

NTPC Dam Safety Program



Revised 2023



DOCUMENT HISTORY				
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1	All	Rewrite to follow dam safety management document structure proposed in Dam Safety Guidelines (2013).	Jamie Tennant	1-May-21
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1. Introduction

1.1 Purpose and Overview

The Northwest Territories Power Corporation (NTPC) is the owner of all hydro dams in the Northwest Territories and is therefore responsible for their operation, maintenance, and surveillance to ensure dams are kept safe and Canadian Dam Association Guidelines are followed.

Each hydro site is regulated by a water license that is held with either the Mackenzie Valley Land and Water Board or Wek'èezhii Land and Water Board. Dam Safety is regulated at the territorial level by these boards under the water licenses that are held for each hydro facility. The purpose of the Dam Safety Program is to provide a framework to ensure the safe operation of all dams and related facilities during various conditions that could impact property, the public, the environment, or other stakeholders. This document is intended to provide pertinent information on NTPC dams and a general overview of the dam safety management system structure and some of the key components of the program.

1.2 Why have a Dam Safety Program?

Dams by their very nature create risks, and while these risks may be minimal, they can increase substantially without proper operation, maintenance, and surveillance measures. Many subtle signs which can be symptomatic of larger problems may go unnoticed for a variety of reasons. Sooner or later these problems will become apparent even to the untrained eye. However, by the time a problem has progressed to this point, potential risks have greatly increased, and repairs can become complex and extremely expensive. In most situations a Dam Safety Program that includes regular preventative maintenance, routine surveillance including monitoring and inspections, and the identification of problems in their early stages will ensure that the dam remains in good operating condition.

1.3 Objectives of the Program

1. Ensure safety of dams and related structures to promote public safety and minimize environmental and economic losses through effective, scientific, and efficient use of the compliance assurance program and tools including awareness, prevention, and enforcement.
2. Provide comprehensive information to raise awareness regarding dams and related structures including inventory of dams, public safety, and best practices.
3. Prepare, publish, and distribute literature to enhance knowledge with regards to the dam safety regulatory framework and system including administration of the regulation roles and responsibilities of individuals.
4. Plan, collaborate and participate in seminars, workshops, and conferences to facilitate effective communication among key stakeholders with regards to the dam safety regulatory system to enhance technical skills including emergency preparedness and response.
5. Ensure that reporting and tracking of dam safety deficiencies are consistent along with the identification, review and assessment of critical deficiencies, formal follow up actions, and activities tracking.

6. Ensure that roles and responsibilities with regards to consequences of non-compliance are clearly assigned and actions for non-compliance, follow-ups, and reporting are timely and consistent including the use of formal compliance authority and tools to ensure mitigation of any unacceptable risks.

1.4 What is a safe dam?

According to the US Bureau of Reclamation a safe dam is one which performs its intended functions without imposing unacceptable risks to the public and environment by its presence.

1.5 Canadian Dam Association Guidelines

The Canadian Dam Safety Association initially published Dam Safety Guidelines describing the steps required to be taken by the dam owner in 1995. In 1999, these guidelines were revised by the Canadian Dam Association (CDA). Work on the guidelines continued in 2003 when the CDA began soliciting input and suggestions for revisions and additions through the internet and workshops across the country which resulted in the revised Guidelines made public in 2007.

The CDA Dam Safety Guidelines (2007) consists of two sections: Section 1 describes the principles that are applicable to all dams in Canada and Section 2 describes guidelines outlining processes and criteria for management of dam safety in accordance with these principles. The Guidelines are useful to dam owners, regulators, managers, operators, and other decision makers, as well as engineers and consultants. The most current CDA Guidelines were published in 2013 and these are the guidelines NTPC currently follows for the operation, maintenance, and surveillance of its dams.

Dam safety management is the management of risks associated with dams including release of water because of structural failure, inappropriate operation, natural disaster, sabotage actions, and any other causes.

The standard of care to be exercised in the management of dam safety shall be commensurate with the consequences of dam failure. The potential consequences of dam failure may include loss of life, injury, and disruption of the lives of the population in the inundated area; environmental and cultural impacts; and damage to infrastructure and economic assets. The dam classifications should be evaluated based on the failure scenario that would result in the worst consequences either sunny day failure or flood failure.

Temporary construction facilities should be designed and constructed such that the risks of the dam, cofferdam, and appurtenant structures are appropriately managed. The owner is responsible for the safe management of a dam. Dam safety management takes place within the context of public policy and the business objectives of the owner. During the operational stage, public safety should be an important element of the dam owner's due diligence.

The dam safety management system provides a framework for safety activities, decisions, and supporting processes within the context of public policies and the owner's objectives. The owner's policy should clearly demonstrate commitment to safety management throughout the complete life cycle of the dam.

1.6 Dam Safety Management

NTPC's dam safety management system consists of the following:

- An inventory of dams and appurtenances in each hydro system (Sections 2-14 of this document provide pertinent information of all NTPC dams).

Planning:

- Responsibility, Accountability, and Roles Matrix (RACI chart) for work program components and responsibilities (Section 15).
- Dam Safety Work Plan – tracking recommended actions from third party inspections and internal plans and addressing work through projects, maintenance, procedural revisions, etc. (Section 16).

Implementation:

- Operation, Maintenance, Surveillance Manuals & best practices for each hydro system maintained and revised as required (Section 17).
- Emergency Preparedness, Emergency Response, and Public Safety Plans for each hydro system maintained and revised as required (Section 18).
- Recurring Dam Safety Maintenance/Surveillance activities including a Vegetation Management Program, Crest Surveys, and Seepage Monitoring completed on a regular basis (Sections 22-24).

Checking & Reviewing:

- NTPC Inspection Structure includes conducting regular Dam Safety Reviews every five years for each hydro system, an annual dam safety inspection by NTPC staff and an external qualified engineer, and monthly dam safety inspections by hydro plant operators (Section 19).
- Dam Safety Training, annual Testing & Training of Emergency Preparedness Procedures, other training (Section 20).
- NTPC Incident Reporting Structure for all sites (Section 21).
- Equipment testing, preventive and predictive maintenance activities scheduled in computerized maintenance management system (CMMS).
- Monitoring daily inflows of the Snare, Taltson, and Yellowknife rivers.
- Maintaining monthly readings of known seepage areas, thermistors, piezometers, and other dam instrumentation.

Corrective Actions:

- In response to deficiencies and recommendations identified by Inspections, Incident Investigations, Internal review: follow-up, prioritize, and correct deficiencies in dam performance, supporting infrastructure, operation, maintenance, surveillance, security procedures, and the management system.
- Typically, recommendations and deficiencies will be addressed as a Capital Project, a maintenance project, by internally updating processes or documents, or performing technical studies and reviews that may be required.

Reporting: (Section 25)

- Annual Reporting to Mackenzie Valley Land and Water Board and Wek'èezhìi Land and Water Board as per water license requirements.
- Submission of Annual Inspection Reports and Dam Safety Reviews to these boards, along with a response and plan of action for addressing the recommendations of these reports.
- Annual Report on Dam Safety Program to NTPC Management & Operations.

Supporting Processes:

- Training of all individuals with responsibilities for dam safety activities and maintaining a record of training received (Section 20).
- Communicating program requirements and activities to management and operations staff.
- Maintaining record of the design, construction, operation, and performance of the dam and the management system. Currently this is done in SharePoint.

A flowchart is provided below for an overview of NTPC's dam safety management system, following the structure proposed in the Canadian Dam Safety Guidelines (2013).

Dam Safety Program

Reporting:

- Annual Reports to Water Boards
- DSR Reports & Proposed Actions to WB
 - Annual Inspections to WB
- Annual Internal Dam Safety Report to Management & Operations

Planning:

- RACI Chart – outlines responsibilities
- Work Program: OMS work, Capital & Maintenance Projects
- Yearly schedules for projects with budget approval

Corrective Actions:

- Tracking List of recommendations, internal plans, deficiencies.
- Addressed through capital projects, preventive or corrective maintenance projects, updates to procedures, technical reviews, studies, etc.

Implementation:

- OMS procedures for each hydro system
 - Emergency Preparedness Plans
 - Emergency Response Plans
 - Public Safety Plans
- Recurring Maintenance Activities

Checking & Reviewing:

- NTPC Dam Inspection Structure
- Incident Investigation Procedures
- Recurring Surveillance Activities
- Scheduled Equipment Testing & Plant Maintenance

Supporting Processes:

- Staff Training (Dam Safety Inspections, Emergency Plans, position requirements)
 - Communication to management and operations on dam safety program
- Recordkeeping all major technical reports, project files, inspections, drawings, instrument readings, etc. for each hydro system (SharePoint)

2. NTPC Hydro Systems

NTPC has nineteen (19) dams and eight (8) spillways in three hydro systems namely Snare, Taltson & Bluefish.

1. Snare Hydro consists of 14 dams and 4 spillways.
2. Taltson Hydro consists of 3 dams and 2 spillways.
3. Bluefish Hydro consists of 2 dams and 2 spillways.

2.1 Snare Hydro

The Snare Hydro System is located about 144km north-northwest of Yellowknife, NT on the Lower Snare River (see Figure 16.1 at end of the report). The System is a cascade type development comprising four hydro plants and utilizing the difference in elevation (63.3m) between Big Spruce Reservoir (above Snare Rapids G.S.) and Strutt Lake (below Snare Forks G.S.) for electric power production, (see Figure 16.2) The project drainage area supplying Snare Rapids G.S. / Big Spruce Reservoir is 15,200 km² in extend producing a mean annual flow of 48.3 m³/s.

The incremental drainage areas intercepted by each of the three downstream plants are minimal and produce negligible increases to the flow as measured at Snare Rapids.

Big Spruce Reservoir is a medium sized reservoir having a maximum surface area of 130 km², when full and a live storage volume of 546 MCM between the full supply level of 222.2 m and the low supply level of 217.9 m. This volume is sufficient to provide flow regulation on an annual cycle, but too small to support multi-year regulation. Storage volumes in the forebay reservoir of the downstream plants are relatively limited, sufficient for daily regulation at Snare Falls and Snare Forks but too small for any practical regulation at Snare Cascades.

Rated plant capacities are as follows:

- Snare Rapids = 8.5MW - 8.0MW (Francis) + 0.5MW (Fixed Blade Propeller).
- Snare Falls = 7.4MW – Kaplan Vertical Turbine.
- Snare Cascades = 4.3MW – Kaplan S Turbine.
- Snare Forks = 9.2MW – 4.6MW x 2 units Francis Vertical Turbine.

2.1.1 Snare Rapids

Snare Rapids reservoir consists of:

- Rapids Main Dam – Rock fill dam with earth fill impervious core – Built in 1948
- 5B Spillway – 8 bay concrete structure with stop logs – Built in 1962
- 5B Dam – Rock fill dam with earth fill impervious core – Built in 1962
- 4B Dam – Sand gravel fill impervious core – Built in 1960
- 9B Dam – Sand fill core with upstream clay blanket – Built in 1960

2.1.2 Snare Falls

Snare Falls reservoir consists of:

- Falls Main Dam – Rock fill with earth fill impervious core - Built in 1960
- Saddle Dam 1 — Rock fill zoned earth fill impervious core – Built in 1960
- Saddle Dam 2 – Rock fill zoned earth fill impervious central core - Built in 1960

2.1.3 Snare Cascades

Snare Cascades is a run of the river system with no associated reservoir storage, it is made up of:

- Labyrinth Concrete Spillway – Built in 1996 on bedrock.
- Power Canal Dyke with concrete core at center of rock fill dam - Built in 1996 on bedrock.

2.1.4 Snare Forks

Snare Forks reservoir is made up of:

- Main Dam – Built in 1976 on bedrock and rock fill dam with clay core impervious section.
- Strutt Dam – Built in 1976 on bedrock and rock fill dam with clay core impervious section.
- North Dam – Built in 1976 on bed rock and rock fill dam with clay core impervious section.
- Dyke # 1 – Built 2006 on permafrost / lacustrine soil.
- Dyke # 2 - Built 1976 on permafrost / lacustrine soil.
- Dyke # 3 - Built 1976 on permafrost / lacustrine soil.



Figure 2.1: Snare Rapids Dam

2.2 Taltson Hydro

The Taltson hydro facility is located on the Taltson River approximately 56 km Northeast of Fort Smith at 60° 25'N latitude and 110° 24'W longitude. The Nonacho Lake Dam is located 215 km Northeast of Fort Smith at 61° 40'N latitude and 109° 56'W longitude.

The Taltson Hydro System is comprised of one powerhouse and several water control structures including the Twin Gorges Dam, North Valley Dam, South Valley Spillway and Nonacho Lake Dam. An upstream control structure at Nonacho Lake is located about 160km upstream of Twin Gorges. A site plan showing the forebay reservoir and location of structures is presented in Figure 11.2.

2.2.1 Main Dam

Twin Gorges dam is a 285 m long, maximum 25 m high zoned earth and rock fill dam with a filtered central till core. A reinforced concrete intake structure located on the upstream face of the main dam is equipped with trash racks, sectional bulkheads (stop logs) and a fixed-wheel closure gate. The powerhouse contains a single vertical shaft Francis-type turbine-generator unit with a rated capacity of approximately 18 MW. A 4.9 m diameter, 375 m long buried steel penstock connects the intake to the powerhouse and is fitted with a 12.2 m diameter steel surge tank. The North Valley Dam is located approximately 3 km north of the Twin Gorges Dam. It is a rock fill freeboard dam with no impervious core, with a rock toe berm constructed on the downstream side equal to the maximum estimated flood level.



Figure 2.2: Twin Gorges Dam

2.2.2 South Valley Spillway

The South Valley spillway is located approximately ten kilometers northeast of the Twin Gorges Main Dam. It consists of three sections, two reinforced concrete ogee weirs separated by a rocky knoll and a third section through a small natural channel. Any flows in the Taltson River not passing through the plant for power production are spilled over a 200m long overflow concrete spillway constructed in a natural spill section called "South Valley", some 13km northeast of the plant. The spill water re-enters the Taltson River via a 30 km long reach of Trudel Creek at a point 2km below the Twin Gorges powerhouse.

2.2.3 North Valley Dam

The North Valley Dam was constructed in 1968 and is located approximately three kilometers North of Twin Gorges Dam. It is a rock fill type structure used for freeboard control of the reservoir at maximum flood levels. The base of the dam is slightly above the FSL of the forebay reservoir.

2.2.4 Nonacho Lake Storage Dam

Early in 1968, a rock fill dam was constructed at the outlet of Nonacho Lake to create upstream storage to supplement natural winter flows to meet increased power demands on the system from the Pine Point Mine. The dam contains three manually controlled gates (1.8m x 1.8m). A natural rock escarpment adjacent to the dam has been widened to 67 m to form an overflow spill (see Figure 4 and 5). A fraction of the spill flow exits from Nonacho Lake through a natural gap (referred to as Tronka Chua gap) into Tronka Chua Lake, and eventually re-enters the Taltson River above the Twin Gorges. A live storage volume of 1030 MCM is provided between a full supply level (FSL) of 320.0m and a low supply level (LSL) of 318.2m. Since the closure of Pine Point Mine in 1986 the Nonacho Lake Dam has not been operated for power generation purposes.

