/day.

3.1. Sewage Flows

The sewage flows for the Taltson Camp have been established based on historical flow data, Table 2.2.2.2.B. of the Alberta Private SSTP, and various sewer design resources such as Metcalf and Eddy. The design daily flow (DDF) estimated for the camp residents is expected to be 300 L/p/d with 220 L/d/p generated by the dorms and 80 L/d/p generated by the kitchen facility assuming two warm meals and a bag lunch. The peak occupancy for the camp's maximum operating window each year is expected to be 20 people staying in the dorms and a total of 40 people using the kitchen services. This results in a maximum expected DDF of 7,600L/d and an average daily flow (ADF) of 3,800 L/d (DDF/2) expected at the disposal field for any given 30-day window. The field loading is based on the average daily flow being delivered to the field for any 30-day window as supported by the SPM.V3.

• 20 camp residents @ 220L/d/p DDF dorm waste	4,400L/d
• 40 camp residents @ 80L/d/p DDF kitchen waste	3,200L/d
Total Daily Design Flow	<u>7,600L/d</u>
• 20 camp residents @ 110L/d/p ADF dorm waste	2,200L/d
• 40 camp residents @ 40L/d/p ADF kitchen waste	1,600L/d
Total Average Daily Flow *Over a 30-day window	<u>3,800L/d</u>

3.2. Wastewater Quality

The quality of a sewage treatment system is defined by the type of effluent achieved after treatment. The effluent types are established by the regulatory body. The required treatment type for a system is primarily based on site constraints and disposal methods. The pertinent wastewater quality parameters are the five-day Biological Oxygen Demand (BOD₅) and Total Suspended Solids (TSS). For these parameters, typical domestic levels are 290 to 560 mg/L and 175 – 500 mg/L for BOD₅ and TSS respectively. Typically camps tend to generate sewage with elevated BOD₅ and TSS levels as a result of commercial kitchen/cafeteria services and therefore a combination of kitchen waste pre-treatment and increased primary treatment capacity is recommended to facilitate higher concentration waste from the kitchen during peak operation.

The Ministry of Health classifies effluent quality from treatment as Type 1, Type 2, and Type 3. The different treatment classes are defined as follows:

- **Type 1:** Septic holding treatment resulting in an effluent quality of 150-300 mg/L BOD₅ and 50-80 mg/L TSS. Further reduction to 100-150 mg/L BOD₅ and 20-55 mg/L TSS is possible with and added septic tank effluent filter;
- **Type 2:** Septic holding and activated sludge (MBR) treatment or disposal to sand filter resulting in an effluent quality of <45/45 mg/L for BOD₅ and TSS respectively;
- **Type 3:** Septic holding, activated sludge, and disinfection resulting in an effluent quality of <10/10 mg/L for BOD₅ and TSS respectively as well as a significant reduction in pathogens prior to disposal.

3.3. Wastewater Loading Rate

3.3.1. Hydraulic Loading Rate (HLR)

The effluent loading rate is the amount of effluent that can be applied each day over a basal (bottom) area of the infiltrative surface without compromising the permeability or conductive capacity of the soil. The SPM.V3 indicates that the soil texture and structure must be used to evaluate the conductive capacity of the soil along with the standard percolation test or a hydraulic conductivity test using a permeameter.

Based on the soil profile and characteristics identified in the field and the average soil conductivity of the native soils the loading rate identified in Table II-22 of the SPM.V3 is a maximum of 12 L/d/m². With the addition of

a minimum 600mm thick sand filter mound, the loading rate can be applied to the top surface of the sand mound is 50 L/d/m² which produces a Type 2 effluent at the native soils resulting in a permitted basal loading rate of 15 L/d/m². Due to the significant site constraints, this design reduces the basal loading rate to the native soils to approximately 10 L/d/m² to mitigate risk associated to effluent breakout.

3.3.2. Lineal Loading Rate (LLR)

Based on the identified site constraints and soil characteristics, the SPM.V3 Table II-27 (Pg. II-39) recommends a maximum linear loading rate of 35 L/d/m. As site area and length are restricted on this site, the use of a sand mantel downslope of the sand mound disposal system will be implemented to manage potential breakout risk, provide additional treatment, and allow an LLR of 50L/d/m to be applied. The minimum lineal length recommended is therefore 152m (7,600 L/d ÷ 50L/d/m = 152m). The total proposed design lateral length is 160m which results in an actual lineal loading rate of 47.5 L/d/m. To further mitigate the risk of breakout associated with the site constraints the system is being designed to load the native soils at less than 10% of the water holding capacity and micro-dosing application.

3.3.3. Sand Loading Rate

The SPM.V3 Table II-24, Page II-37 indicates that the maximum loading rate for Type 1 effluent to sand filter coarse sand is 50 L/d/m². Existing reports and field sampling suggest a suitable source is available at the landing strip. The selected sand should meet the sieve specifications shown below. A material sieve should be provided prior to use in this application.

Sieve Size	Percent Passing
9.5mm	100
4.75mm	95-100
2.36mm	80-100
1.18mm	45-85
0.600mm	15-60
0.300mm	3-15
0.150mm	< 2
0.075	< 1

4.0 SEWAGE TREATMENT

Treatment of sewage from a commercial kitchen typically requires pre-treatment which consists of grease catchment and potentially pre-treatment to lower the BOD₅ and TSS to that of typical residential waste concentrations prior to entering primary treatment facilities. As this system will not sustain peak capacity consistently for long term operations, oversized grease trap and dedicated kitchen treatment with dual filtration combined with an increase in the primary treatment tank has been recommended to provide better treatment under periods of higher loading. This has also been implemented to provide additional solids waste storage within the tanks as the site is very isolated and maintenance during peak operation will be limited to once annually and during long term operation, it will be very limited.

The recommended treatment design for the camp facility consists of the following:

- Dedicated Kitchen Treatment
 - 4,000L (1,100 USGal) single chamber grease trap tank
 - Zable A-100 1.5 mm (1/16”) effluent filter
 - 1,800L (475 USGal) single chamber pre-filtration tank
 - Zable A-100 1.5 mm (1/16”) effluent filter

*This treatment provides treatment for kitchen waste only

- Primary Treatment
 - 19,000 Liter (5,000 USgal) two-chamber septic tank
 - Zabel A-100 1.5 mm (1/16”) effluent filter

*This provides treatment for combined kitchen and dorm waste

4.1. Grease Trap Tank, Filtration Tank, Effluent Filter, and Smart Alarm

The grease trap tank, filtration tank, and effluent filtration function as a dedicated treatment process to reduce commercial kitchen waste concentrations to that of typical residential waste before entering the primary treatment tank. For a camp application of this nature, we would typically provide a minimum grease treatment volume of three times the average daily flow or approximately 4,800L. Due to the reduced maintenance capacity at this remote site, we have recommended the minimum treatment size to be 5,800L (3.6*ADF). This increase in size across two tanks will help facilitate a higher level of treatment during peak operations and provide greater storage volume of solids to reduce maintenance requirements to every year during peak operation and every 5 years during long term operations depending on kitchen usage.

Most sewage regulation recommends that an effluent filter be installed at the outlet tee that filters particles greater than 3mm. For this application, we recommended the use of a Zabel A-100 effluent filter with 1.5mm (1/16”) filtration to further improve effluent quality on both the grease trap tank and the filtration tank. Additionally, a high-level alarm panel for both filters is also recommended and must meet the following specifications:

- Rhombus Tank Alert XT liquid level alarm or approved equivalent
- Must be CSA approved
- Power LED display indicator
- Installation on a separate circuit from pumps or other infrastructure
- NEMA 3X enclosure for indoor/outdoor mounting
- Audible & visual alarm, automatic alarm reset, silence switch, and test switch

4.2. Septic Tank, Effluent Filter, and Smart Alarm

The septic tank functions as a primary treatment process and produces a Type 1 effluent. The minimum septic tank size varies across different design standards. For a camp application of this nature, we would typically provide a minimum tank volume of two times the daily design flow or approximately 15,200L. Due to the commercial kitchen application and reduce maintenance capacity we have recommended the minimum tank size to be 19,000L (2.5*DDF). This increase in size will help facilitate a higher level of treatment during peak operations and provide greater storage volume of solids to reduce maintenance requirements to every 3 years during peak operation and every 15 years during long term operations.

Most sewage regulation recommends that an effluent filter be installed at the outlet tee that filters particles greater than 3mm. For this application, we recommended the use of a Zabel A-100 effluent filter with 1.5mm (1/16”) filtration to further improve effluent quality. Additionally, a septic tank high-level alarm panel is also recommended and must meet the following specifications:

- Rhombus Tank Alert XT liquid level alarm or approved equivalent
- Must be CSA approved
- Power LED display indicator
- Installation on a separate circuit from pumps or other infrastructure
- NEMA 3X enclosure for indoor/outdoor mounting
- Audible & visual alarm, automatic alarm reset, silence switch, and test switch

5.0 SEWAGE DISPOSAL

Sewage treatment and disposal for this design requires pressure distribution as a result of the site constraints and facility operations. Refer to Appendix B for the pressure distribution design spreadsheet and to Appendix A for the detailed design drawings.

The proposed disposal system has been designed for a maximum daily design flow of 7,600 L/d at a maximum hydraulic loading rate (HLR) of 15 L/d/m² at the basal surface. This results in a required minimum total basal area of 507m². With a maximum LLR of 50 L/d/m (supported by sand mantle) the required minimum contour length is 160m.

Based on the above loading constraints, the use of two hydraulically separate sand filter coarse sand mound disposal fields is recommended. The two separate fields can be alternated or used together depending on the camps specific operating conditions. Due to length restrictions, two separate mounds will be constructed, each with a length of 80m and 10m horizontal separation to establish an overall lineal length of 160m. Each sand filter mound consists of four header supply pipes from a dedicated effluent pump servicing eight perforated disposal laterals.

This arrangement results in a total sand mound loading area of 160m² and a total basal loading area of 640m². As a result, the actual HLR for the disposal fields is 11.8 L/d/m² and an actual LLR is 47.5 L/d/m. The sand mantle will be positioned downslope of each sand filter mound for a minimum distance of 7.5m to manage risk of lineal mounding and breakout

5.1. Dosing Frequency and Instantaneous Loading

Reducing both the daily and instantaneous hydraulic loading rates and providing uniform distribution over the infiltration surface can help maintain lower soil moisture levels. Lower soil moisture results in longer wastewater restoration times in the soil and causes the wastewater to flow through the smaller soil pores in the unsaturated zone, both of which enhance treatment and mitigate risk of breakout or excessive organic loading under unexpected increased daily flows.

It is optimum when the instantaneous volume per dose is between 1/24th and 1/8th of the average daily wastewater volume. Frequent and uniform dosing (12 times or more per day) in coarser soil (or sand filter) maximizes the effects of biological, chemical, and physical treatment mechanisms. Micro dosing has been applied to this design with a maximum of 24 doses per field per day or an approximate instantaneous loading of approximately 1/48th of the daily design flow.

The detailed pressure design considers the orifice placement, volume of effluent delivered under pressure, and the hydraulic application rate (HAR) at the disposal surface. Given the nature of the native soils, this system has been design with a maximum HAR of 2.0 mm/dose which is equivalent to less than 10% of the estimated water holding capacity of the native soil with 72% of the effluent delivered to the field under pressure each dose.

In order to achieve uniform distribution across each of the disposal fields the density of orifices should be as high as possible without generating excessive pumping requirements. Typical orifice spacing varies between 0.6m and 1.2 m depending on the field arrangement with a maximum dose area per orifice of 0.56 m². For this type of system, small 3 mm (1/8”) diameter orifices spaced at a maximum of 0.625m is recommended resulting in a dose area per orifice of 0.56 m².

5.2. Pump Chamber, Pump and Control

Following the septic tank treatment system, effluent flows into a pump chamber that is designed to provide the necessary dosing volume to the field with adequate distribution, surge volume, and emergency storage volume after pump alarm sounds. The recommended 8,500L (2,250 USgal) tank provides volume in excess of the daily design flow for the camp to allow for unexpected peak flows or emergency storage as required.

The proposed pump for each field is a MYERS ME100 1.0HP effluent pump (or approved equivalent) complete with 4 floats, weather-proof sealed junction box, and simplex timed dose control panel. Each pump shall include the following:

- 6m of power cord
- 50mm dia. (2in) SCH 80 discharge
- 50mm (2in) SCH 80 check valve
- 50mm (2in) PVC union.