2.3 Bluefish Hydro

2.3.1 Bluefish Dam

Bluefish Dam is located on the Yellowknife River approximately 600m North of where the Yellowknife River discharges into Prosperous Lake. Bluefish Dam impounds the Bluefish Lake reservoir. Bluefish Lake was enlarged by the 1940 construction of the original Bluefish Dam: a timber crib rock fill buttress dam. Before the dam was constructed in 1940 there was a waterfall at the outlet from Bluefish Lake. The original Bluefish Hydro facility was constructed to generate electricity for a gold mine in Yellowknife operated by Miramar Con.

The current Bluefish Dam was commissioned in October 2012. It consists of a rock fill dam with a stainless-steel membrane embedded into concrete plinth, keyed into bedrock. The upstream dam slope is 2H:1V while the downstream slope is 2.5H:1V. The dam length is 250m with a 5.5m crest width. The maximum flood elevation is 170.44m and the full supply level is 168.87m. The dam's design crest elevation is 171.22m.

2.3.2 Duncan Dam

Duncan Dam is a control structure located near the southwest end of Duncan Lake and is approximately 27m long and 5m high. Duncan Dam was originally constructed as a timber crib dam in 1942 and replaced with a reinforced concrete gravity dam in 1974. The new dam was built 20m downstream from the old dam site and consists of one sluiceway with stop logs and two ogee crested uncontrolled spillways. In May 2007, observations beneath the dam noted the left abutment of the dam was washed out of the material between boulders which was repaired in the same year. The sill elevation of the sluiceway is 209.40m while the top of the ogee section is 212.49m and the top of the dam is 213.41m.



Figure 2.3: Bluefish Dam

3. Hydro Catchment Areas

3.1 Snare Catchment

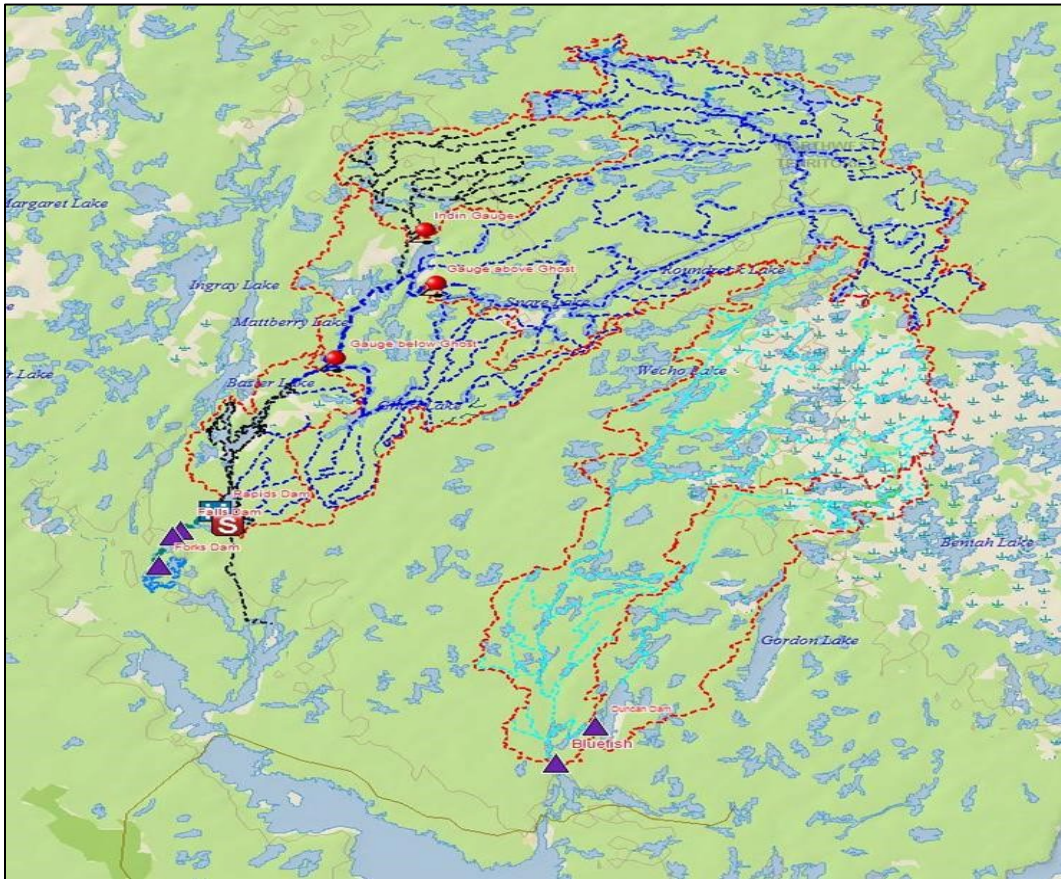


Figure 3.1.1: Snare Catchment Area (top area)

3.2 Taltson Catchment

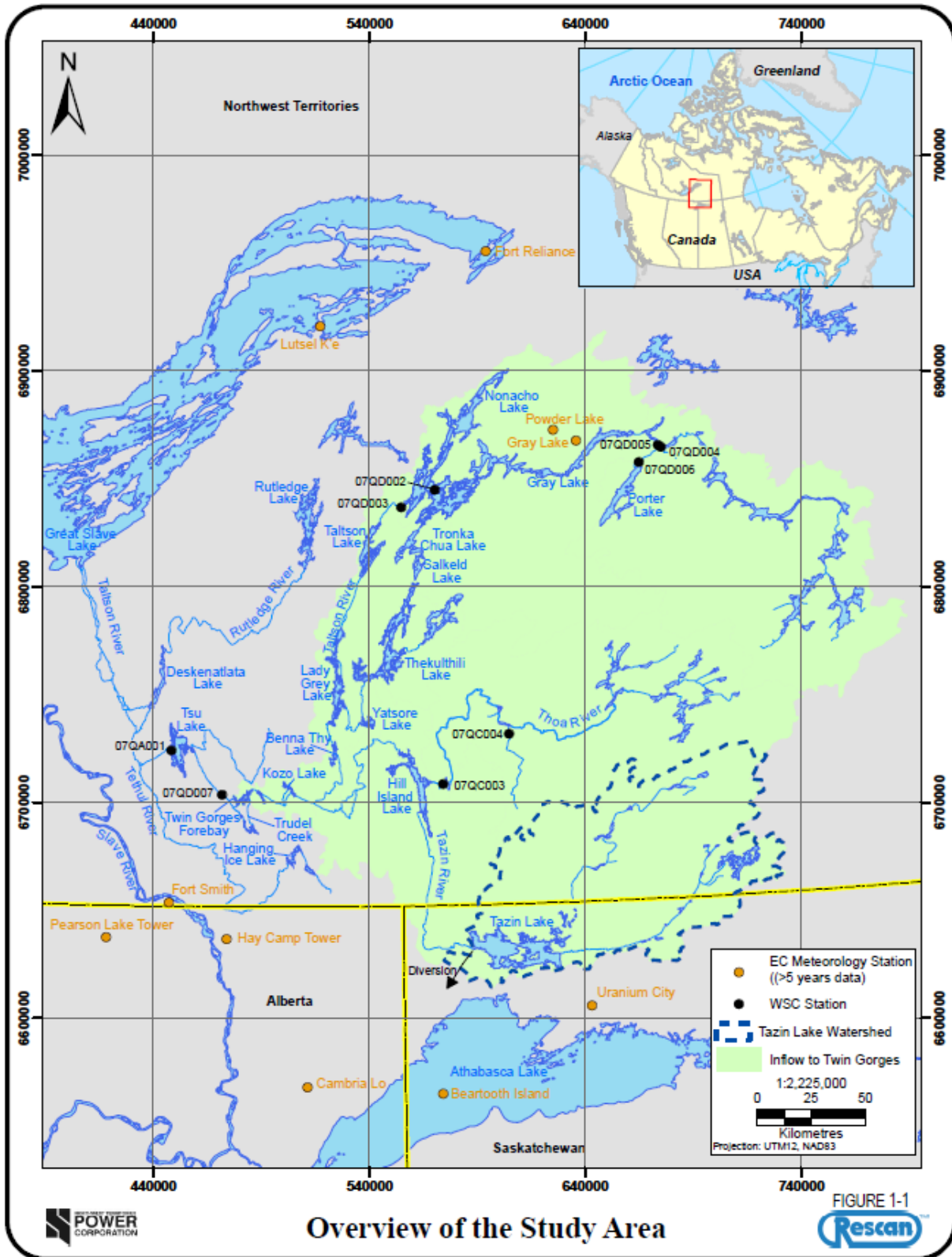


Figure 3.2.1: Taltson Catchment Area

3.3 Bluefish Catchment

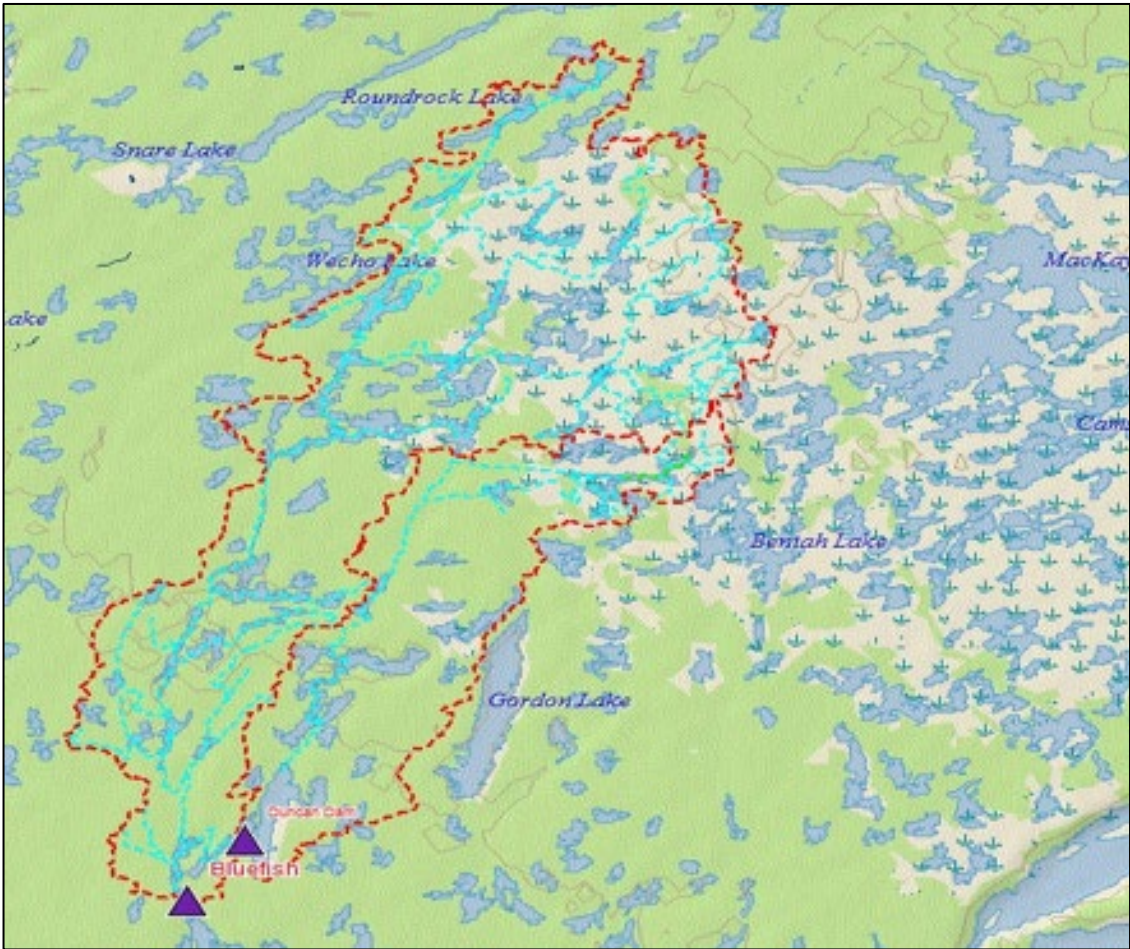


Figure 3.3.1: Bluefish Catchment Area

4. Schematic Diagrams

4.1 Snare

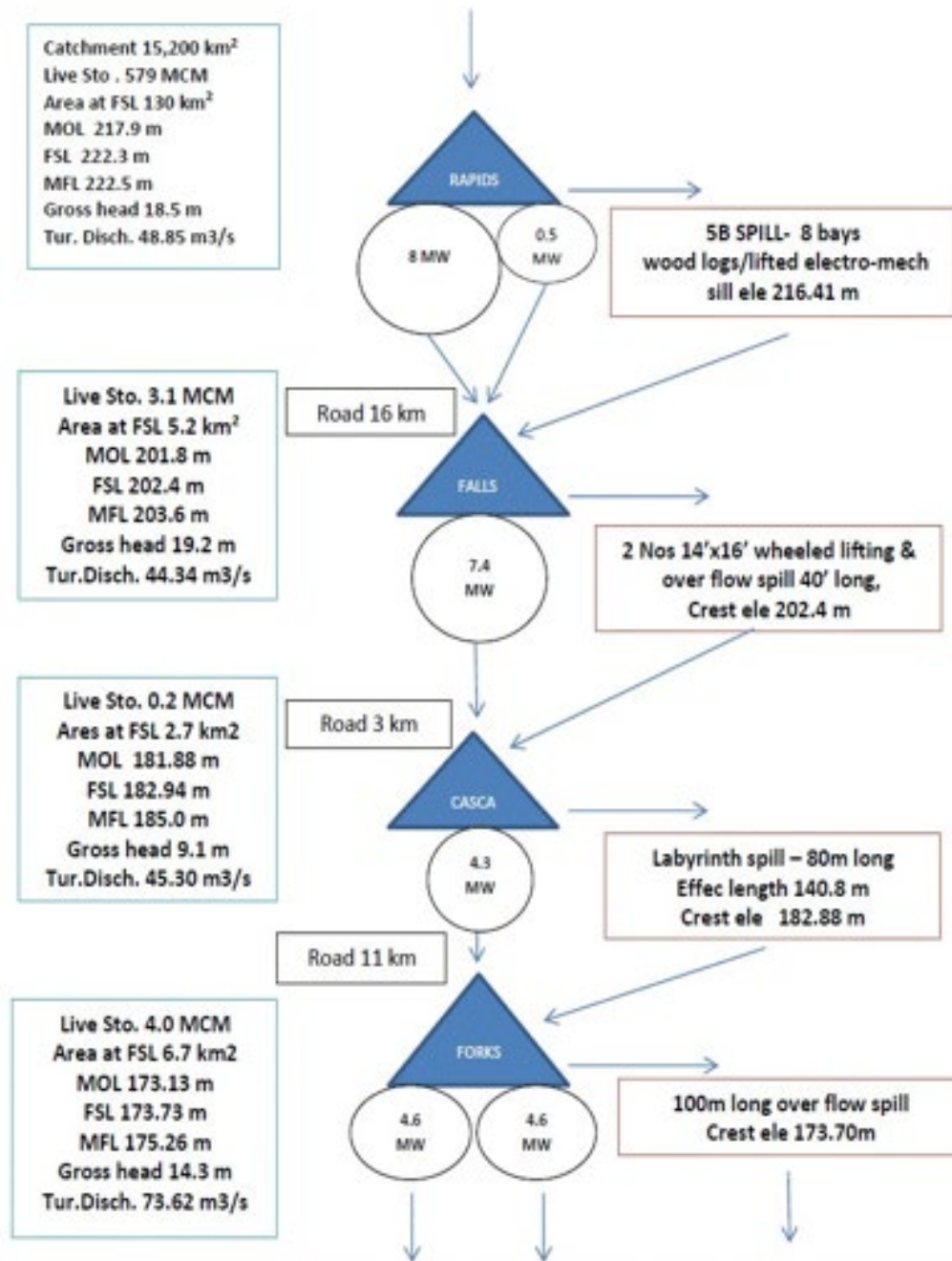
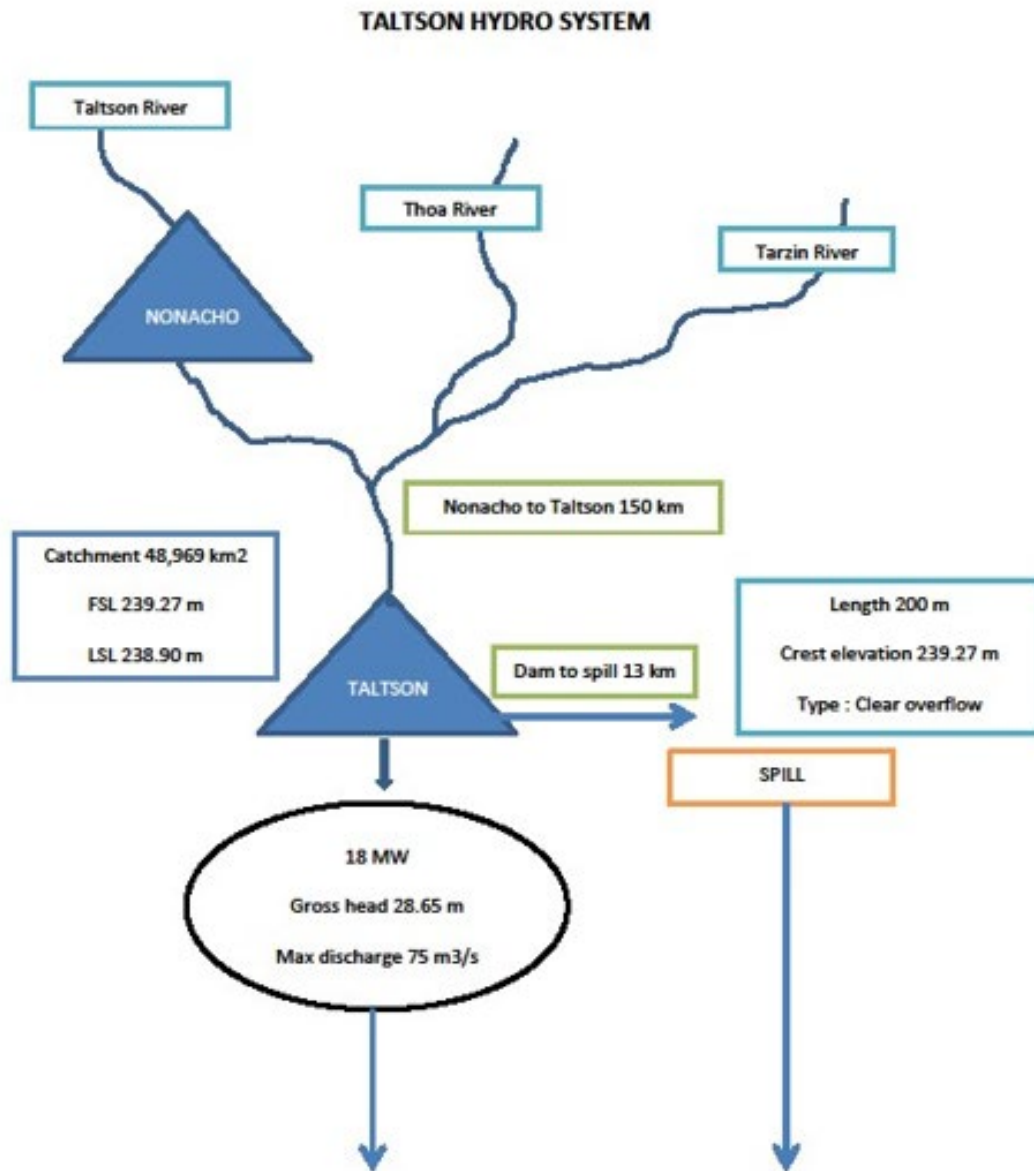


Figure 4.1: Snare Schematic Diagram

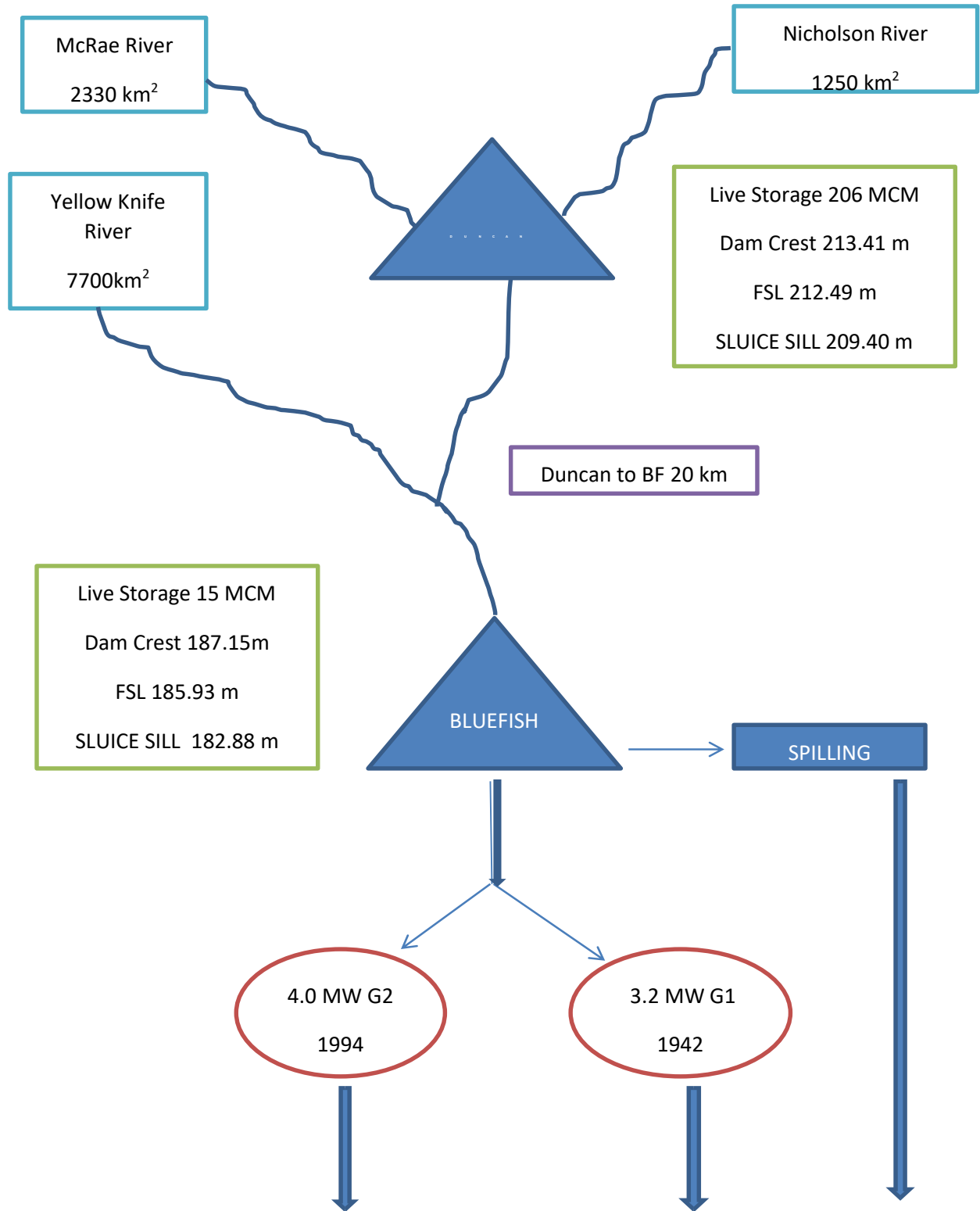
4.2 Taltson



Gamini July 28 2012

Figure 4.2: Taltson Schematic Diagram

4.3 Bluefish



Gamini July24,2012

Figure 4.3: Bluefish Schematic Diagram

5. Dam Characteristic Tables

5.1 Snare

Table 5.1: Snare System Characteristics

Facility	Structure	Design Crest (m)	Top Core (m)	Max Height (m)	Length (m)	US Slope	DS Slope	Core Material	Instrument
Snare Rapids FSL 222.29m	Rapids Dam	224.02	223.0	21	220	3H:1V	2H:1V	Silt	Thermistor
	5B Spillway	Bay 3 & 4 -224.02 Sill 215.4 Others 219.75	223.00	8.6	59.7	N/A	N/A	Concrete	
	Dam 4B	224.4	224.4	8	130	2.5H:1V	2.5H:1V	Silt	
	5B Dam Section	Dam 5B	224.03	8	110	2.5H:1V	2.5H:1V	Silt	
	Dam 9B	224.50	224.10	3	60	3H:1V	3H:1V	U/S clay blanket	
Snare Falls FSL 202.40m	Falls Dam	205.74	204.82	23	152	2.5H:1V	2H:1V	Silt	
	Saddle Dam 1	204.30	204.30	2.6	100	1.75H:1V	2H:1V	Clay	
	Saddle Dam 2	207.26	207.26	8	90	1.75H:1V	2H:1V	Clay	
Snare Cascades FSL 182.94m	Labyrinth Spill	182.94	182.94	5	70	N/A	N/A	Concrete	
	Power Canal Dyke	185.00	184.50	7	192	1.5H:1V	1.5H:1V	Concrete	
Snare Forks FSL 173.73m	Forks Dam	176.79	175.58	10	105	2H:1V	1.5H:1V	Sloped Till Core	
	Strutt Dam	176.68	175.58	18	160	2H:1V	1.5H:1V	Sloped Till Core	
	North Dam	176.78	176.78	2.5	380	3H:1V	1H:1V	Sloped Till Core	
	Dyke 1	175.69	175.69	3	300	4H:1V	1H:1V	U/S Till Blanket	
	Dyke 2	175.97	175.69	2	200	4H:1V	1H:1V	U/S Till Blanket	
	Dyke 3	175.92	175.69	2	260	4H:1V	1H:1V	U/S Till Blanket	
	Spillway	173.73	173.73	2.25	100	N/A	N/A	Concrete	

5.2 Taltson

Table 5.2: Taltson System Characteristics

Facility	Structure	Design Crest (m)	Top Core (m)	Max Height (m)	Length (m)	US Slope	DS Slope	Core Material	Instrument
Taltson Hydro FSL 239.27m	Twin Gorges Dam	243.29	241.71	16	285	2.5H:1V	2H:1V	Glacial till	
	Spillway	239.27	N/A	7.6	200	Ogee	Ogee	Concrete	
	North Valley Dam	243.29	N/A	3.0	95	1.5H:1V	2H:1V	No core	
	Nonacho Dam	324.00	N/A	9	160	2H:1V	2H:1V	No core	Settlement Monitoring

5.3 Bluefish

Table 5.3: Bluefish System Characteristics

Facility	Structure	Design Crest (m)	Top Core (m)	Max Height (m)	Length (m)	US Slope	DS Slope	Core Material	Instrument
Bluefish New Dam FSL 168.80m	Main Dam	171.22	170.92	11.2	250	2H:1V	2.5H:1V	Steel	Piezometers Thermistors Corrosion
	Spillway	168.80	N/A	7.5	136	N/A	N/A	Concrete	
	Bottom Outlet	166.67	N/A	2.74	2.74	N/A	N/A	Concrete	
Duncan Dam FSL 212.49m	Spillway	213.41	N/A	7.3	29.4	Vertical	1H:3.9V	Concrete	

6. Storage, Inflow, Flood and Forebay Values

Table 6.1: Storage, Inflow, Flood and Forebay values for Dam Facilities

Facility	Catchment Area (km ²)	Average inflow (m ³ /s)	Storage (MCM)	Area at Full Supply level (km ²)	Design Flood (1000 year m ³ /s)	Design Flood (PMF m ³ /s)	Minimum Flow as per Water License (m ³ /s)	Minimum Forebay Level as per Water License (m)	Maximum Forebay Level as per Water License (m)
Snare Rapids	15,200	48.3	579	130	560	1175	N/A	217.9	222.3 (daily) 222.5 (High Flow Max)
Snare Falls	15,200	48.3	3.1	5.2	526	1175	0 for a maximum of 24 hours	201.8	202.4 (daily) 203.6 (High Flow Max)
Snare Cascades	15,200	48.3	0.2	2.7	526	1175	N/A	181.88	184.5
Snare Forks	15,200	48.3	4	6.7	526	1175	0 for a maximum of 24 hours	173.13	175.26
Taltson	48,969	210	N/A	N/A	850	N/A	28 (after confluence w Trudel)	238.9	239.27 (daily) 240.9 (High Flow Max)
Nonacho	22,408	96	215	N/A	425	N/A	14	319.3	321.6
Bluefish	11,280	29	20	3.32	152	662	6	165.73	168.78 (daily) 170.22 (High Flow Max)
Duncan	3,580	17	206	59	105.2	131	N/A	212.04	212.49 (daily) 213.35 (High Flow Max)