The floats shall have 6m of cord and shall include:

- FS#1 Pump redundant off
- FS#2 Timer activate
- FS#3 High level alarm
- FS#4 Timer override
- FS#5 High level filter alarm (located in septic tank)

Each pump requires its own pump control panel shall be CSA Approved and supplied with the following features:

- Simplex Control Panel
- NEMA 4X enclosure rated for indoor or outdoor mounting
- Power LED display indicator
- Pump disconnect circuit breaker
- Pump run light
- Pump run time meter
- Pump run counter
- Hand-off-automatic selector switch (H.O.A.)
- Float level indication lights
- High level alarm light and beeper with reset
- Dosing timer

5.3. Timed Dosing and Distribution

For the design of this system, the two MYERS ME100 1.0HP pumps will each dose 3,800 L/d over 24 doses to their respective field. This results in a total volume per dose to each field of 158L. The system laterals will drain out into the field after each dose and the pressurized supply line and headers should drain back to the pump tank in less than 1 hour to prevent freezing.

This dosing schedule results in a pump flow rate of 66.7 lgal/min to each field. Each pump will operate for 57 seconds and have an off time of 59 minutes each dose cycle before dosing the field again.

The design pump operating flow rate is 85USgpm with an expected operating head and squirt height of 11.9m (39ft) and 3.2m (10.4ft) respectively.

5.4. Sewage Collection System

The sewage collection system for the camp should consist of 100mm diameter SDR 28 PVC for all underground installation between the camp infrastructure and the septic treatment tank. Cleanouts are to be provided every 15m, change in horizontal alignment, or vertical grade as required. The minimum pipe slope is to be 1.0% but is preferred at a minimum 2.0% slope.

5.5. Disposal Field Supply Pipe

The disposal field supply pipes consist of 50mm diameter SCH.40 PVC pipe from the pump tank outlets to the disposal field headers. The supply pipes are intended to

drain back to the pump tank after each dose and require a minimum 0.5% pipe slope towards the pump tank discharge. The configuration chosen for the field has resulted in no need for distribution valves. Refer to Appendix A for the pressure field details.

5.6. Header Pipe

The header pipe delivers flow from the supply pipe to the disposal laterals and consists of 50mm diameter SCH.40 PVC. The header pipe is to be sloped such that it drains back to the pump tank or out into the disposal laterals. Headers are to be complete with cleanouts and insulated covers at finished grade.

5.7. Disposal Laterals

Each header distributes flow through two perforated 10m long 25mm diameter SCH.40 PVC lateral pipes. Perforations are to be 1/8" in diameter and set at a maximum distance of 0.625m on center with the first and last being 0.3m from the ends of the lateral. Each lateral is to be equipped with a cleanout at the end of the lateral run c/w insulated cover to the finished grade of the mound. Ensure all orifices are facing down except for the first and last orifice. Provide orifice shields for all downward facing laterals. See drawing details in Appendix A for field lateral details.

5.8. Infiltrator Chambers

Quick4 Equalizer Standard infiltrators have been recommended (34"W x 48"L x 12"H). A potential alternative to infiltrators would be a minimum of 150mm of drain rock base and filter fabric over the installed distribution pipe. Provide perforated inspection pipes inside of the chambers to allow monitoring from the surface. Refer to Appendix A for infiltrator and alternative infiltration trench installation details.

6.0 SEWAGE SYSTEM CONSTRUCTION PROCEDURE

6.1. Septic Tank and Pump Chamber

Install level as per the manufacturer's guidelines for the approved depth range. Before the septic system is approved, a leakage test must be performed on the tank. The tank shall be completed filled with a minimum of 50mm of water into all tank risers. This is to ensure that a watertight connection has been made between the riser and the tank. A leakage test must be performed by the system's installer prior to the engineer's construction inspection. Once the test has been passed by the installer, the leakage test will be witnessed for one hour on the day of the construction inspection by the engineer.

6.2. Disposal Field Supply Pipe

Install the disposal field infrastructure in accordance with the manufacturer's guidelines at a minimum 0.5% grade towards the pump tank. Insulated pipe cover is recommended for areas where snow clearing and vehicle traffic are expected over the supply pipe. A minimum of 0.9m of cover is recommended where vehicle loading is expected.

6.3. Header Pipe

Install header pipe in accordance with manufacturer's guidelines at a minimum 0.5% slope back to the force main supply pipe or into the disposal field laterals.

6.4. Disposal Field Construction

1. The field area shall be cleared with any stumps removed. Any organics are to be removed but as much of the native mineral soil profile is to be left in place as possible. If fill is required beneath the proposed sand mound disposal field, utilize a material meeting the sand mound specification or approved alternative import fill.
2. Prior to placing sand mound media, scarify the native soil surface to a depth of 150mm to create a binding layer between the treatment media and the native soils. The basal area for the sand mound should be sloped at a minimum of 0.5% towards the boundary of the site development.
3. A minimum 600mm thick layer of sand treatment media is to be placed uncompacted on the scarified native soil. The top of the sand mound is to be installed level with less than 0.5% slope. The site is designed with a 1% grade along the length of the fields. In order to avoid excessive sand placement, step the field down for each header zone as required given site conditions. It is important to ensure sand treatment media remains clean and free of native soil contaminants.
4. The laterals piping shall be placed level with no more than 0.5% slope back towards the supply header and force main. Each lateral is to be equipped with a lateral inspection pipe inserted into the infiltrator and a lateral cleanout at the end of each lateral section. All cleanout riser sleeves are to be filled with insulation chips and provided with an insulated cover.
5. Prior to the pressure testing procedure open up all lateral and header cleanouts to flush the system of debris. Orifice shields are required on all downwards

facing orifices. The infiltrators shall be placed over the pressure laterals with the laterals strapped to the top of the chambers using nylon tie straps.

6. The trenches shall be backfilled with un-compacted sandy loam backfill or a material meeting the sand mound soils specification.
7. The top of the field area surface shall be sloped at a minimum 2% grade to encourage surface water shedding. The entire area shall be seeded with grass and small shrubs or decorative landscaping.

7.0 RAW WATER SUPPLY SYSTEM DESIGN

The water demand for the work camp supply system considers the same peak daily design flow as the onsite sewerage system as it is not expected that a considerable volume of water will be used for outside of the domestic potable use. The maximum daily demand for the work camp is estimated at 7,600 L/d and the associated methodology for that estimate is provided in earlier sections. As described in the earlier sections of this report, the site poses significant subsurface soil restrictions such as bedrock for deep utility installation. The selected method for water supply to the work camp will be above grade insulation jacketed water supply line from a submersible pump in the Talston River/Reservoir with an automatic recirculation system to mitigate freezing.

7.1. Proposed Camp Facility Water System

The proposed camp facility water system is being provided by the camp manufacturer but is understood to consist of a UV disinfection system and approximately 6,000L (1,600 USgal) in treated potable water storage followed by a booster pump distribution system. To meet the estimated maximum daily demand for the work camp the raw water supply must be able to provide a minimum of 1 USgpm (3.9 L/min). We have recommended a minimum raw water supply rate for this system of 6 USgpm.

7.2. Water Intake Design

Due to ground conditions, concerns for environmental impact, and seasonal temperatures the chosen water intake methodology for this site will be a submersible pump encased in an exposed stainless steel casing mounted to the concrete inlet structure of the penstock feed to the hydroelectric facility. The submersible pump is to be set approximately 4.5m below the service platform of the inlet structure such that the pump discharge is a minimum of 1m below the low water level for the reservoir. The steel casing is to be provided with a screened

intake for the submersible pump that ensures that water intake moves across the motor. The minimum effective screen area to be provided is 0.02m² with a maximum design opening of not more than 2.5mm as indicated by the Fisheries and Oceans Canada Interim Code of Practice for end-of-pipe fish protection screens for small water intakes in freshwater. The base of the casing is to be perforated with maximum 2.5mm diameter perforations.

7.3. Raw Water Supply Pump Design

The estimated length of water supply service from the water intake to the proposed camp facility is 450m with approximately 14m of elevation difference. Based on the selected supply service being a 25mm diameter PEX pipe we have recommended a Grundfos 10S05-6 0.5hp 230V 60hz submersible pump with an expected supply rate of approximately 8USgpm at 140ft of head. This pump should achieve the maximum daily demand with a total daily pump run time of approximately 200 minutes.

7.4. Raw Water Supply Service

The chosen material of water supply conveyance for this work camp is Urecon Dual PEX-Flex 2 x 1" insulation jacketed supply and return pipe. This system allows for the recirculation of the supply water to mitigate freezing for the exposed pipe in colder temperatures. The insulation jacket houses two 26.2mm inside diameter PEX pipes for the supply and return. This pipe network will work with the submersible raw water supply pump and dual recirculating pumps to maintain a constant flow in the service line while domestic water is in use and when it is not. This service will be installed above grade and within culvert sleeves at road crossings from the submersible pump at the reservoir intake to the work camp facilities potable water and recirculating system.

7.5. Raw Water Recirculating System

To reduce the risk of freezing for the above-grade raw water supply system, recirculating pumps and a recirculation line will continuously move water from the camp to the submersible raw water supply pump and back to the work camp. Recirculation will remain operational during the supply pump operation. This will utilize dual Grundfos CR 3-6 A-FGJ-A-E-HQQE 1.5hp 230V 60Hz vertical multistage centrifugal pumps. The pumps will be in duplex for redundancy to further mitigate the risk of freezing of the water supply line to the facility. Each pump connection to the raw water supply/recirculation system will require a check valve out the discharge end along with isolation valves and unions on the inlet and outlet for full isolation and maintenance as indicated on the design drawings.

7.6. Water Supply Operating Logic

The operating logic for the water supply and recirculation system will utilize a pressure switch, float controlled electrically actuated valve, and flow switch. When the potable water cistern calls for water the electronically actuated valve will open, dropping water pressure in the system causing the submersible raw water supply pump to deliver flows. When the potable water cistern is full the float will activate the electronic valve to close, resulting in increased pressure in the supply system and the raw water supply pump to shut down. The recirculating pumps will be turned on and off manually as required by the seasonal temperatures. A flow switch on the incoming feed to the pumps will be provided as a redundant off control to ensure they do not operate without water in the system.

8.0 WATER SYSTEM CONSTRUCTION PROCEDURE

8.1. Proposed Camp Facility Water System

The connection of the raw water supply to the camp facility water system should occur directly after the recirculating pumps. Manual and electrical isolation valves are required at this connection to control the delivery of water to the potable water cistern. The camp facility water treatment and distribution system are provided by others.

8.2. Water Intake Structure

The casing for the submersible water supply pump should be 4.6m in length and installed level with the elevation of the service platform of the inlet structure for the penstock supply to the hydroelectric facility. This casing is recommended as a 200mm diameter galvanized stainless steel spool piece complete with perforated endcap for the pump to rest on and an intake screen with an effective screen area of 0.02m². The intake screen openings should have a maximum dimension of 2.5mm. A torque arrestor is recommended to secure the pump from rotating during start-up. The casing is to be fixed to the concrete inlet structure between the high water level and the top of the concrete structure. Engineered shop drawings are to be submitted for approval prior to construction for the mounting methodology. The casing will contain the dual PEX-Flex piping complete with jacket to within 150mm of the submersible pump discharge along with a redundant off float for the submersible pump and submersible electrical and pump communication wiring.

8.3. Raw Water Supply Pump

The raw water supply pump is to be a submersible Grundfos 10S05-6 0.5hp 230V 60hz installed within the proposed casing. The pump is to be equipped with a check valve at the discharge prior to connection to the insulation jacketed Dual PEX-Flex water supply and recirculation loop. The submersible pump will be controlled by a pressure switch at the work camp facility domestic supply system and a redundant shut off float set at the top of the pump discharge. It is important to maintain the recirculation loop and insulated jacket too as close to the pump discharge as possible.

8.4. Raw Water Supply Pump

The raw water supply pump is to be a submersible Grundfos 10S05-6 0.5hp 230V 60hz installed within the proposed casing. The pump is to be equipped with a check valve at the discharge prior to connection to the insulation jacketed Dual PEX-Flex water supply and recirculation loop. The submersible pump will be controlled by a pressure switch at the work camp facility domestic supply system and a redundant shut off float set at the top of the pump discharge. It is important to maintain the recirculation loop and insulated jacket too as close to the pump discharge as possible.

8.5. Raw Water Supply Service

The raw water supply/recirculation system piping is to be installed as per the manufacturer's guidelines for the jacketed Dual PEX-Flex 2 x 1 system. It is critical that the integrity of the insulated jacket is maintained across the length of the system including fittings between the connection to the raw water supply pump and the camp facility. Minimum 300mm diameter CSP culverts are to be provided at all road crossings to ensure pipe protection. Due to the extreme temperatures at this location, heat tracing is recommended for the length of the supply run to assist the recirculation system to mitigate freezing. The line is to be installed such that high/low points are eliminated wherever possible. An air release valve is recommended as the services enter the work camp facility.