7. Spill Discharge Capacities

Table 7.1: Spill Discharge Capacities for Dam Facilities

Name of Hydro	Type	Operation Type	Year Built	Foundation	Length (m)	Height (m)	Design Flood Inflow (m3/s)	Design Flood Outflow (m3/s)	Spill Discharge Capacity (m3/s)
Snare Rapids 5B Spill	Gated – 8 Bay Controlled	Stop log	1962	Bedrock	60	5.8	560	526	528
Snare Falls Spillway	Gated- 2 bay Controlled	Lifting gates (4.27m x 4.88m)	1960	Bedrock	10	17	526	525	478
Snare Cascades Spillway	Labyrinth – Overflow Uncontrolled	Natural	1996	Bedrock	70	5	525	525	550
Snare Forks Spillway	Clear Overflow	Natural	1976	Bedrock	100	2.25	525	525	504
Taltson Spillway	Clear Overflow	Natural	1965	Bedrock	200	7.6	875	N/A	1750
Bluefish Spillway	Clear Overflow	Natural	2012	Bedrock	128	1	387	387	387
	Bottom Outlet	Gate	2012	Bedrock	2.74	2.74	387	387	60
Duncan Dam & Spillway	Clear overflow and gate	Lifting Gate	1974	Bedrock	29.4	7.3	131	131	77

8. Water Licenses & Expiry Dates

Table 8.1: Water Licenses Effective & Expiry Dates:

Hydro Facility	Water Board	License number	Effective Date	Expiry Date
Snare Rapids, Falls & Forks	Wek'èezhii Land & Water Board	N1L4 – 0150 (Renewal)	May 30, 1999	May 29, 2024
Snare Cascades	Wek'èezhii Land & Water Board	W2014L4- 0003 (Renewal of MV LC- 0014)	Sep 05, 2014	May 20, 2024
Bluefish	Mackenzie Valley Land & Water Board	MV2020L4-0005	Apr 03, 2021	April 02, 2046
Taltson	Mackenzie Valley Land & Water Board	MV 2011L4- 0002	Aug 31, 2012	Aug 30, 2027

9. DSR Schedule & Expiry Dates

Table 9.1: Comprehensive Dam Safety Review Schedule

Hydro Facility	Completed By	Consequence Category	Completed Date	Next DSR Scheduled
Snare	KGS	High	2018	2023
Bluefish	Tulloch	High	2021	2026
Taltson	Tulloch	Significant	2021	2026

10. Location Maps

10.1 Snare

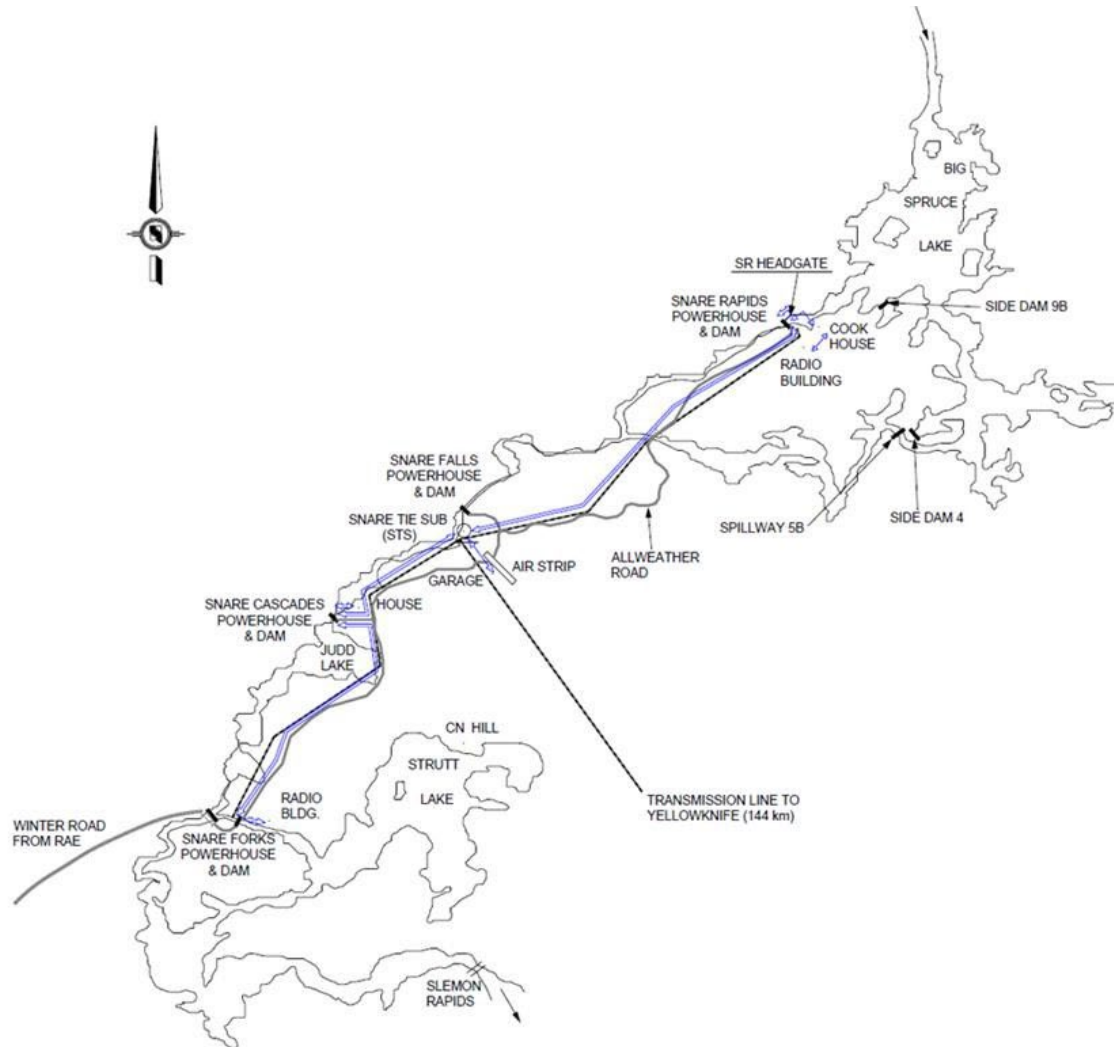


Figure 10.1.1: Snare System facilities and road system

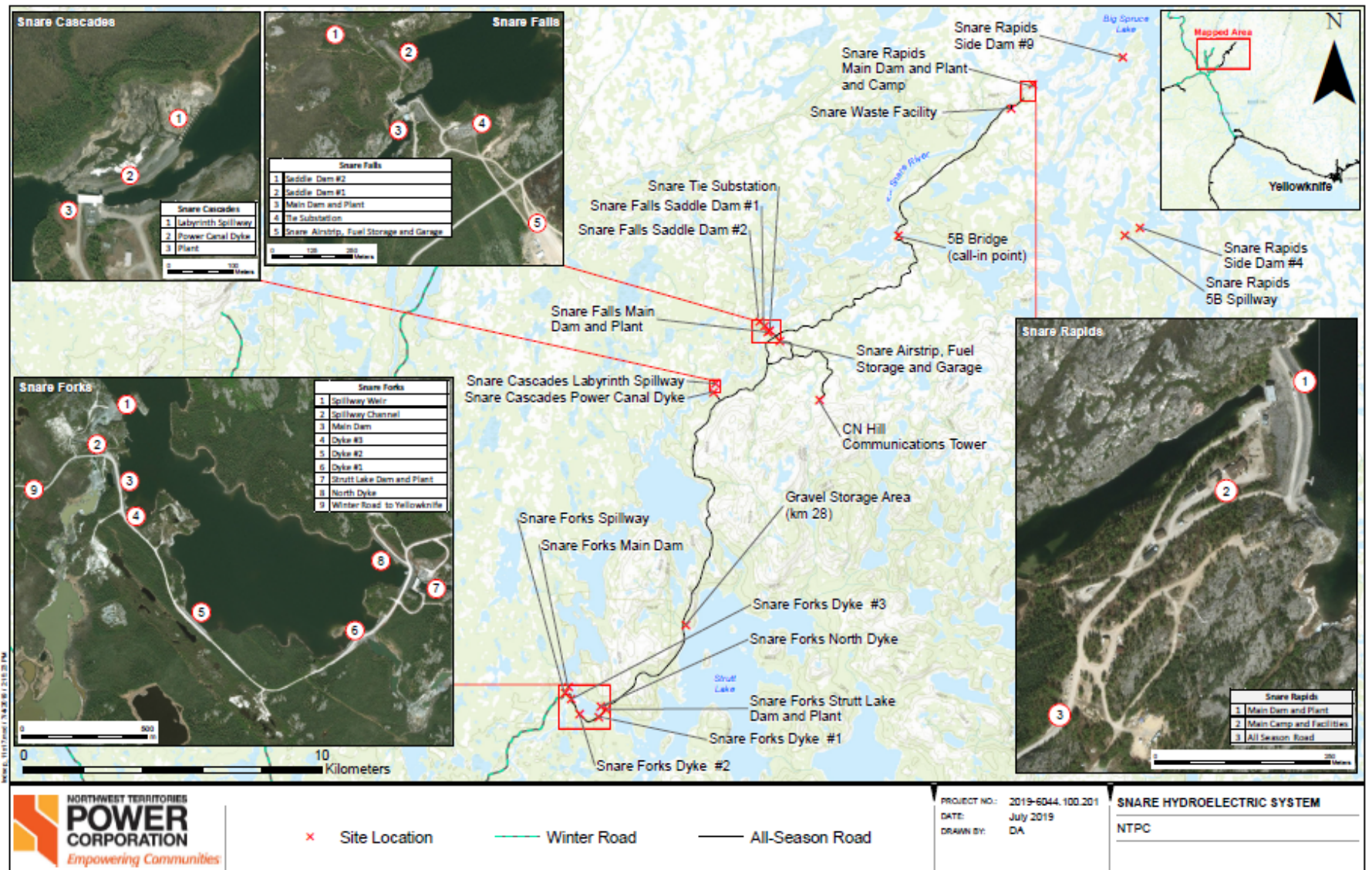
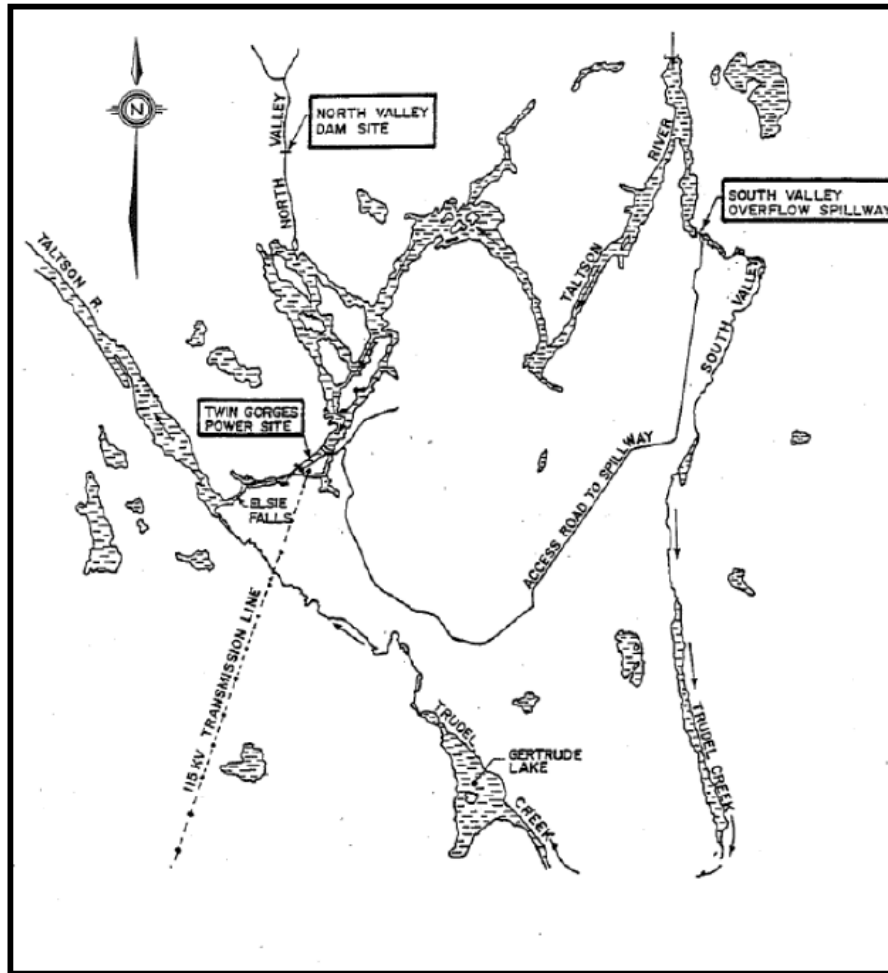


Figure 10.1.2: Snare System dams and dykes

10.2 Taltson



Taltson Hydro – Site Plan

Figure 10.2.1: Taltson System facilities

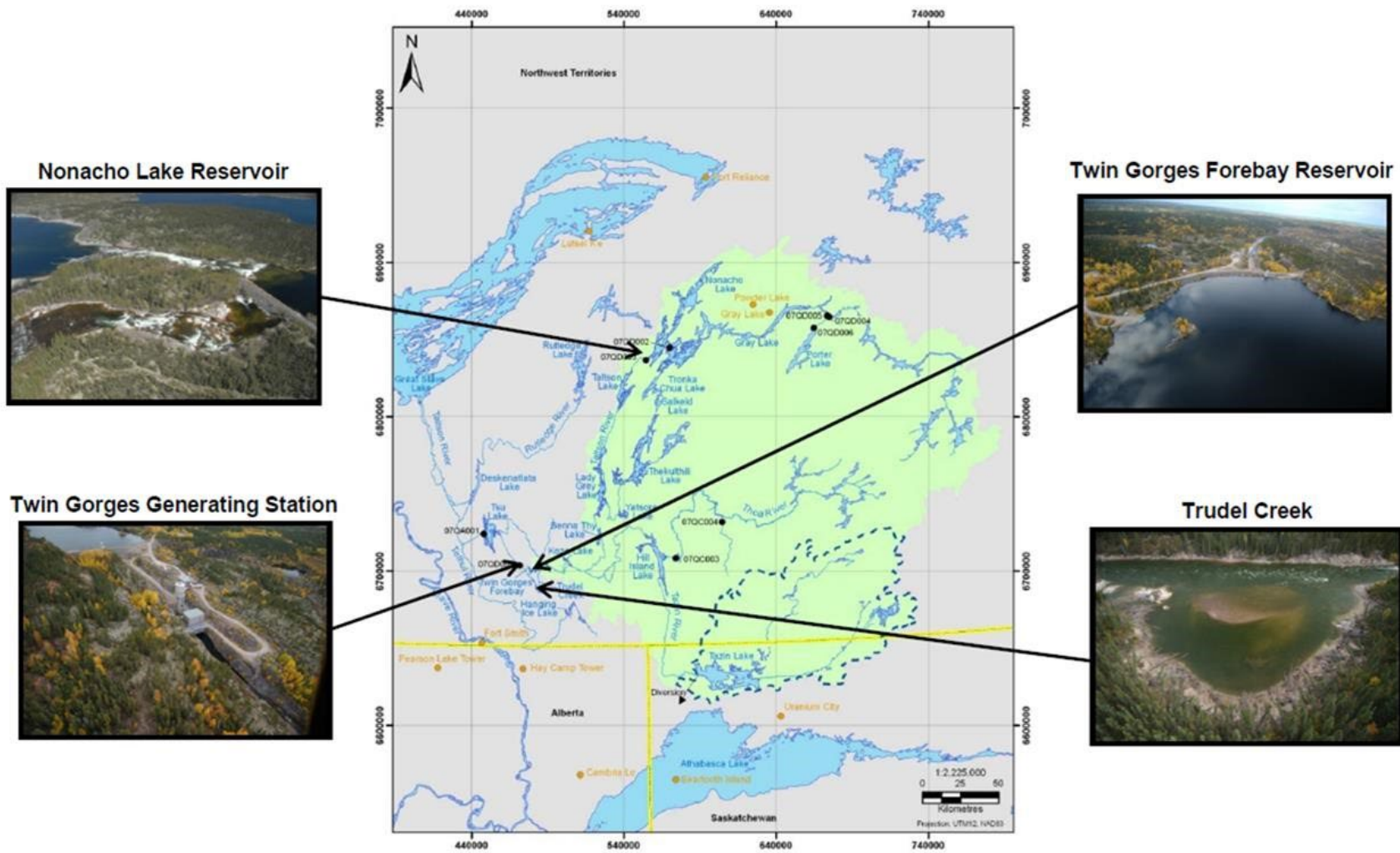


Figure 10.2.2: Taltson System

10.3 Bluefish

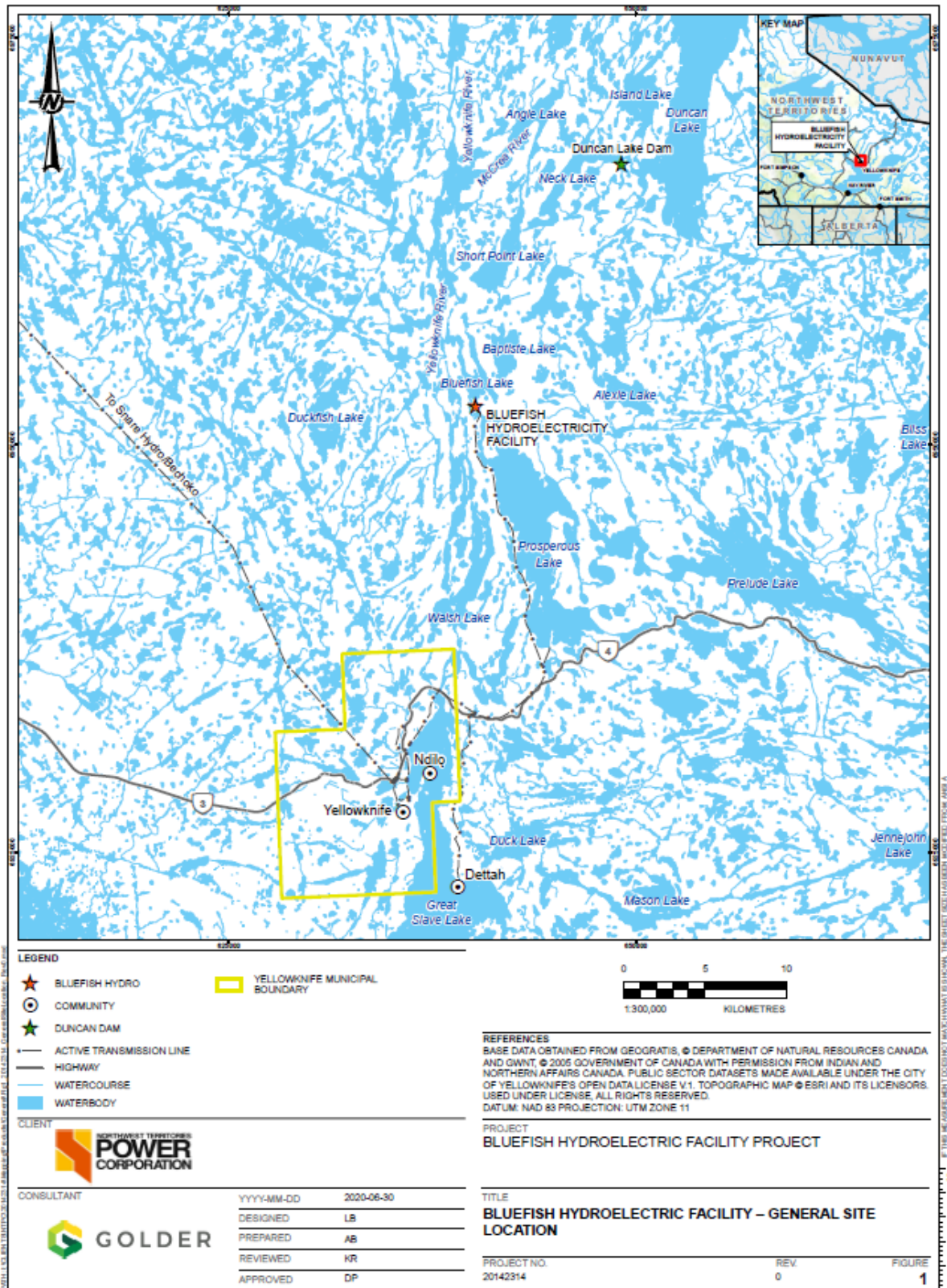


Figure 10.3.1: Bluefish Dam Locations

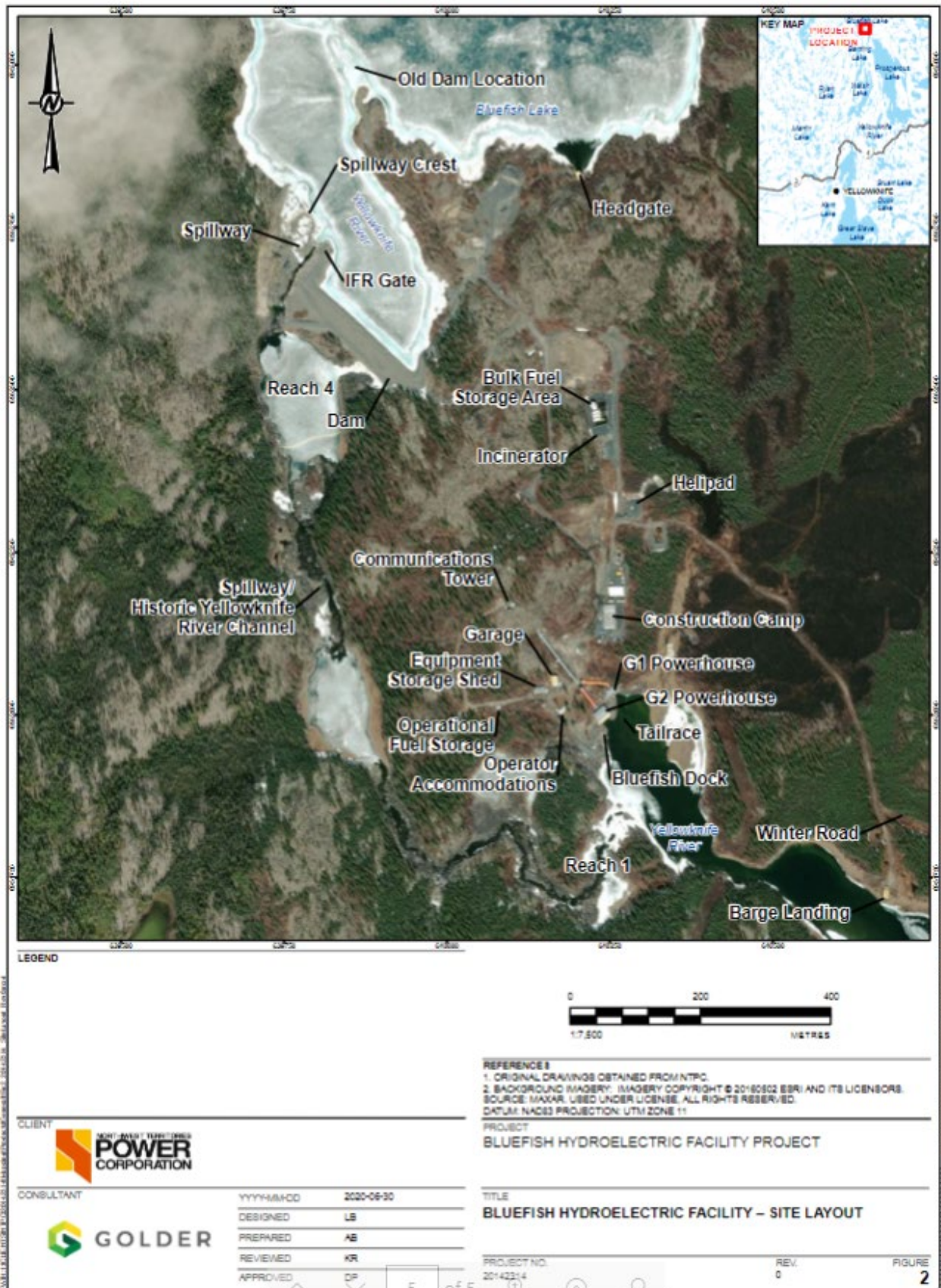


Figure 10.3.2: Bluefish Hydro facilities and layout

11. Elevation Capacity Charts

Elevation Capacity Charts measure the volume (millions m³) of a reservoir below a certain elevation. Knowledge of elevation-capacity of these reservoirs is important to properly plan and optimize operations of water regulations and evaluate the balance of availability and utilization of water energy.