8.6. Raw Water Recirculating System

The raw water recirculating system is to be installed with full redundancy (duplex pumps installed in parallel). The pumps are to be Grundfos CR 3-6 A-FGJ-A-E-HQQE 1.5hp 230V 60Hz or approved equivalent. Each pump is to be equipped with discharge check valves completed with isolation valves and unions on the supply and

discharge line to allow isolation and maintenance as required. The pumps are to be equipped with independent controls including flow switch activated redundant off and audible alarm indicating pump failure. An air release valve is recommended on the recirculating line prior to exiting the work camp facility.

9.0 EARTHWORKS

The proposed earthworks are based on a combination of digital elevation model data (assumed at UTM) and GPS site survey completed at a local coordinate system. These surfaces were combined and used as the basis for the grading design and volume analysis.

9.1. Site Grading

The site grading plan intends to achieve a minimum 0.5% slope across the entire site, with the primary grading occurring from the existing access to the proposed site to the south at the end of the sewage disposal fields. Grading beneath the sewage sand mound disposal fields should achieve a 0.5% slope across the basal width of the sand mound towards the boundary of the site development to promote drainage. Grading in areas that will support the camp and accessory buildings shall be completed in such a way as to minimize fill under the structures. Grading in areas that have the sand mound should be completed in such a way as to minimize cut in the basal area of the sand mound. The subgrade must have no low points or areas for water to become trapped beneath the capping structure.

9.2. Site Access

The existing access to the proposed work camp location is to be graded such that it transitions into the proposed site grading with a maximum 8% grade and a minimum vertical curve transition length of 8m. The site access and all areas of the proposed site, excluding the basal area of the sewage disposal fields, are to be capped with a minimum 150mm thick layer of SGSB gravels or approved equivalent granular soils.

9.3. Volume Analysis

The depth and consistency of the native clay soils in the proposed development area is relatively unknown, with soils in the area consisting of both clay and rock. The analysis assumes that all cut volumes can be used as fill. If the cut material is deemed unusable as fill, approved imported fill is to be used in place of unsuitable material. Import or embankment fill shall be placed and compacted in lifts not exceeding 300mm. Any import fill that is to be placed beneath the sand mound

disposal field shall match the sand mound specification or approved equivalent granular soil. The approximate earthwork volumes are:

- Native Soil Cut: 600 cu.m Source: onsite
- Native Soil Embankment Fill: 600 cu.m Source: onsite
- Surfacing Aggregate Import: 420 cu.m Source: Pit V or Pit W
- Sand Mound Import: 220 cu.m Source: Pit C
- Sand Mound Cover Import: 300 cu.m Source: Organics or Pit C

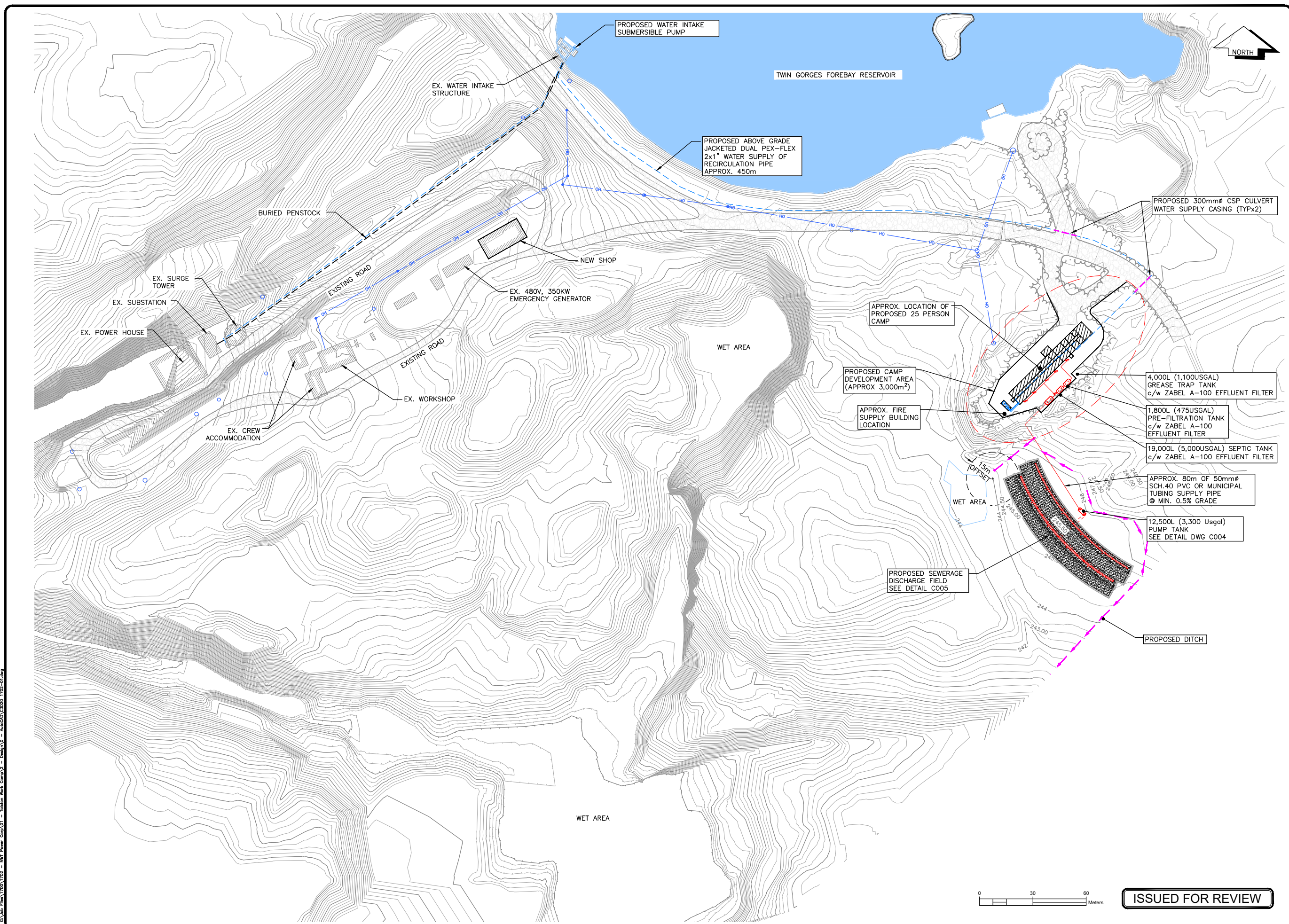
If you have any questions regarding the contents of this report, please feel free to contact the undersigned directly.

L&M ENGINEERING LIMITED

Prepared by:



Jamie Schenkeveld, P.Eng
Associate



LEGEND

EXISTING

- EX. TEST PIT & DRILL HOLE
- EX. BENCHMARK & SURVEY HUBS
- EX. I.P.s & I.S.M.s
- EX. LEGAL LINE
- EX. LEGAL R.O.W. & EASEMENT
- EX. SANITARY & MANHOLE
- EX. SANITARY FORCE MAIN
- EX. STORM & MANHOLE
- EX. SINGLE & DOUBLE CATCHBASIN c/w CB LEADS
- EX. CATCHBASIN MANHOLE
- EX. CULVERT
- EX. FIRE HYDRANT & VALVE ASSEMBLY
- EX. WATERMAIN & VALVE
- EX. BLOW-OFF ASSEMBLY
- EX. CURB STOP
- EX. ROAD & SIDEWALK
- EX. ROAD SIGN(S)
- EX. SHOULDER
- EX. TOP OF SLOPE
- EX. TOE OF SLOPE
- EX. DITCH or SWALE
- EX. FENCE
- EX. OVERHEAD LINES
- EX. UNDERGROUND LINES
- EX. POWER POLE & ANCHOR
- EX. GAS MAIN

PROPOSED

- PR. LEGAL LINE
- PR. LEGAL R.O.W. & EASEMENT
- PR. SANITARY & MANHOLE
- PR. STORM & MANHOLE
- PR. SINGLE & DOUBLE CATCHBASIN c/w CB LEADS
- PR. CATCHBASIN MANHOLE
- PR. CULVERT
- PR. DITCH or SWALE
- PR. FIRE HYDRANT & VALVE ASSEMBLY
- PR. WATERMAIN & VALVE
- PR. GRAVEL SHOULDER
- PR. ASPHALT
- PR. CURB & SIDEWALK
- PR. ROAD SIGN(S)

NO.	DATE	REVISION	DR.

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ENGINEER:	JSS
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DRAWING FILE:	C3D20 1702-01.dwg
CORRESPONDENCE:	
GRID:	
DATE:	JAN 2020
SCALES:	FULL: 1:1000 HALF: 1:2000

NWT POWER CORPORATION
 WORK CAMP
 ONSITE SEWERAGE SYSTEM
 OVERALL SITE PLAN

CONSULTANTS PROJECT No.
1702-01
 DRAWING No.
C000

SHEET No.	REV. No.
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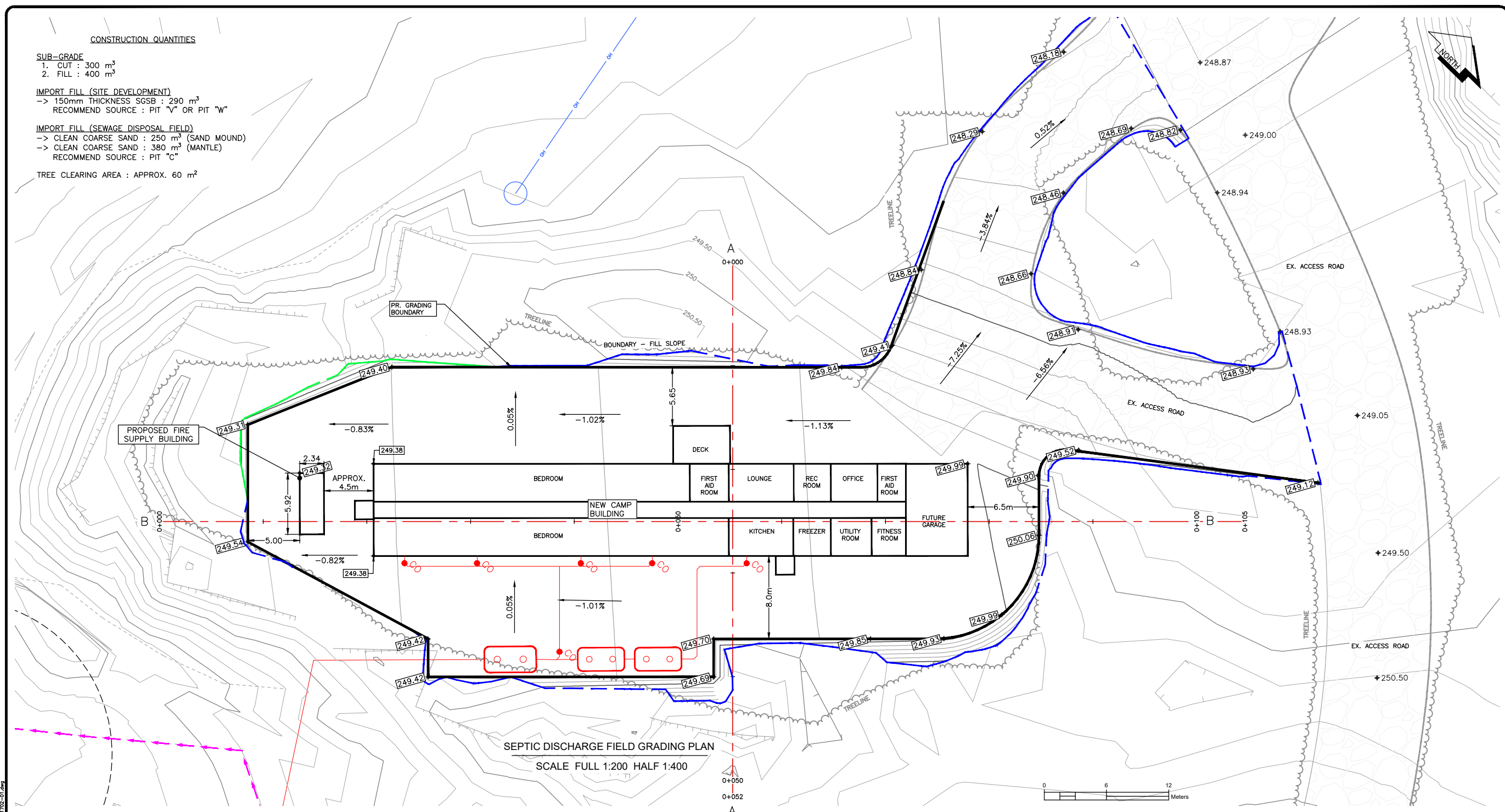
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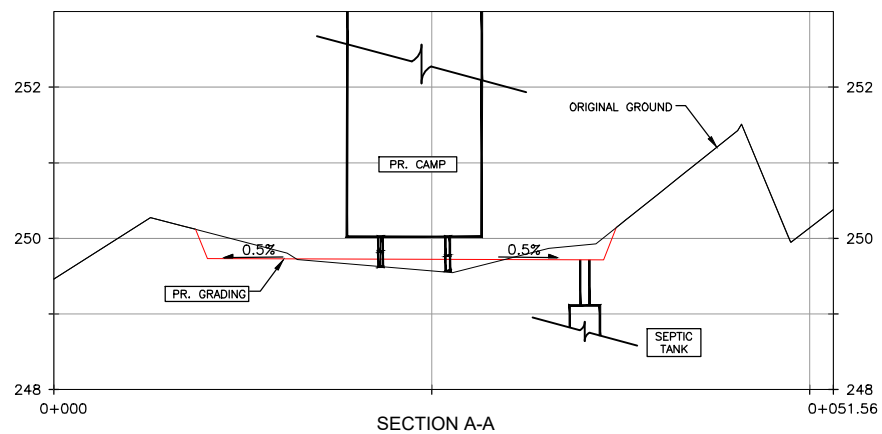
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CONSTRUCTION QUANTITIES