11.1 Snare Rapids

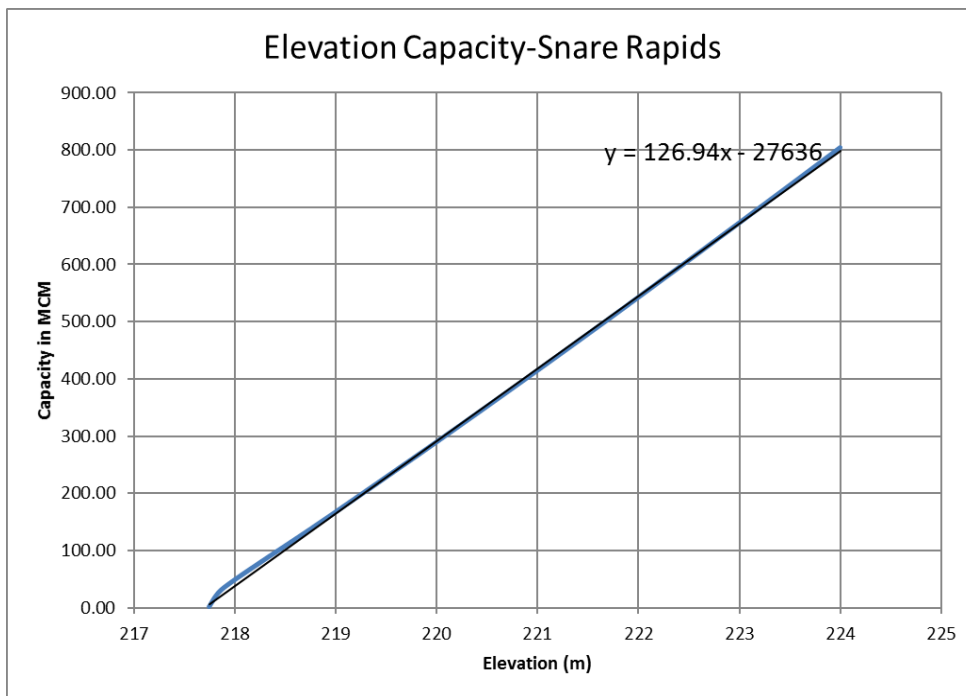


Figure 11.1: Snare Rapids Elevation Capacity Chart

11.2 Snare Falls

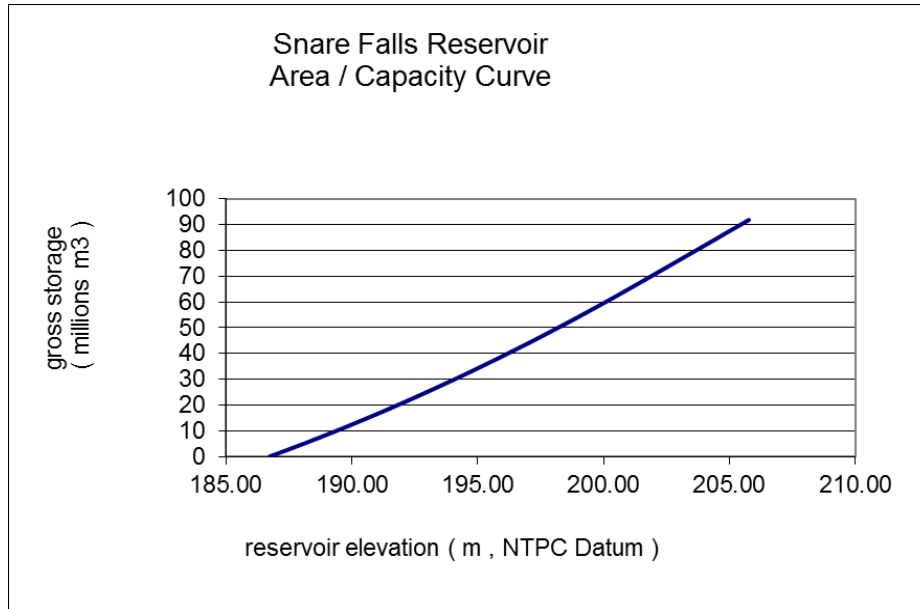


Figure 11.2: Snare Falls Elevation Capacity Chart

11.3 Snare Forks

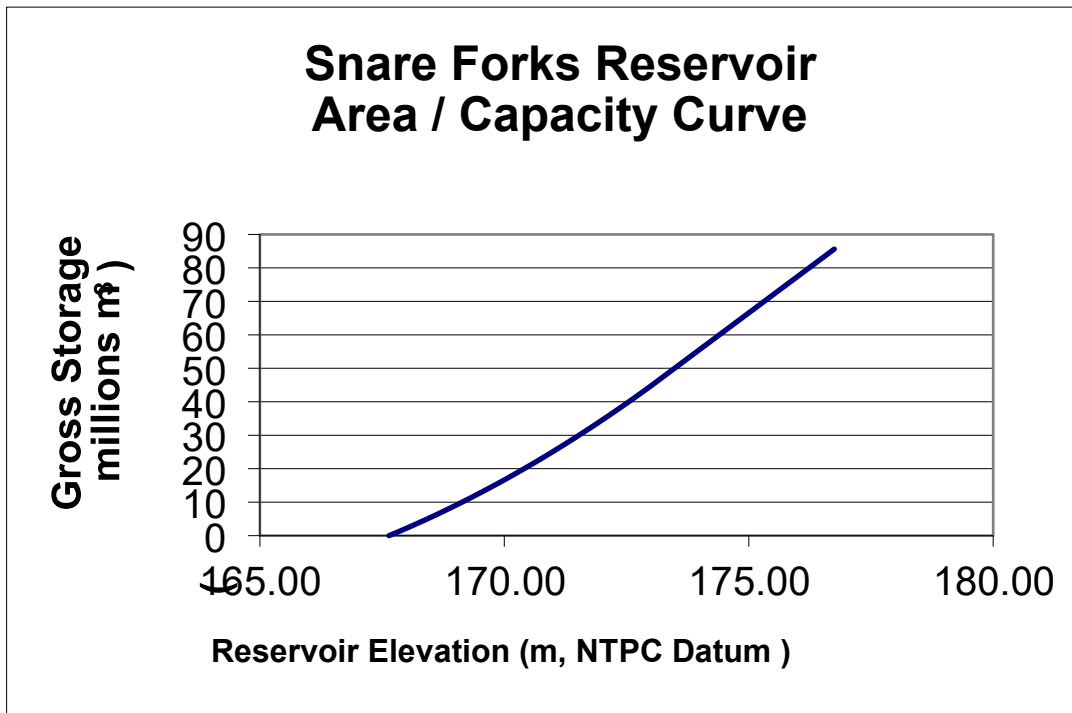


Figure 11.3: Snare Forks Elevation Capacity Chart

11.4 Bluefish

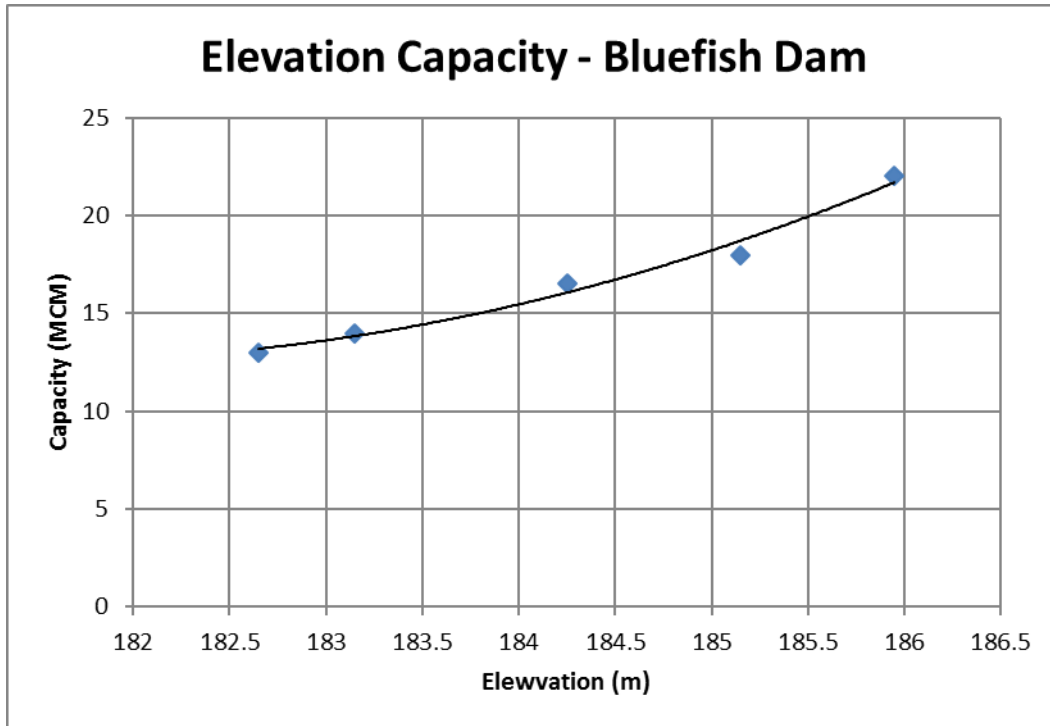


Figure 11.4: Bluefish Dam Elevation Capacity Chart

11.5 Duncan

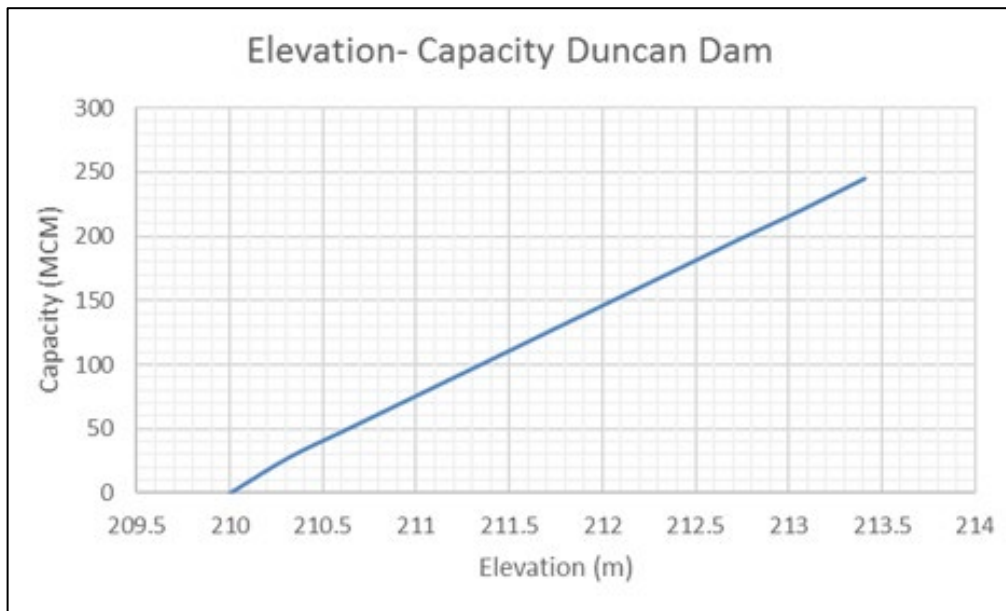


Figure 11.5: Duncan Dam Elevation Capacity Chart

12. Spillway Rating Curves

Spillway Rating Curves describe the elevation-discharge relationship or the associated discharge with certain water elevations. These rating curves are dependent on the hydraulic characteristics of the stream channel or reservoir and will vary over time due to changes in a stream channel. They are developed by making frequent discharge measurements at gaging stations. As an example, the curve in Figure 12.1 from the 2006 KCB dam safety report shows the Cascades spillway can discharge approximately 400m³/s at a water elevation of 184.3m.

12.1 Snare Cascades

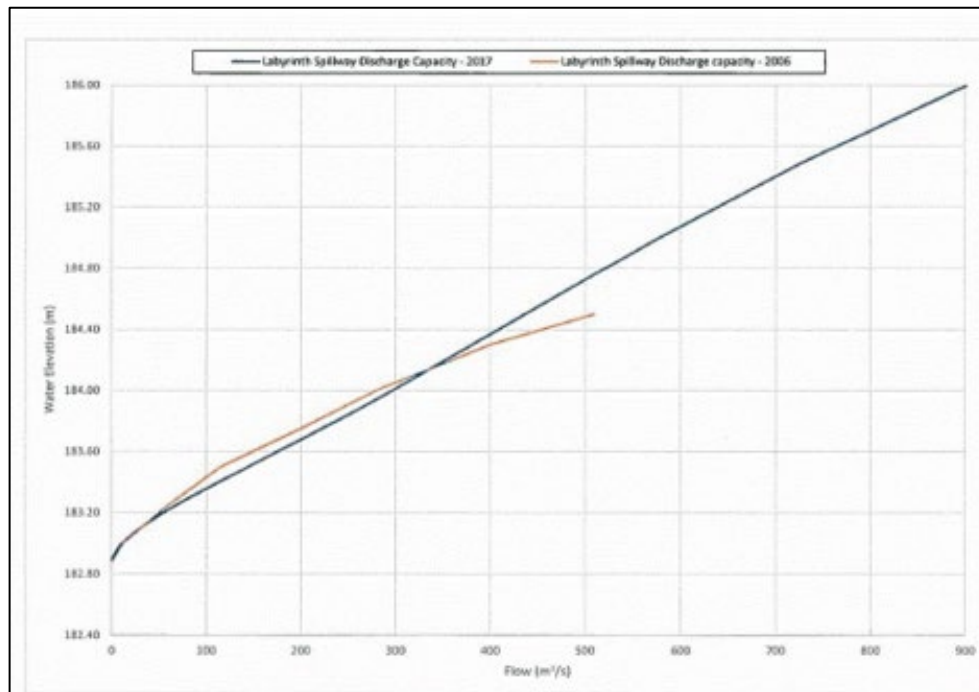


Figure 12.1: Snare Cascades Spillway Rating Curve

These curves are important in assessing whether a spillway can adequately discharge the inflow design flood (IDF) corresponding to the dam's hazard classification. For the Cascades, the 2015 Meco Snare Hydro Flood Risk Analysis report indicated the IDF at the dam site was higher (526m³/s vs 457m³/s previously) than spillway capacity due to Snare Cascades changed consequence classification from 'low' to 'significant.' Further studies by NTPC in 2017 produced the updated blue line curve in Figure 12.1. A project to raise the core wall elevation to 185.0m and place surrounding rockfill of the dyke wall will be undertaken to handle the revised IDF flows of 526m³/s.

12.2 Snare Forks

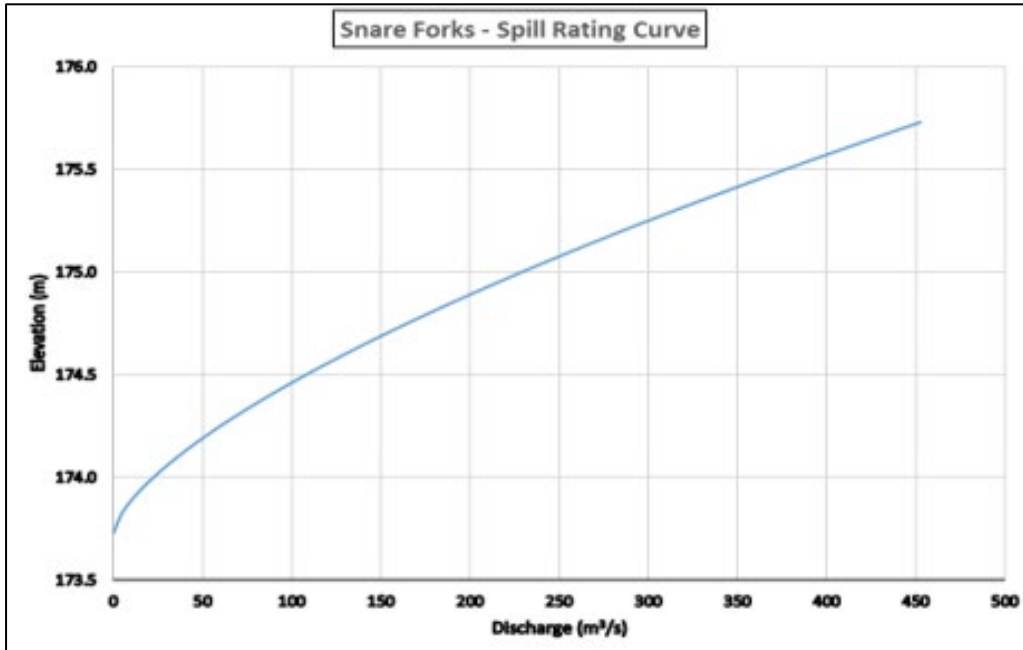


Figure 12.2.1: Snare Forks Spillway Rating Curve

The 2006 Dyke 1 failure resulted from design crest elevations not being maintained coupled with high forebay reservoir levels. The crest had been allowed to settle by approximately 1m as shown in Figure 12.2.2 below which illustrates the capacity of the Forks spillway before overtopping occurs without allowances for freeboard. Following closure of the breach on June 28th 2006, there was 187cms passing through the spillway and 82cms through the powerhouse units: flows too high for the spillway to adequately discharge and keep reservoir levels below the low 174.7m crest. The Forks dykes experience some settlement due to permafrost in their foundations and are now surveyed annually and maintained at or above their design crest elevations.