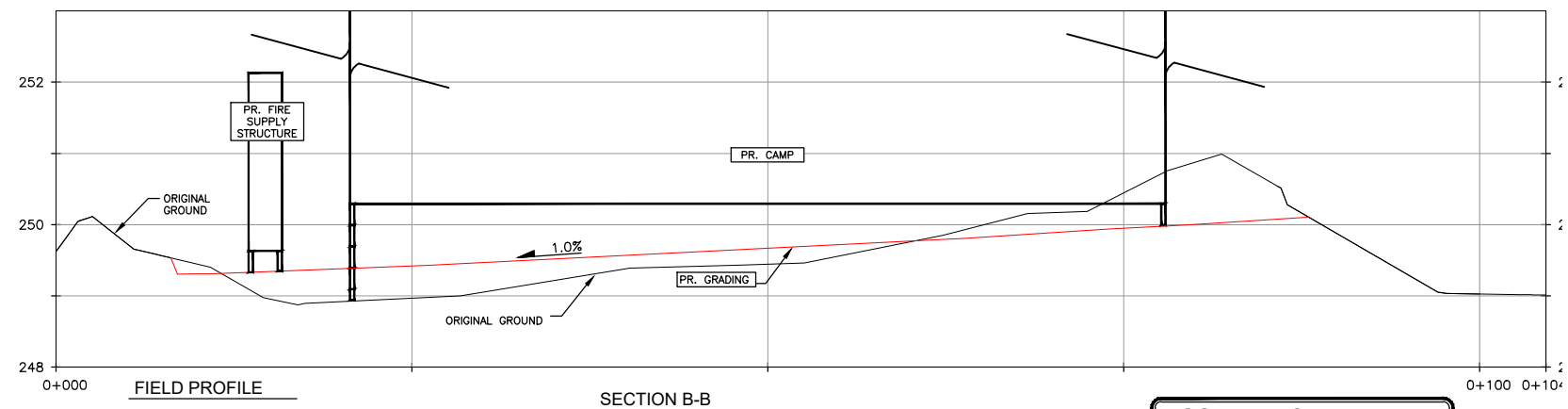
- SUB-GRADE**
 1. CUT : 300 m³
 2. FILL : 400 m³
- IMPORT FILL (SITE DEVELOPMENT)**
 -> 150mm THICKNESS SGSB : 290 m³
 RECOMMEND SOURCE : PIT "V" OR PIT "W"
- IMPORT FILL (SEWAGE DISPOSAL FIELD)**
 -> CLEAN COARSE SAND : 250 m³ (SAND MOUND)
 -> CLEAN COARSE SAND : 380 m³ (MANTLE)
 RECOMMEND SOURCE : PIT "C"
- TREE CLEARING AREA : APPROX. 60 m²



SEPTIC DISCHARGE FIELD GRADING PLAN
 SCALE FULL 1:200 HALF 1:400



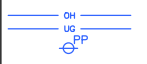
SECTION A-A



FIELD PROFILE
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XXX.XX PR. ELEVATION
 +
 XXX.XX EX. ELEVATION



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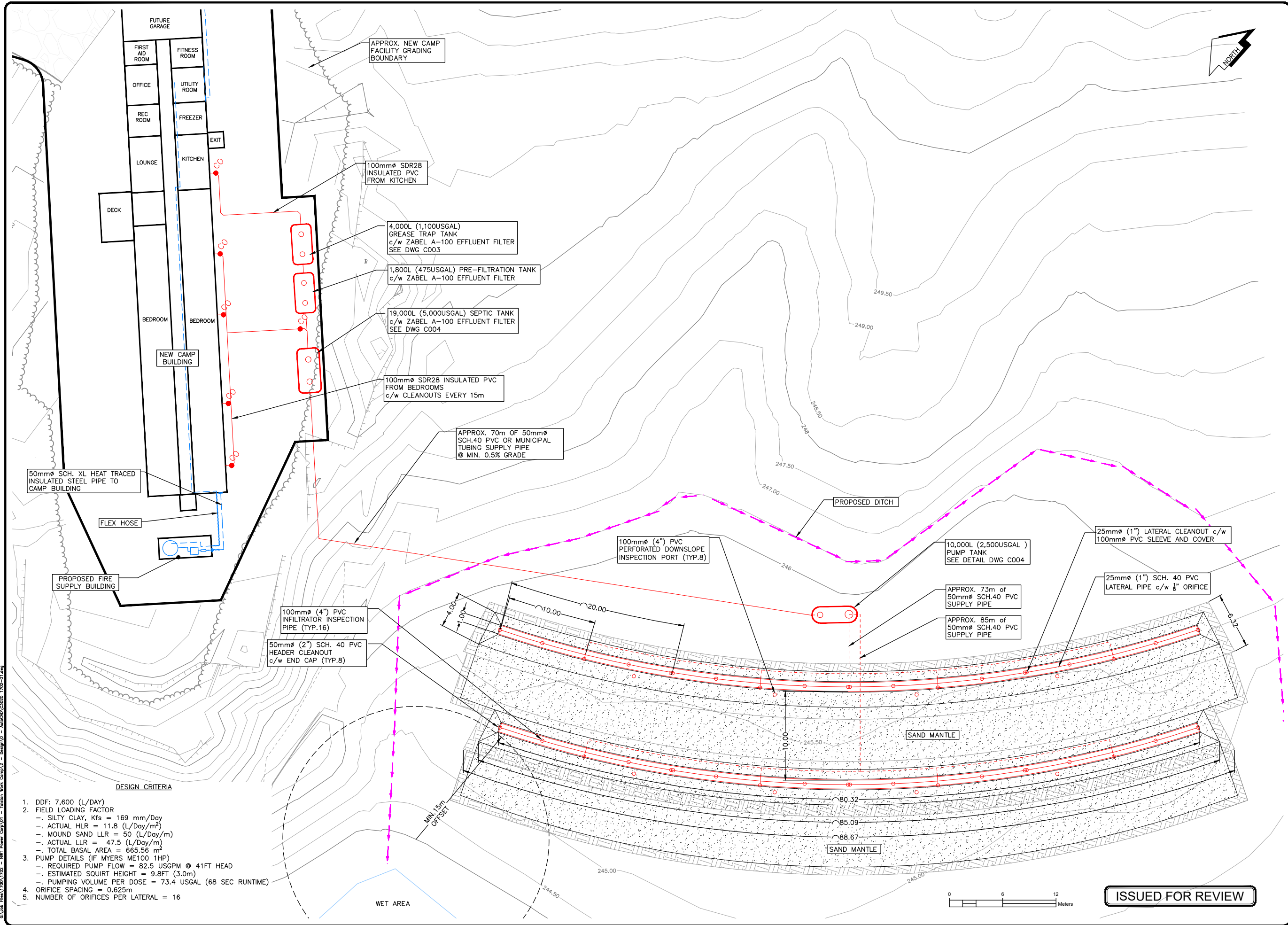
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GRID:	
DATE:	27/FEB/2020
SCALES:	AS NOTED

NWT POWER CORPORATION
 WORK CAMP
 ONSITE SEWERAGE SYSTEM
 SITE GRADING PLAN

CONSULTANTS PROJECT No.
1702-01
 DRAWING No.
C001

SHEET No.
 2 OF 8
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- DESIGN CRITERIA**
- DDF: 7,600 (L/DAY)
 - FIELD LOADING FACTOR
 - SILTY CLAY, Kfs = 169 mm/Day
 - ACTUAL HLR = 11.8 (L/Day/m²)
 - MOUND SAND LLR = 50 (L/Day/m)
 - ACTUAL LLR = 47.5 (L/Day/m)
 - TOTAL BASAL AREA = 665.56 m²
 - PUMP DETAILS (IF MYERS ME100 1HP)
 - REQUIRED PUMP FLOW = 82.5 USGPM @ 41FT HEAD
 - ESTIMATED SQUIRT HEIGHT = 9.8FT (3.0m)
 - PUMPING VOLUME PER DOSE = 73.4 USGAL (68 SEC RUNTIME)
 - ORIFICE SPACING = 0.625m
 - NUMBER OF ORIFICES PER LATERAL = 16

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CORRESPONDENCE:	
GRID:	
DATE:	JAN 2020
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NWT POWER CORPORATION
WORK CAMP
ONSITE SEWERAGE SYSTEM
DETAILED DISCHARGE SITE PLAN

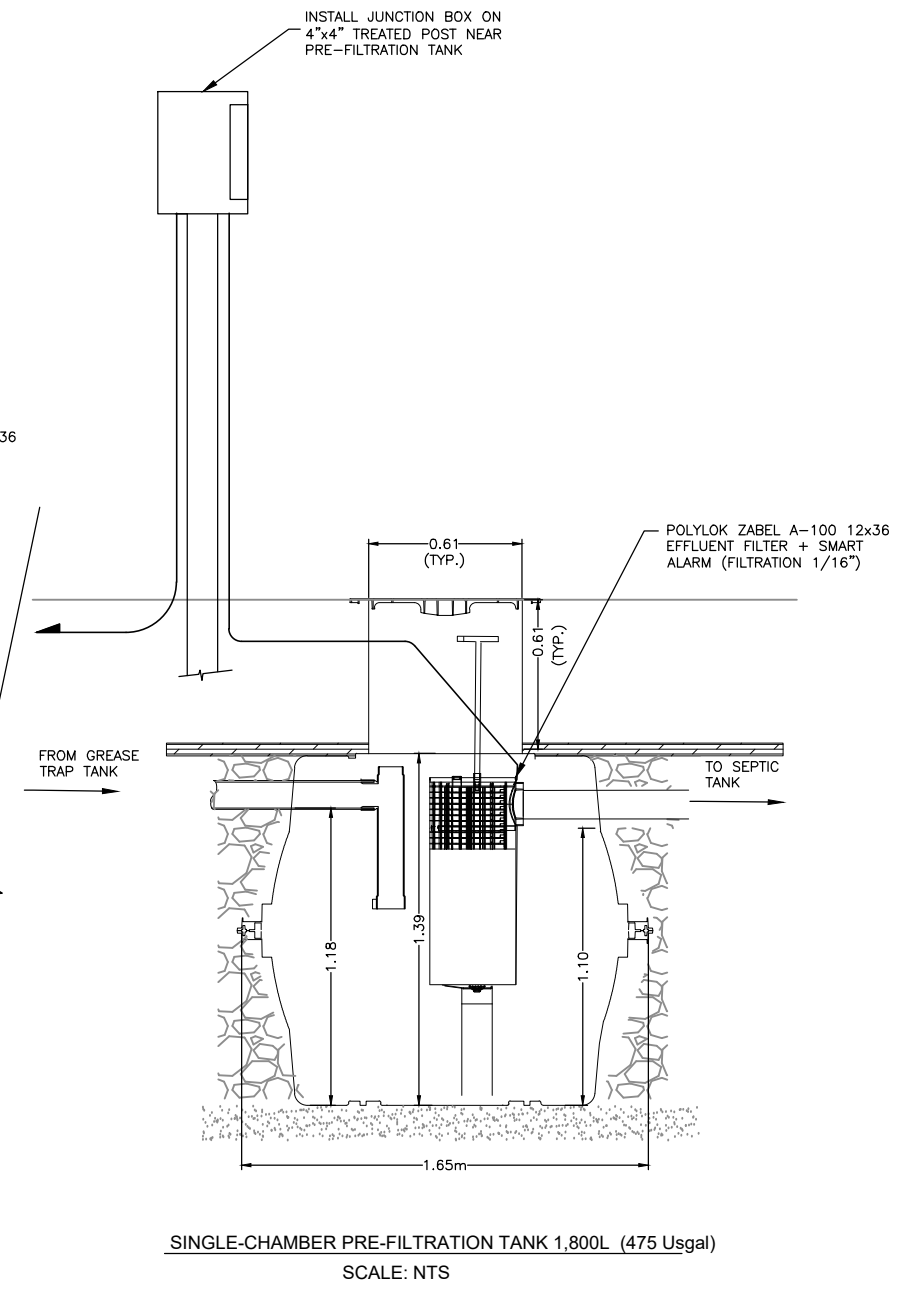
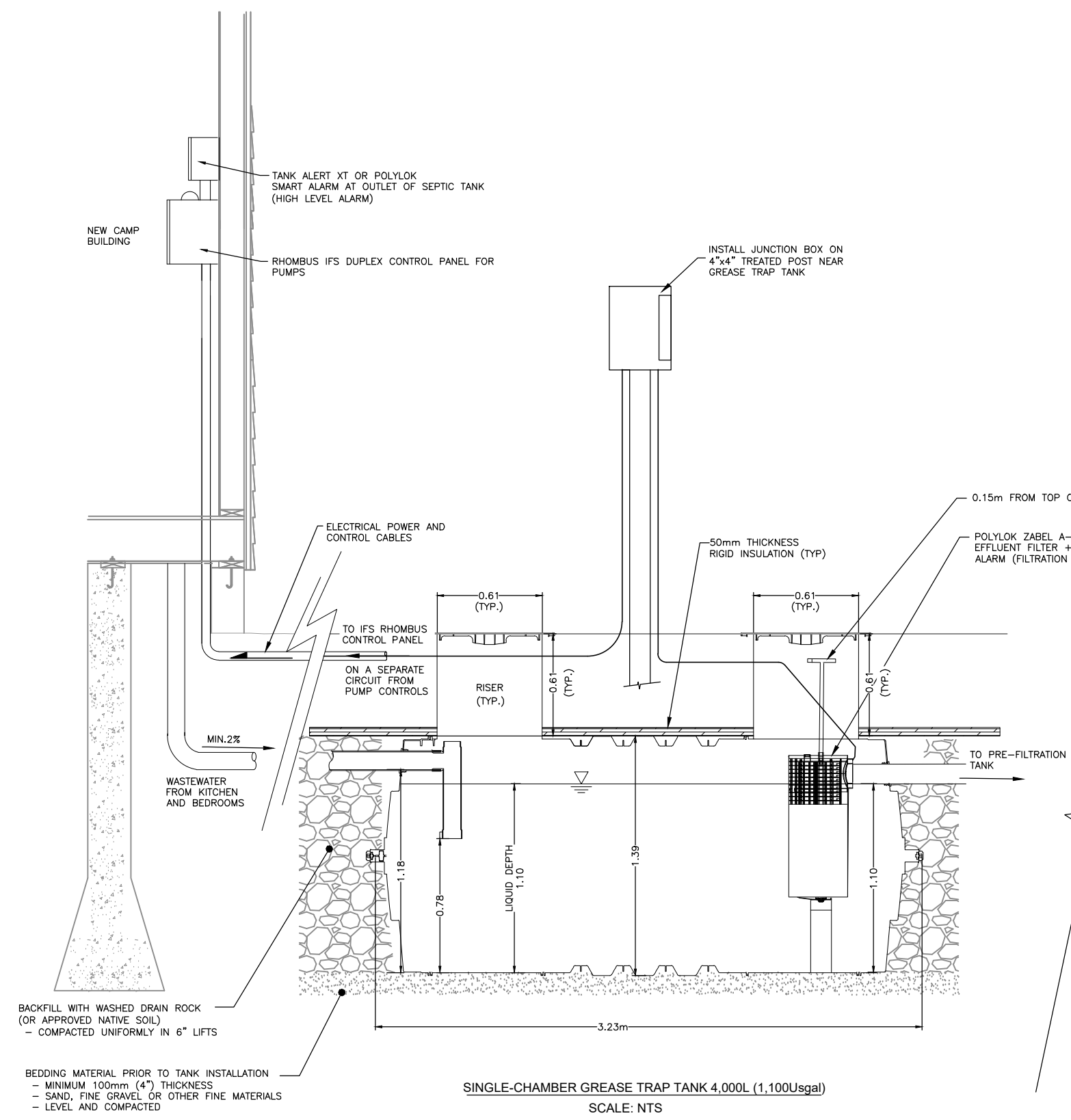
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1702-01
DRAWING No.
C002

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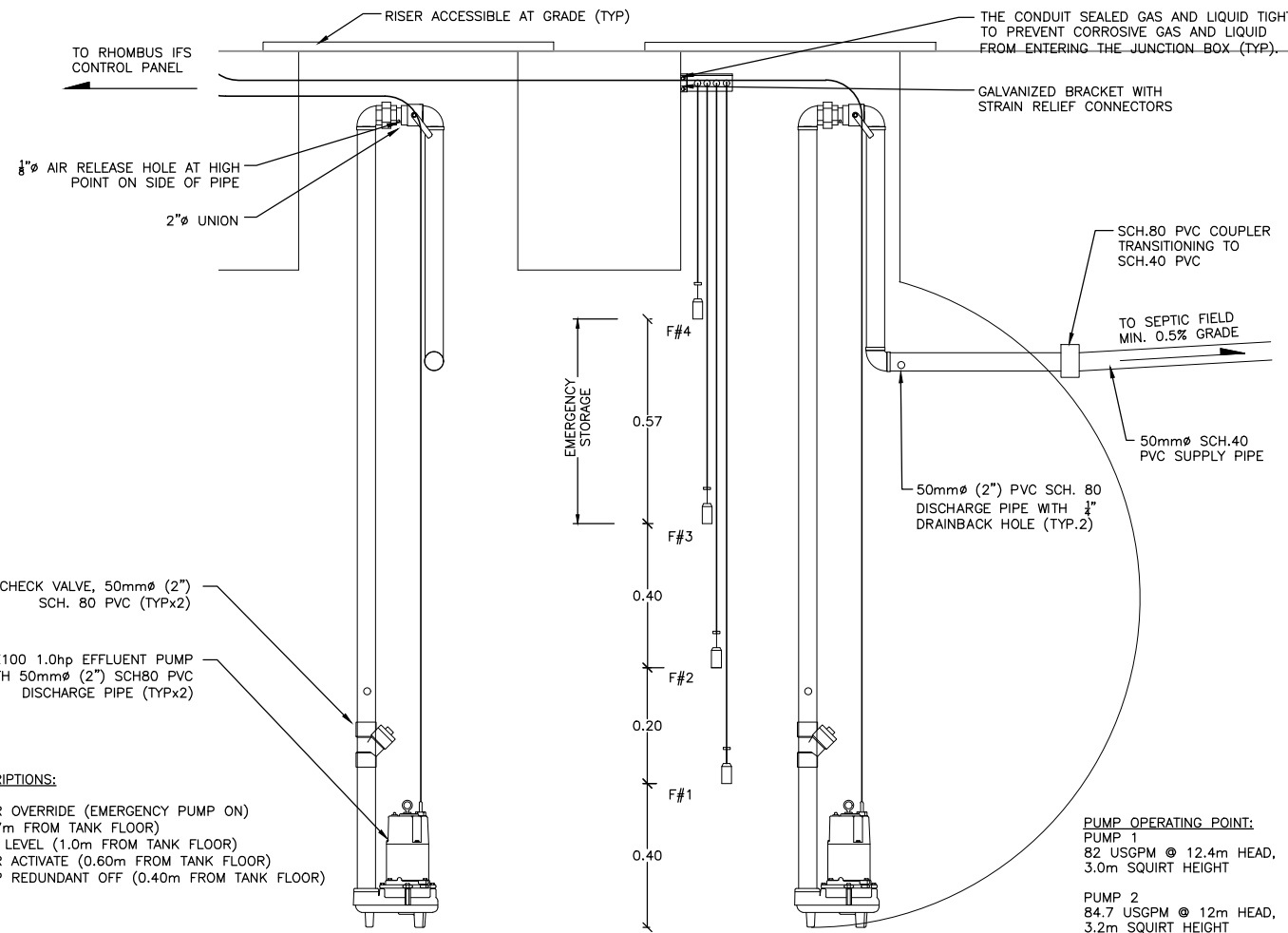
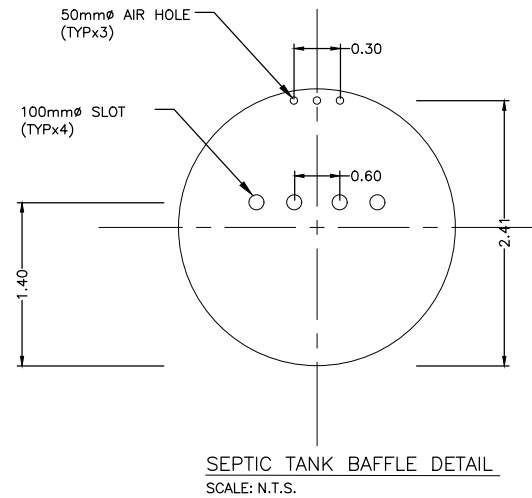
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DATE:	JAN 2020
SCALES:	AS NOTED

NWT POWER CORPORATION
 WORK CAMP
 ONSITE SEWERAGE SYSTEM
 SEPTIC & PUMP TANK DETAIL

CONSULTANTS PROJECT No.
1702-01
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C003