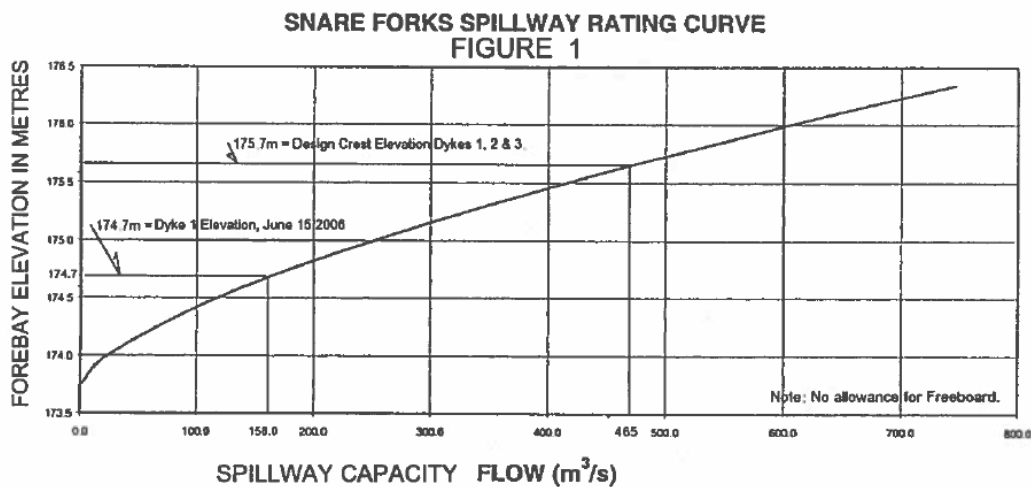


Figure 12.2.2: Snare Forks Spillway Rating Curve with elevations

12.3 Taltson South Valley

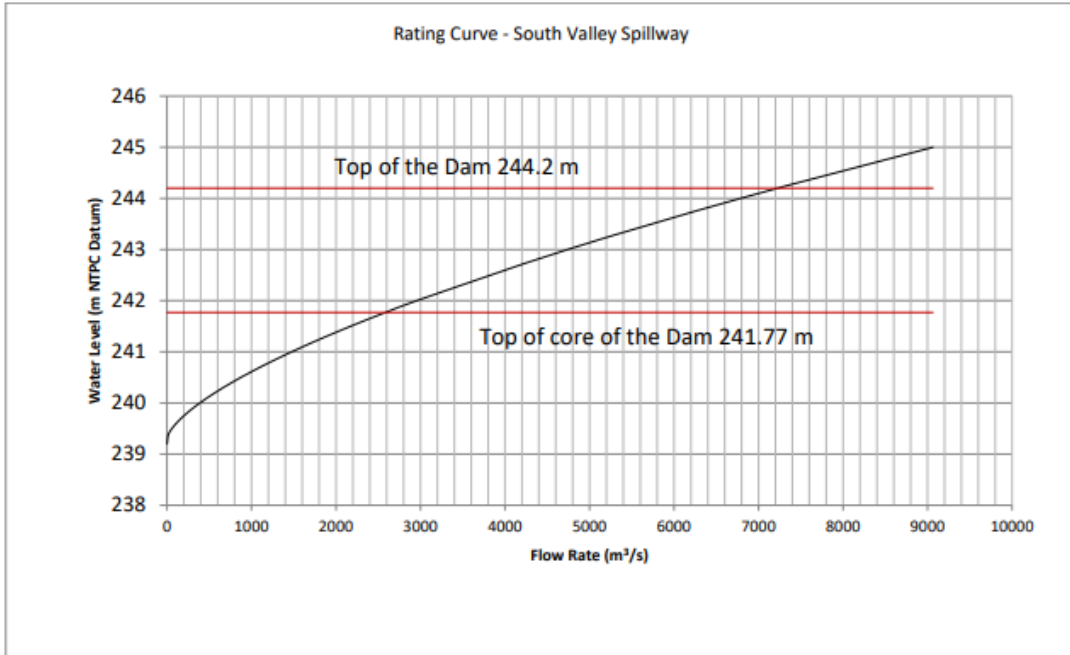


Figure 12.3: Taltson South Valley Spillway Spill Rating Curve

12.4 Nonacho

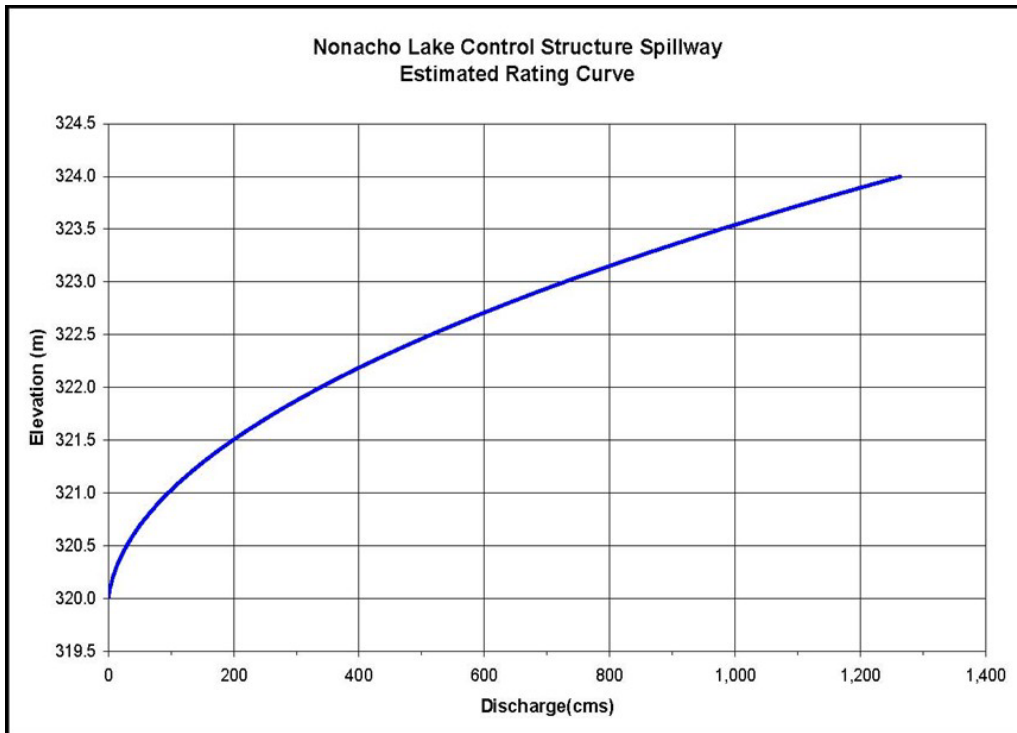


Figure 12.4: Nonacho Spill Rating Curve

12.5 Bluefish

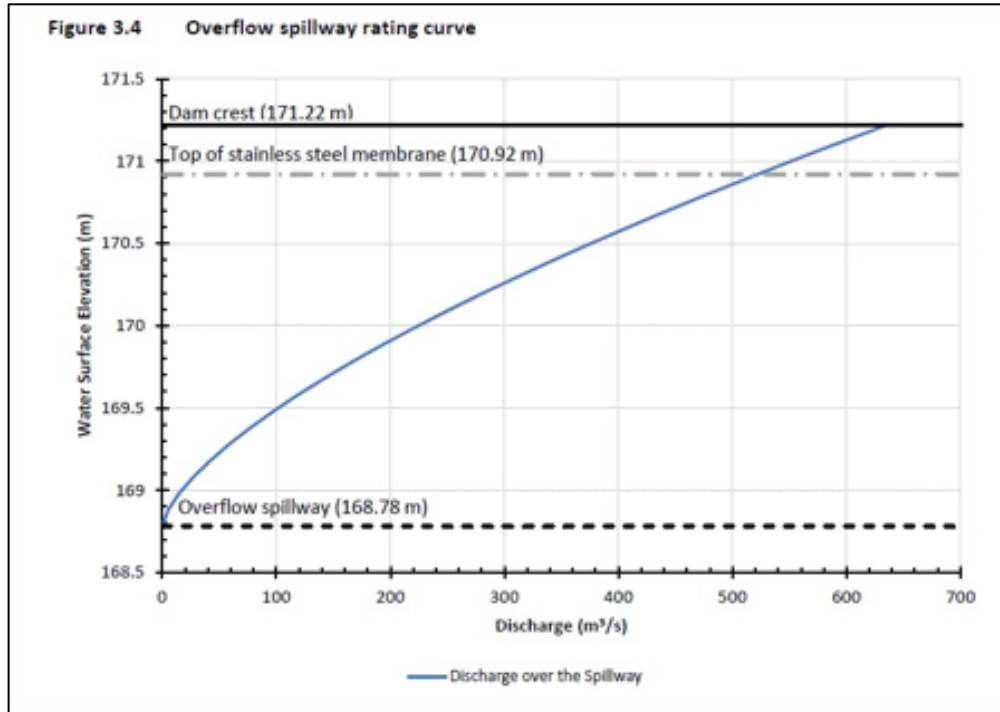


Figure 12.5: Bluefish Overflow Spillway Spill Rating Curve

As shown in Figure 12.3, Taltson can handle the 1:1000-year IDF flows of $850\text{m}^3/\text{s}$. Figure 12.4 shows that Nonacho can safely pass the IDF flows of $425\text{m}^3/\text{s}$ – which it would reach around elevation of 322.2m.

13. Flow Duration Curves

Flow-duration curves are cumulative frequency curves that show the percent of time specified discharges were equaled or exceeded during a given period. These curves combine the flow characteristics of a stream throughout the range of discharge, without regard to the sequence of when these flows occurred. If the period in which the curve is based represents the long-term flow of a stream, the curve may be used to predict the distribution of future flows for waterpower, water supply, or pollution studies. If the curve is to be used as an indication of the flow that may be expected in the future with a continuation of present conditions, only the record obtained during a period when facilities for regulation and pattern of regulation have been constant should be used. With the adjusted curve as a base, one can make allowances for expected additional regulation or for changes in the pattern of regulation.

13.1 Snare Flow Duration

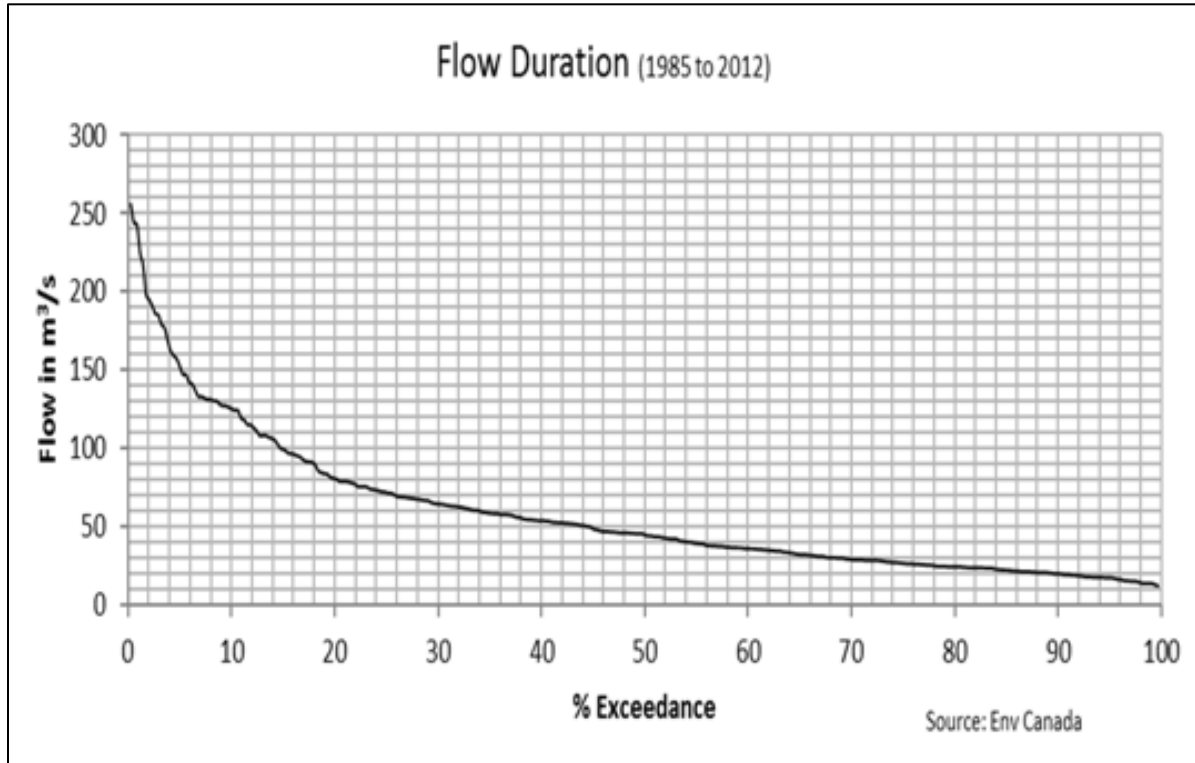


Figure 13.1: Snare Flow Duration Curve

As an example, Figure 13.1 shows that flows at Snare have equaled or exceeded 20cms during 90% of the time between 1985-2012. Typically, these curves have been used to define rates of flow and compute waterpower statistics, though more recently flow-duration curves have also been used to investigate water supply, where to locate industrial plants, and for pollution studies.

[What is a Flow Duration Curve? - Renewables First](#)

13.2 Taltson Flow Duration

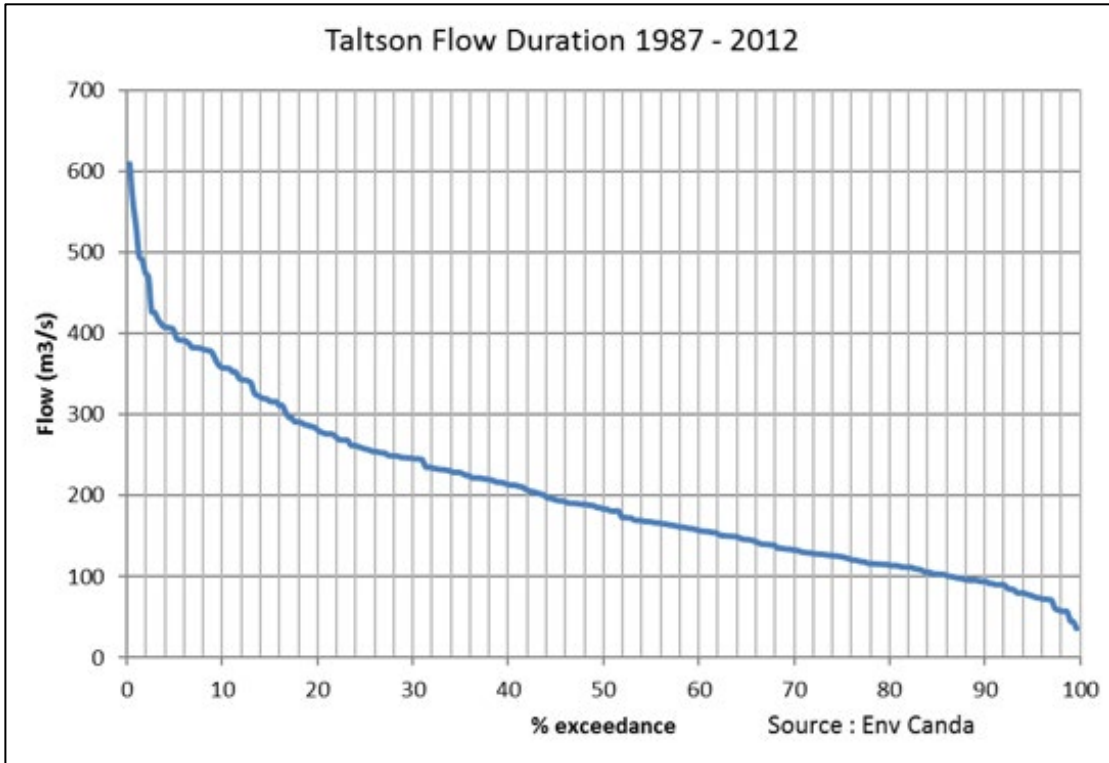


Figure 13.2: Taltson Flow Duration Curve

13.3 Bluefish Flow Duration

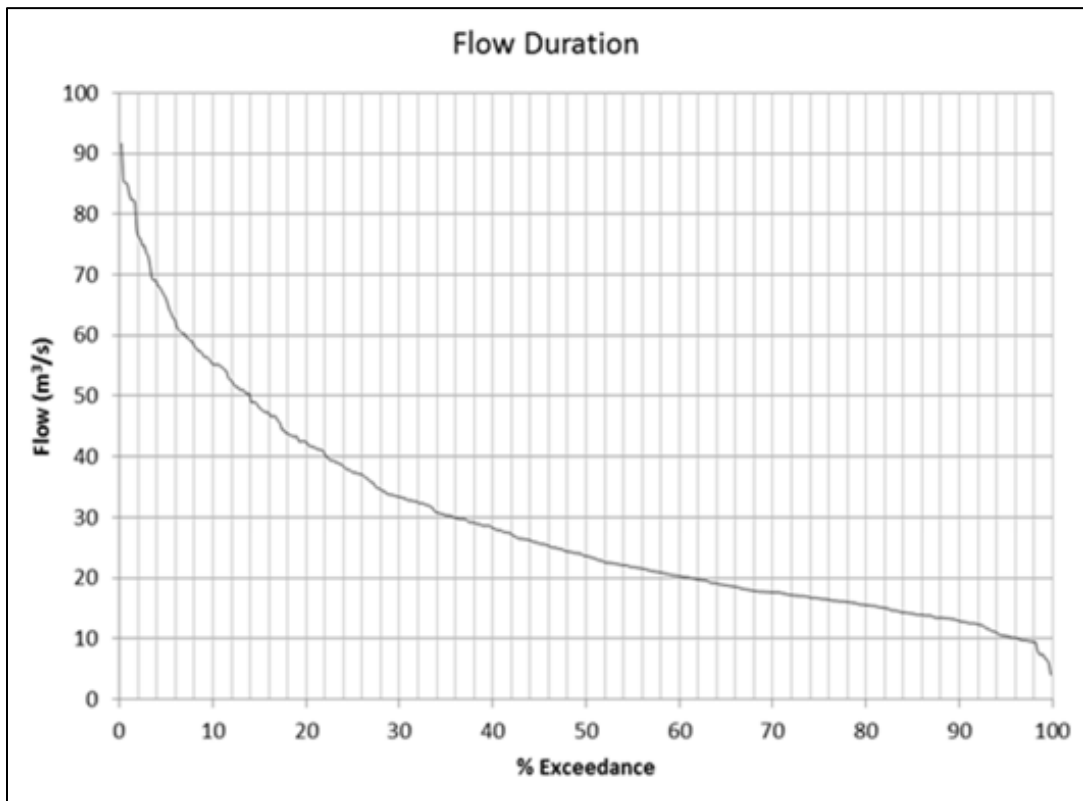


Figure 13.3: Bluefish Flow Duration Curve

14 Inflow Hydrographs

An inflow hydrograph is the time series of streamflow (m^3/s) at a specified location, they are established from historical flow measurements taken at gaging stations. Typically, high flows occur during spring and summer due to increased runoff from snowmelt and precipitation with lower flows occurring in wintertime.