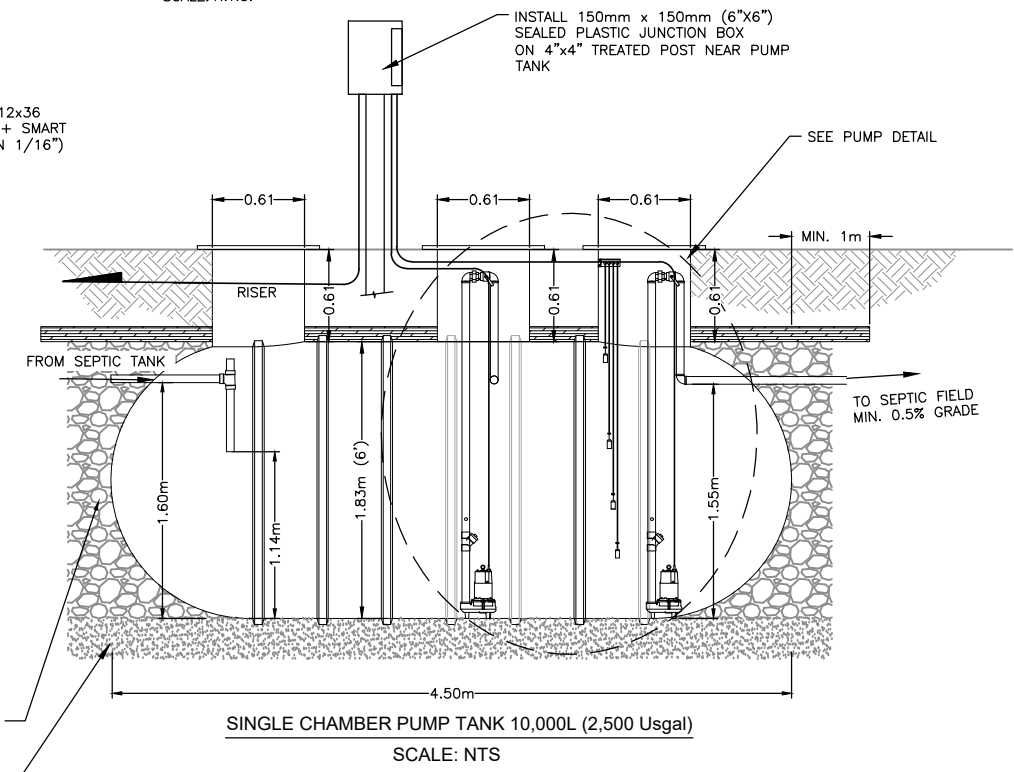
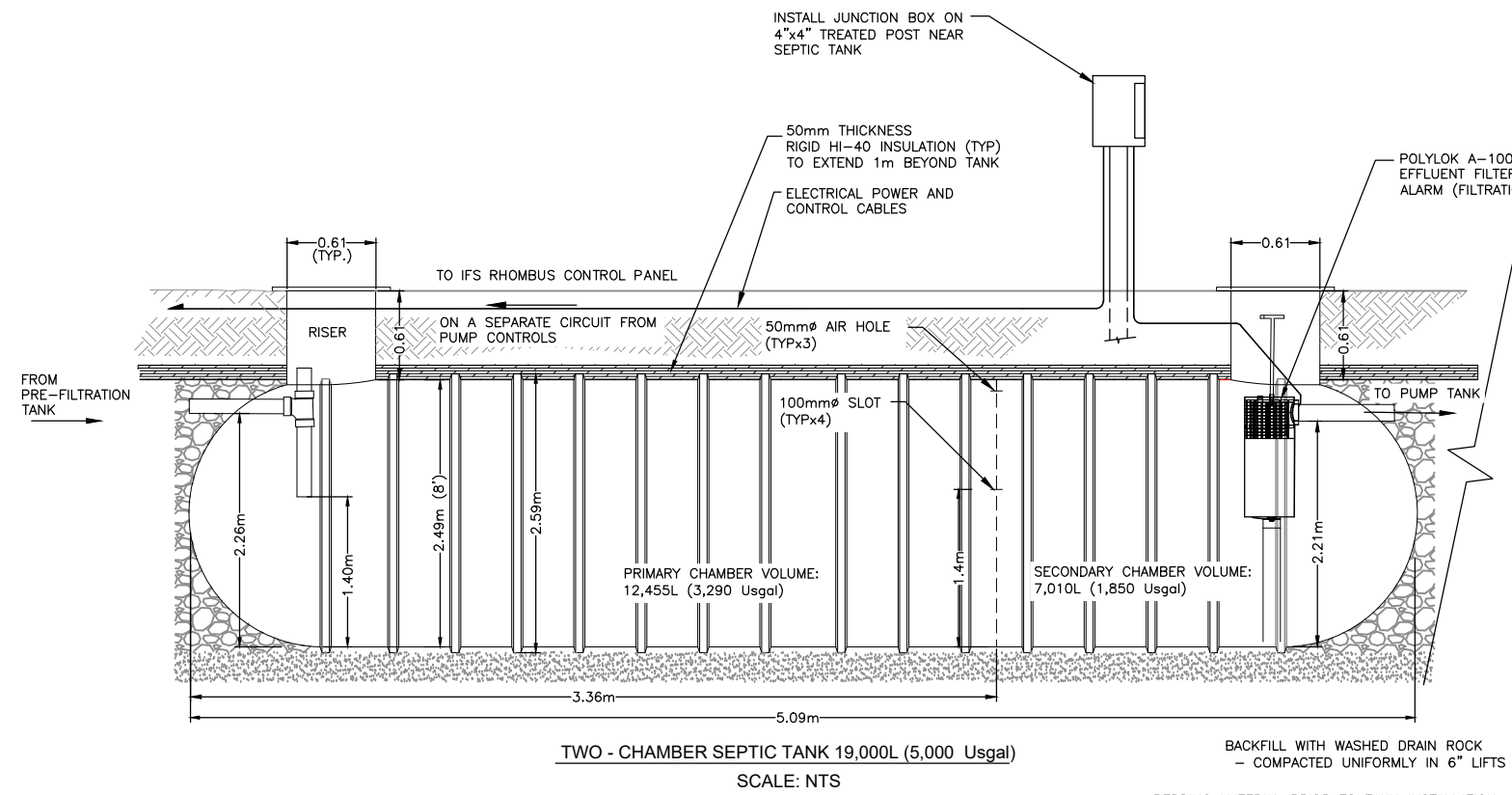
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SHEET No. 4 OF 8	REV. No. 0
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- FLOAT DESCRIPTIONS:
- F#4 - TIMER OVERRIDE (EMERGENCY PUMP ON) (1.57m FROM TANK FLOOR)
 - F#3 - HIGH LEVEL (1.0m FROM TANK FLOOR)
 - F#2 - TIMER ACTIVATE (0.60m FROM TANK FLOOR)
 - F#1 - PUMP REDUNDANT OFF (0.40m FROM TANK FLOOR)

PUMP OPERATING POINT:
PUMP 1
82 USGPM @ 12.4m HEAD,
3.0m SQUIRT HEIGHT
PUMP 2
84.7 USGPM @ 12m HEAD,
3.2m SQUIRT HEIGHT



BACKFILL WITH WASHED DRAIN ROCK - COMPACTED UNIFORMLY IN 6" LIFTS
BEDDING MATERIAL PRIOR TO TANK INSTALLATION
- MINIMUM 100mm (4") THICKNESS
- SAND, FINE GRAVEL OR OTHER FINE MATERIALS
- LEVEL AND COMPACTED

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CORRESPONDENCE:	
GRID:	
DATE:	JAN 2020
SCALES:	AS NOTED

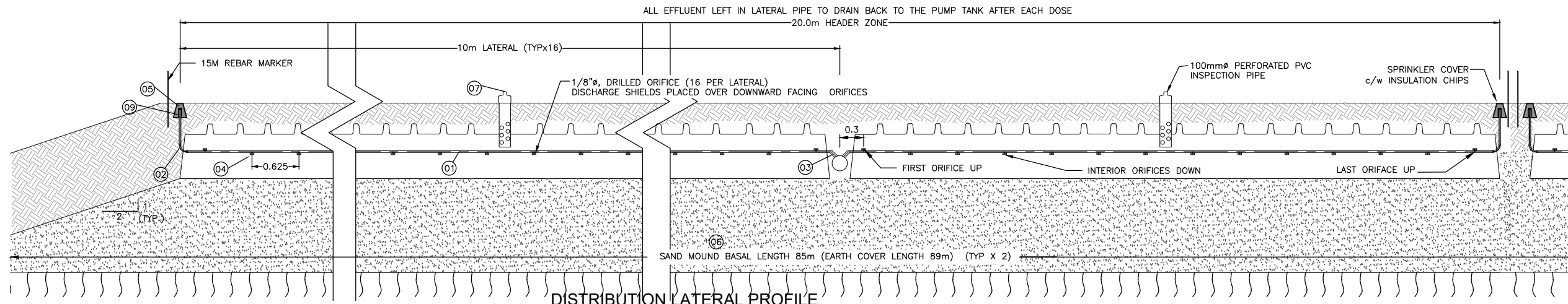
NWT POWER CORPORATION
WORK CAMP
ONSITE SEWERAGE SYSTEM
SEPTIC & PUMP TANK DETAIL

CONSULTANTS' PROJECT No.
1702-01
DRAWING No.
C004

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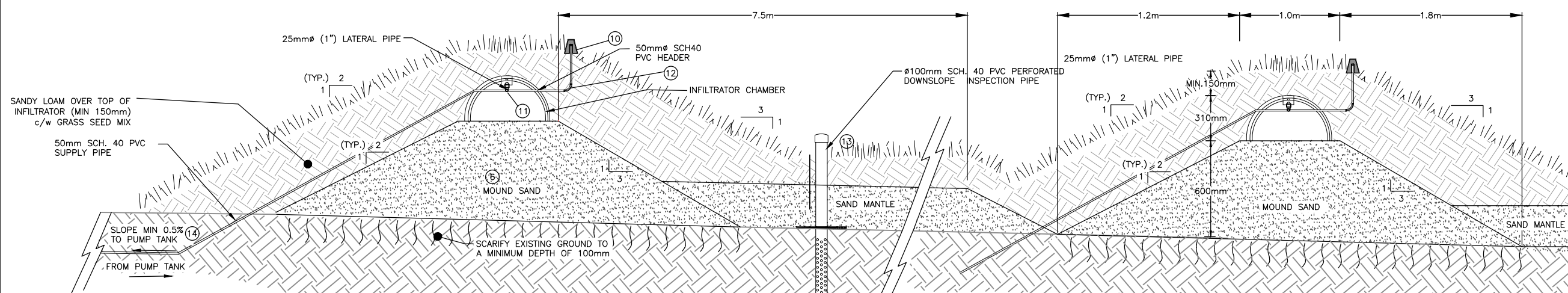
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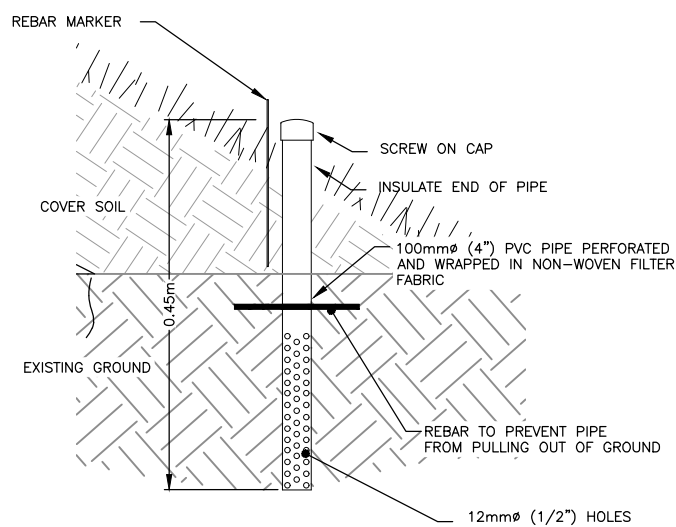
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SCALE : NTS



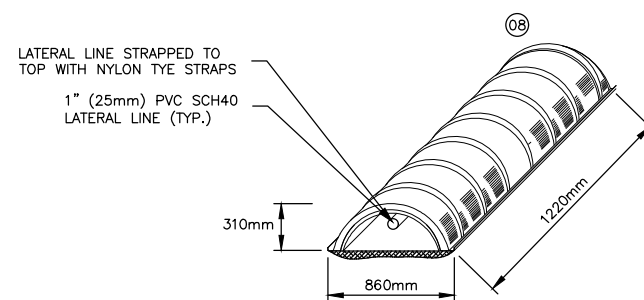
HEADER DETAIL

N.T.S.



DOWNSLOPE INSPECTION PIPE DETAIL

N.T.S.



QUICK4 STANDARD INFILTRATION CHAMBER DETAILS

N.T.S.

ESTIMATE OF MATERIALS (TOTAL)			
ITEM	QTY.	SIZE	DESCRIPTION
01	160m	1"	PIPE, SCH. 40 PVC
02	16	1"	90° L.R. ELBOW, SCH. 40 PVC
03	8	1.0"x1.0"x1.0"	CROSS OR TEE, SCH. 40 PVC
04	256	N/A	ORIFICE SHIELDS
05	16	4"	SPRINKLER COVERS FOR END CAPS
06	250m ³	FINE	MOUND SAND
07	16	4"	PERFORATED PVC LATERAL INSPECTION PIPE
08	160m	STANDARD	INFILTRATOR CHAMBER
09	16	1"	SCH.40 LATERAL CLEANOUTS W/ ENDCAP
10	8	2"	SCH.40 HEADER CLEANOUTS W/ ENDCAP
11	8	2"x1"x1"	CROSS OR TEE, SCH. 40 PVC
12	8	2"	90° L.R. ELBOW, SCH. 40 PVC
13	8	4"	PERFORATED PVC DOWNSLOPE INSPECTION PIPE
14	160m	2"	SCH 40. PVC SUPPLY PIPE

NO.	DATE	REVISION	DR.

L & M
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1210 FOURTH AVENUE
PRINCE GEORGE, B.C.
V2L 3J4
TEL. (250) 562-1977
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DRAWN:	SJ
CHECKED:	JSS
ENGINEER:	JSS
SURVEY FILE:	
DRAWING FILE:	C3D20 1702-01.dwg
CORRESPONDENCE:	
GRID:	
DATE:	JAN 2020
SCALES:	

NWT POWER CORPORATION
WORK CAMP
ONSITE SEWERAGE SYSTEM
DETAILED DISCHARGE SITE PLAN

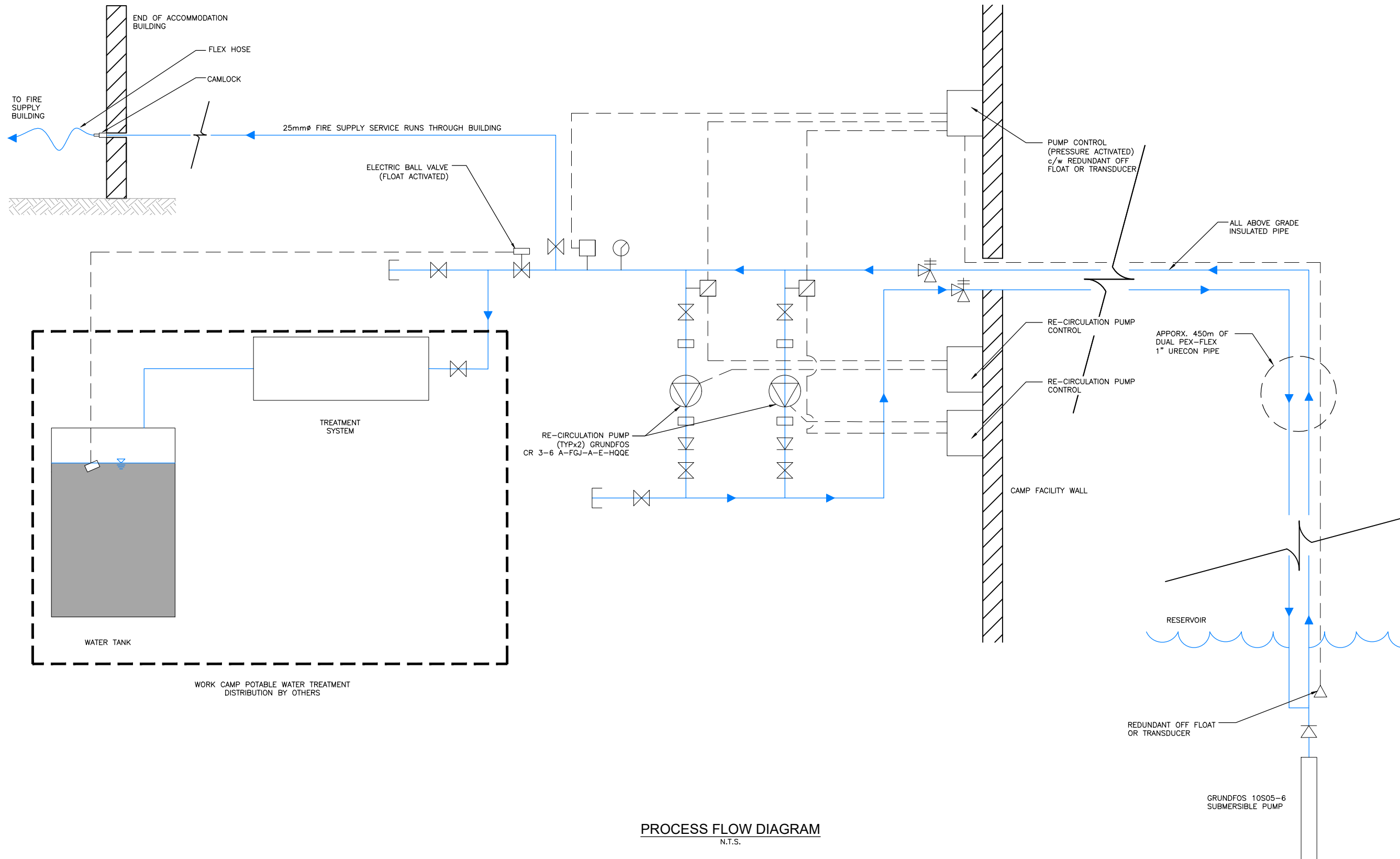
CONSULTANTS PROJECT No.
1702-01

DRAWING No.
C005

ISSUED FOR REVIEW

SHEET No.	REV. No.
6 OF 8	0

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PROCESS FLOW DIAGRAM
N.T.S.

	BALL VALVE
	ELECTRIC VALVE
	RE-CIRCULATION PUMP
	CHECK VALVE
	UNION
	PRESSURE SWITCH
	FLOW SWITCH
	PRESSURE GAUGE
	AIR RELEASE VALVE
	ELECTRIC LINE
	WATER LINE

NO.	DATE	REVISION	DR.

L&M
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DRAWN:	SJ
CHECKED:	JSS
ENGINEER:	JSS
SURVEY FILE:	
DRAWING FILE:	C3D20 1702-01.dwg
CORRESPONDENCE:	
GRID:	
DATE:	JAN 2020
SCALES:	

NWT POWER CORPORATION
WORK CAMP
ONSITE SEWERAGE SYSTEM
WATER INTAKE SYSTEM
SCHEMATIC DIAGRAM

CONSULTANTS PROJECT No.
1702-01
DRAWING No.
C007

ISSUED FOR REVIEW

SHEET No. 8 OF 8	REV. No. 0
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APPENDIX J

TALTSON WASTE DISPOSAL STANDARD OPERATING PROCEDURE

Taltson Hydro Waste Disposal Standard Operating Procedure

In accordance with the requirements of MVLWB Land Use Permit MV2020X0004 for the Taltson Overhaul the waste facility at the Taltson Hydro Facility has been upgraded. The disposal site has been subdivided into seven segregated areas based on the type of material being discarded. The layout of the disposal area is presented in Figure 1. The seven categories of waste are:

1. Old Boilers, Tanks and Appliances
2. Plastics and Rubber
3. General- Waste that does not fall into another category
4. Scrap Metal
5. Old Power Poles and Pressure Treated Lumber
6. Concrete, Bricks, Ceramics
7. Untreated Lumber, Brush and Cardboard (burn pile)

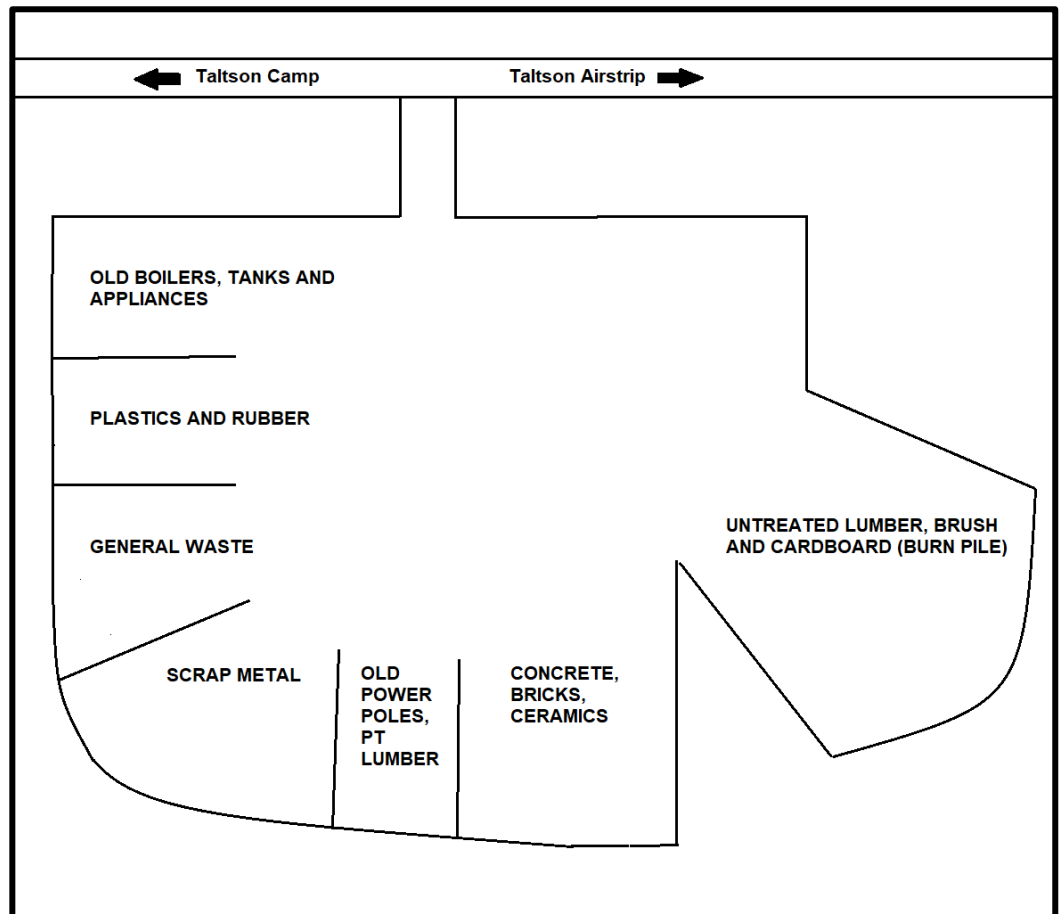


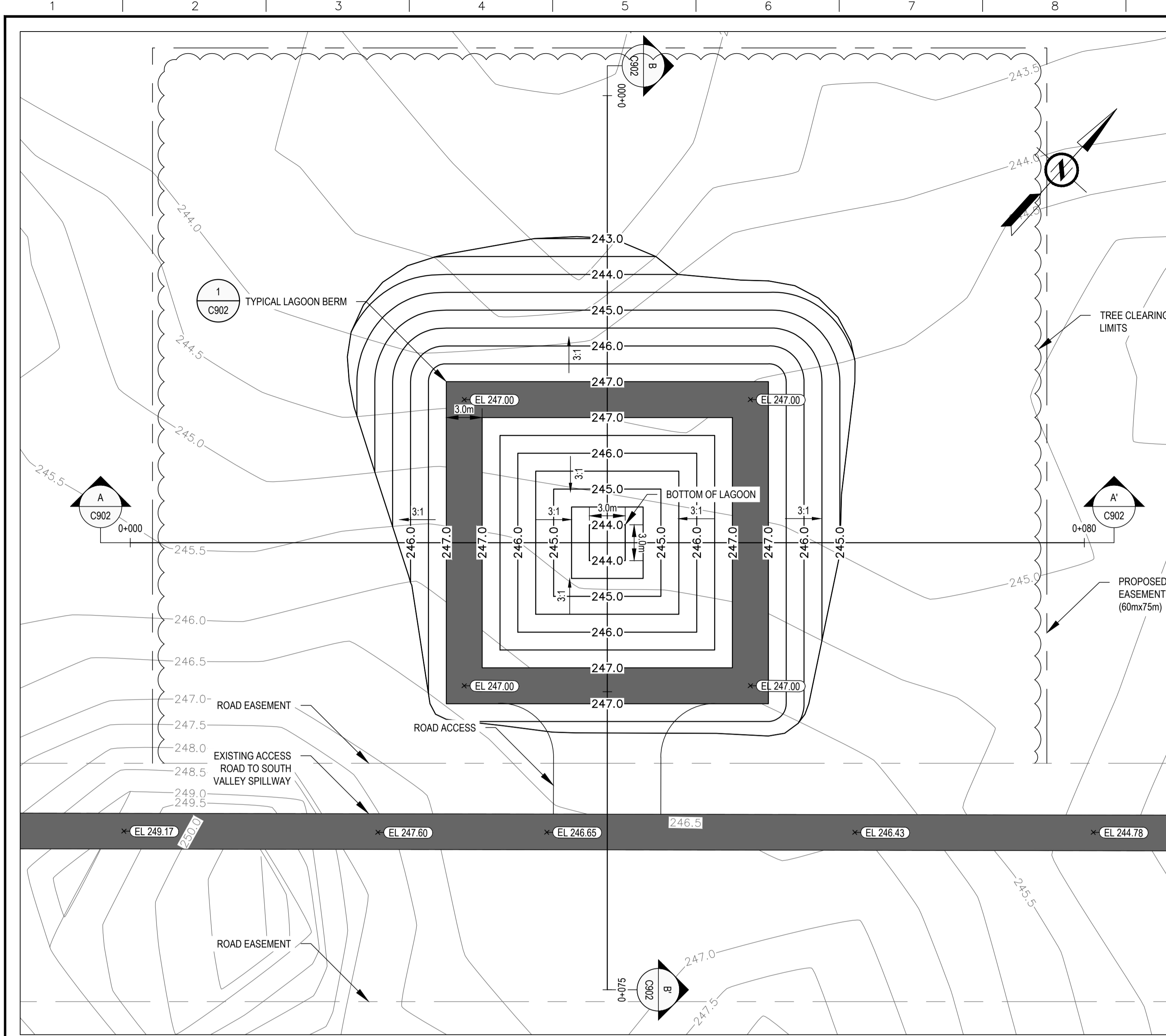
Figure 1- Layout of the Taltson Disposal Site

- This Standard Operating Procedure is to be used in addition to all waste management practices outlined in the *Taltson Hydroelectric Facility and Winter Road- Waste Management Plan*
- All waste going into the disposal site needs to be sorted as per this procedure and posted signage
 - Do not put all waste into the General location; this is only for waste that does not fall into another category
- All hazardous materials must be disposed of as per the *Taltson Hydroelectric Facility and Winter Road- Waste Management Plan* and not enter the disposal site
- Specialized Material must be disposed of as per specific departmental procedures and not enter the disposal site
- Inert metals and concrete can be buried when approved by ENR
 - Do not bury waste without ENR approval
- **The burn pile the only pile that is burned**
 - This should be done in winter months



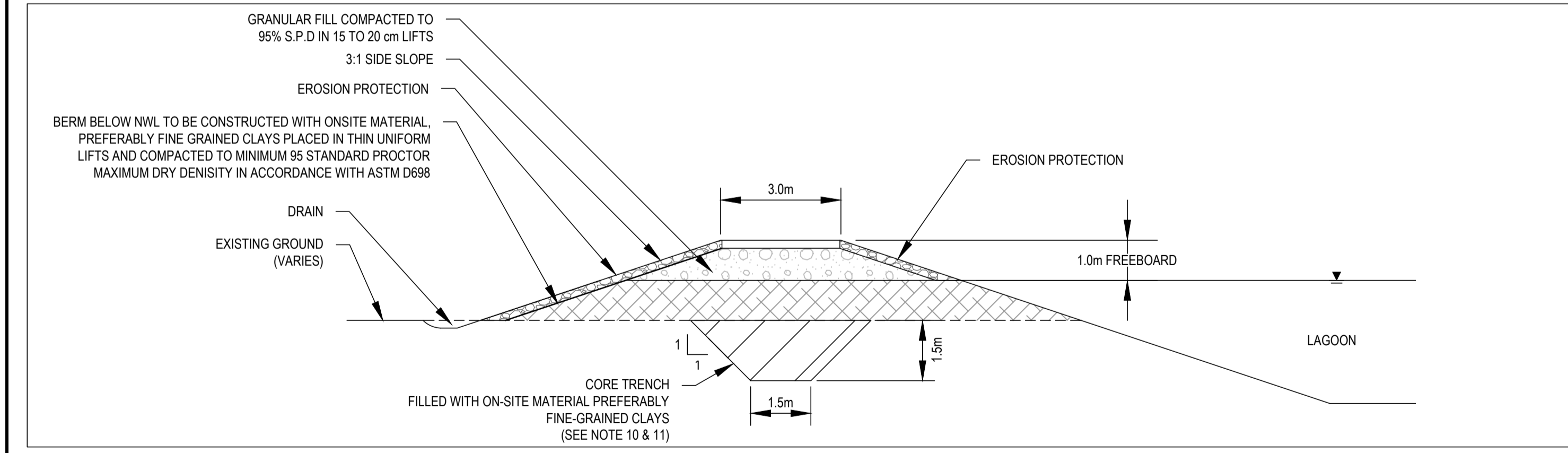
Figure 2- Photo of the Taltson Disposal Site

APPENDIX K
TEMPORARY SEWAGE LAGOON DRAWING



TALTSON HYDRO DAM FACILITY TEMPORARY SEWAGE LAGOON - PLAN

1:250
0 2.5 5 7.5m



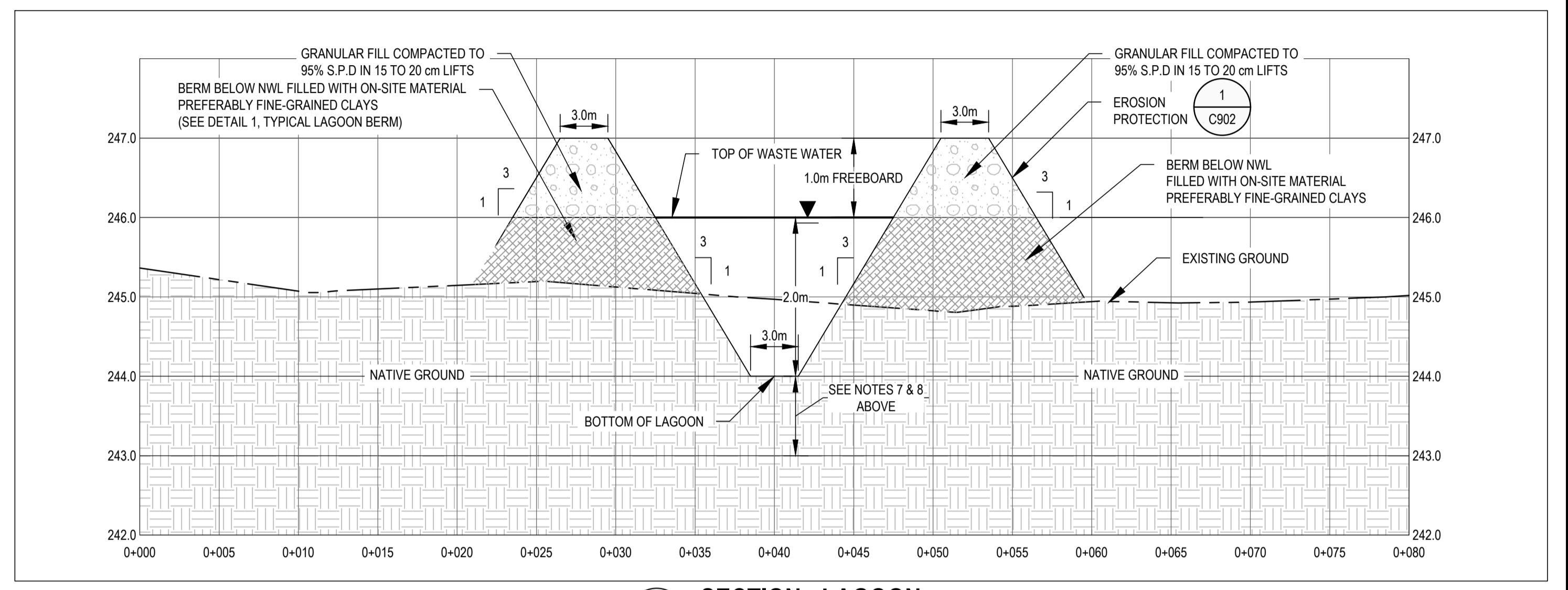
1
C902 NTS
DETAIL - TYPICAL LAGOON BERM

CIVIL GRADING LEGEND

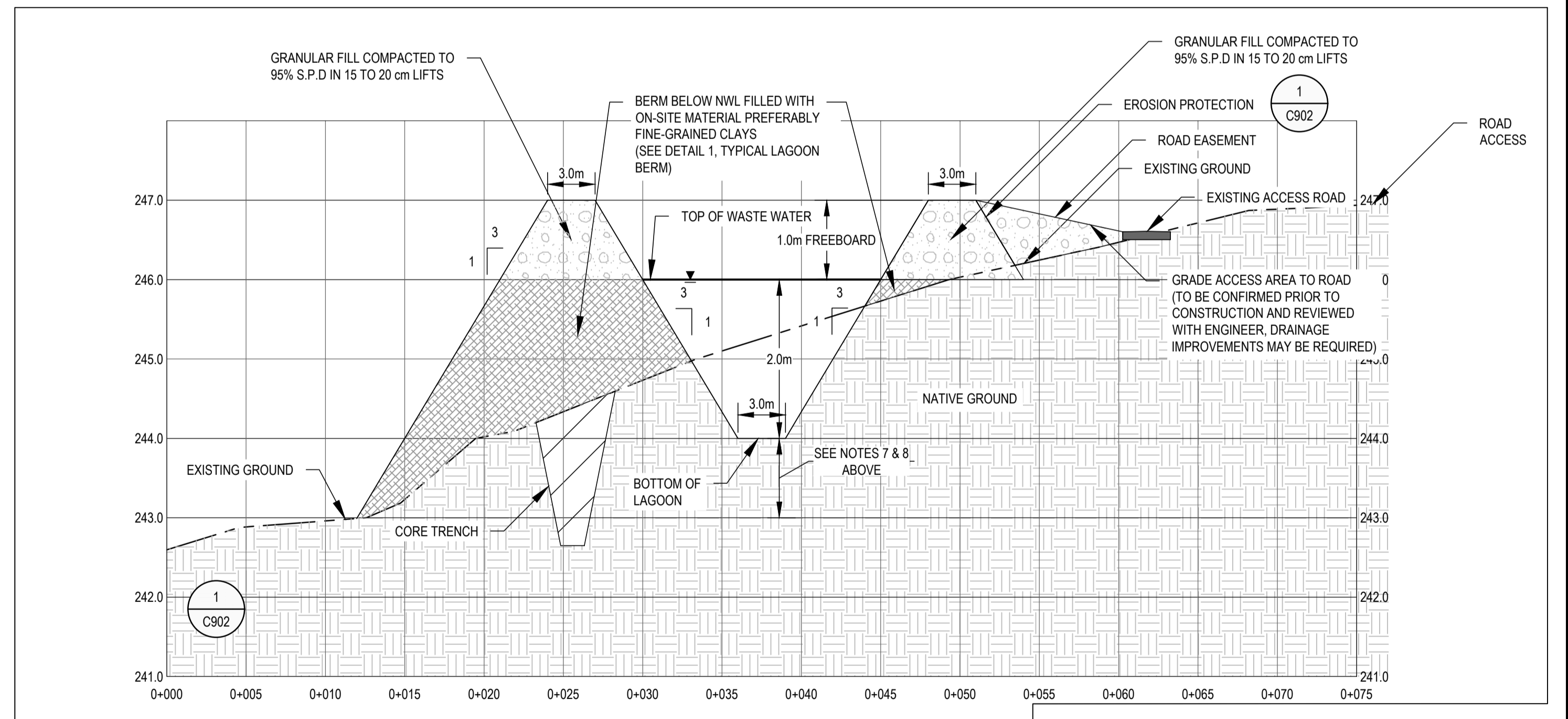
- 242.0 — EXISTING GROUND CONTOUR
- 242.0 — PROPOSED GROUND CONTOUR

CIVIL SITE NOTES:

1. REFER TO GENERAL NOTES ON SHEET P109-51776-C1000(C)
2. EXISTING CONTOURS SHOWN ARE FROM OPEN SOURCE DATA. ELEVATIONS CRITICAL TO THE DESIGN WILL BE CONFIRMED WITH SURVEY IN THE SPRING OF 2021.
3. ALL DIMENSIONS ARE IN SI METRIC UNITS, UNLESS OTHERWISE NOTED.
4. A GEOTECHNICAL INVESTIGATION WILL BE DONE IN THE SPRING OF 2021.
5. DESIGN DETAILS AND LAYOUT FOR THE TEMPORARY SEWAGE LAGOON AND ACCESS ROAD WILL BE PROVIDED PRIOR TO CONSTRUCTION STARTUP UPON THE REVIEW OF THE SURVEY AND GEOTECHNICAL REPORT.
6. ALL GRANULAR MATERIAL WILL BE SPECIFIED AND SUPPLIED FROM ON-SITE SOURCES.
7. SEWAGE LAGOON DESIGN IS BASED ON A BASE SIZE OF 6m X 18m X 2m DEEP.
8. THE ASSUMPTION OF A RELATIVELY PERMEABLE SOIL (SAND/SILTY SAND) AND A K_{SAT} OF 4E-05 CM/SEC AT LEAST 1m THICK ACROSS THE FOOTPRINT OF THE LAGOON WILL BE REQUIRED FOR THE LAGOON TO ACT AS AN INFILTRATION POND.
9. BEDROCK IS ASSUMED TO BE 5m DEEP ACROSS THE FOOTPRINT.
10. CORE TRENCH IF THE EMBANKMENT HEIGHT IS 3m OR LESS.
11. **BERM HEIGHT TOP HEIGHT**
6m OF LESS 3m
>6m 4m



A-A'
C902
SECTION - LAGOON
5H:1V 1:250



B-B'
C902
SECTION - LAGOON
5H:1V 1:250

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ISSUED FOR TENDER

REVISION LETTER	REVISION	WORK ORDER	NAME	DATE	CHECKED BY	DESIGNED BY	STATUS OF DRAWING	DATE
C	ISSUED FOR LAND USE PERMITTING		KMP	03MAY21	DC	DC	TENDER	23APR21
B	ISSUED FOR TENDER		BjB	23APR21	DC/DP	DC	TENDER	23APR21
A	ISSUED FOR TENDER (NOT TENDERED)		DJW	21JAN21	DC/DP	DC	TENDER	21JAN21
0	ORIGINAL - ISSUED FOR TENDER REVIEW		SH	11JAN21	HG / DP	HG	DRAFT	11JAN21

PROFESSIONAL STAMP	PERMIT STAMP	LOCATION	TITLE	SCALE	SHEET	DRAWING NO.	REV.
		TALTSON, NWT	TALTSON REHABILITATION PROJECT 2021 CONSTRUCTION - TBD3 TEMPORARY SEWAGE LAGOON PLAN, SECTIONS AND DETAIL	AS SHOWN	1 OF 1	P109-51776-C902	C