14.1 Snare Inflow

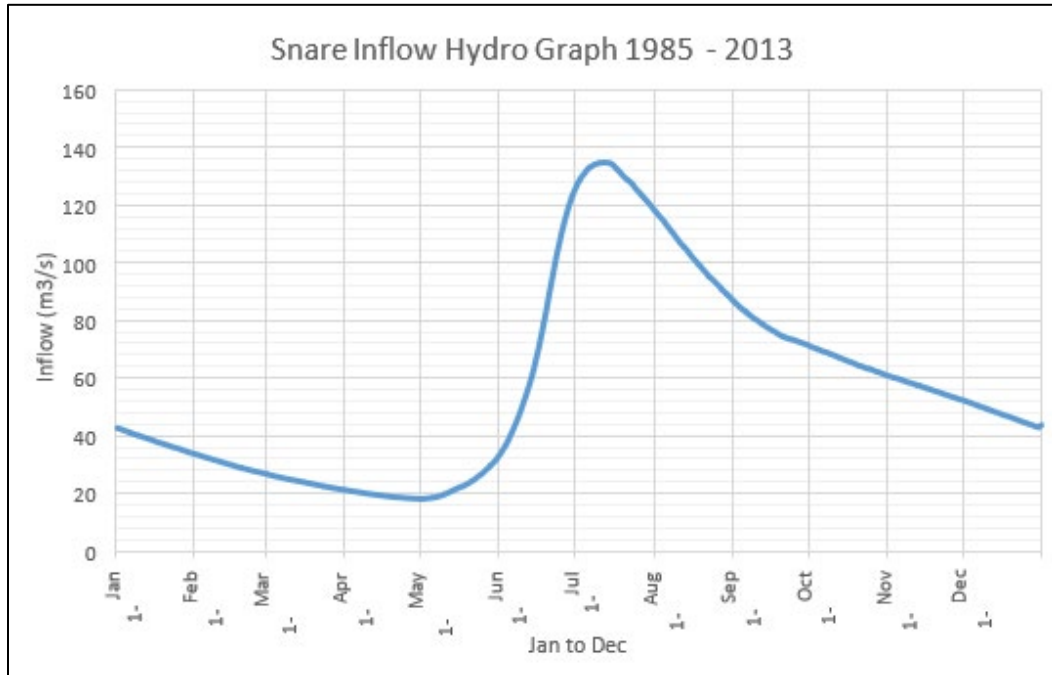


Figure 14.1: Snare Inflow Hydrograph

14.2 Taltson Inflow

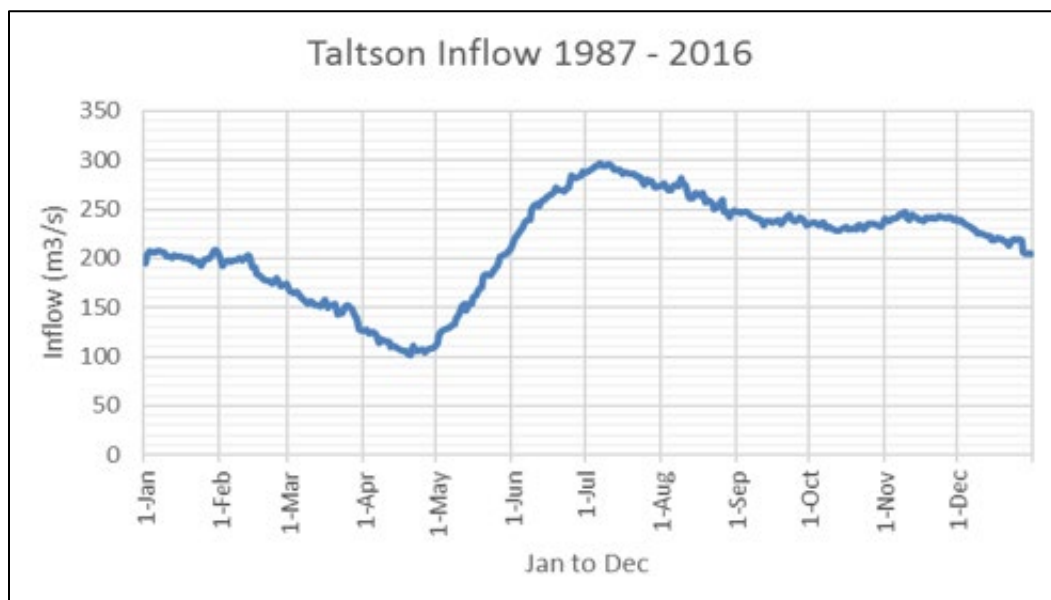


Figure 14.2: Taltson Inflow Hydrograph

14.3 Bluefish Inflow

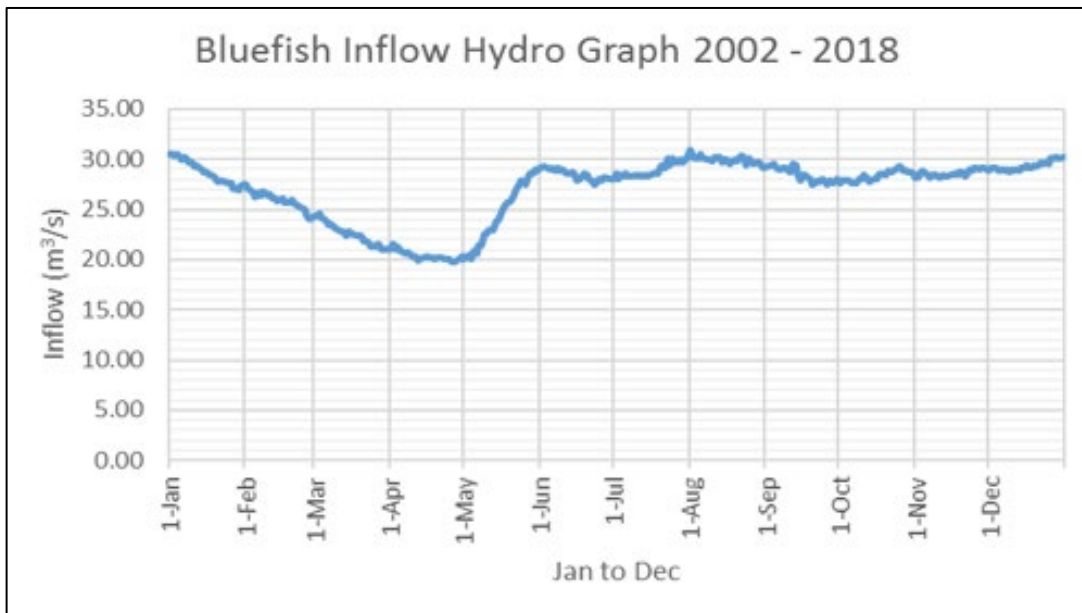


Figure 14.3: Bluefish Inflow Hydrograph

As shown in Figure 14.1, peak inflow values for the Snare system typically occur in July at just under 140m³/s before falling off through the fall and winter to a low of around 20m³/s in April. Taltson inflows also peak in July at around 300m³/s and experience lows in April of 100m³/s as seen in Figure 14.2. Figure 14.3 shows that Bluefish has steady inflows from June to January with a peak of around 30m³/s and lows in April of 20m³/s.

15. Roles & Responsibility

RACI – Role Matrix

Tasks / Activities	Manager Plant Operations	Hydro Plant Operator	Manager System Control	Dam Safety Engineer	AME Project Management	HSE Environmental Licensing	Chief Projects & Engineering Officer	Hydro Asset Manager	Chief Tec Officer (AME)	Civil EIT
Conduct comprehensive DSR for Snare, Bluefish & Taltson Hydro dams	I	I	I	R		C	A	C		R
Sending DSR (Snare, Bluefish & Taltson) reports to Water Board with implementation plan	I			R		C	A	C	I	R
Conduct annual dam safety inspection for Snare, Bluefish & Taltson hydro dams	I	I	I	R		I	A			R
Sending Annual Dam Safety report to Water Board with implementation plan for recommendations				R		C	A	C	I	R
Conduct monthly dam inspection by Plant Operator SR, SF, SC & SK Bluefish & Taltson dams	A	R		C						C
Review monthly dam inspection reports & identify issues		I	I	R			A			R
Work plan to address issues identified in monthly dam inspection (Placing WO)	I	I	I	R			A	I		R
Read & record thermistor readings at Snare Rapids dam	A	R		C				I		C
Read & record thermistor readings at Bluefish dam	A	R		C						C
Review thermistor readings & identify issues	I	I		R		I	A	I		R
Action plan to address issues identified from instrumentation (Placing WO in CMMS)	I	I	C	R			A	I		R
Read & record Piezometer readings at Bluefish dam	A	R		C						C
Review Piezometer readings & identify issues	I	I		R			A	C	C	R
Annually retrieve and observe corrosion coupon conditions	C	C	I	A			R			R
Attending issues identified with instrumentation (Placing WO in CMMS)	C	I	C	R		C	A	C	C	R
Sorting Capital & Maintenance items & for implementation DSR items	I	I	I	C	C	I	R	C	A	
Planning projects next five years for fund allocation	C		C	C		I	R	C	A	
Ensure funds for capital items				C	C		A	C	R	
Ensure funds for maintenance items	C		C	C			R	C	I	C
Arrange contracts & implementing capital items	I	I	C	C	R	C	A	C	C	
Arrange contracts & implementing maintenance items	I	I	I	R	C	C	A	C		R
Providing training for new Plant operators on Dam Safety	C	I	C	R		C	A	I		R
Inflow forecasting for Snare, Bluefish & Taltson	I	I	R	C		I	A	I	I	C
Prepare Hydro Operation Plan for next 6 months & reviewing.	I	I	R	C		I	A	I		I
Prepare a budget for Dam Safety each 5 years & communicate with Finance Division	C	I	I	R	C	C	A	I	I	R
Write Project Brief for fund allocation for Capital Projects recommended in DSR	C			C	R	C	A	C		C
Write RFP for Capital Projects recommended in DSR	C		C	C	R		A	C		C
Write Project Brief for fund allocation for maintenance projects recommended in DSR				R	C		A	I		R
Write RFP for maintenance projects recommended in DSR				R	C		A	I	I	R
Updating O & M Manuals of Snare, Bluefish & Taltson.	C	I	R	C		C	A	I	I	C

Updating Emergency Preparedness Plan of Snare, Bluefish & Taltson	C	I	C	C		R	A	I	I	I
Updating Emergency Response Plan for Snare, Bluefish & Taltson	C	I	C	C		R	A	I	I	I
Tasks / Activities	Manager Plant Operations	Hydro Plant Operator	Manager System Control	Dam Safety Engineer	AME Project Management	HSE Environmental Licensing	Chief Projects & Engineering Officer	Hydro Asset Manager	Chief Tec Officer (AME)	Civil EIT
Providing training on EPP & ERP for Snare, Bluefish & Taltson	C	I	C	C		R	A	C	I	I
Snare 5B Gain heaters should be ON during winter months	R	I	A	C						
Snare Falls spill gate heaters should be ON during winter months	R	I	A	C				I		
Snare Falls Side Dam # 1 –Snow should be removed on crest of the dam during winter months	R	I		C			A	I		
Conducting snow survey during end of every winter in Snare & Bluefish catchment areas.	I			I		C	A	I		
Prepare Inflow forecast for Snare River & Yellowknife River at Bluefish Lake	I		R	I			A	I		
Monitoring and evaluating Indin & Snare Ghost daily inflow – Environment Canada website.	I		R	C			A	I		I
Monitoring and evaluating Nonacho Lake and Taltson River inflows – Environment Canada website	I		R	C			A	I		I
Maintaining and evaluating Bluefish Lake & Duncan Lake inflows – Environment Canada website	I		R	C			A	I		I
Reporting water license flow or water level violation			R	C		R	A			I
Maintaining and evaluating flows through IFR Gate at Bluefish	A	R				C				
Forecasting Flood inflow for each of Snare Rapids, Taltson & Bluefish	C	I	R	C			A	I		I
Operating Spill gates of 5B, Falls, Duncan & Bluefish dams to manage the flood inflows	I	I	R	C			A	I		I
Annual maintenance of Mechanical & Electrical systems of each spill gate in Snare Taltson & Bluefish	R	C	C	C			A	I		I
Compile and review annual instrumentation data (thermistors, piezometers, corrosion coupons, settlement plates).		I		I						R

R = Responsible for doing task **A = Accountable to ensure completed**
C = Consult/Experts **I= Inform (who needs updates)**

16. Dam Safety Work Plans

Dam Safety Reviews and the Annual Inspection result in reports with recommended actions to address deficiencies observed at any of the dam sites or with aspects of the management system. These are responded to with NTPC's proposed actions to address the recommendations and reported to the appropriate water board for their review and comment. These recommendations and other actions identified internally are tracked and addressed in a timely manner based on priority (Low-Very High). Typically, work on dam safety projects is addressed through a variety of methods which include:

- **Capital Projects**
- **Deferred Maintenance Projects**
- **Technical Studies or Investigations**
- **Updates of documents and procedures by the responsible party.**

Updates on DSR recommendations are provided in the Annual Reports to the responsible water boards until work is sufficiently completed. There may be reasons that some recommendations from external reviewers are not acted upon and NTPC will provide reasons why such as in recommendation 1 below, taken from the 2019 Snare DSR completed by KGS.

Snare DSR Recommendations 2019					
Number:	Status:	Description of Recommendation:	Priority:	NTPC Response:	March 2021 Updates:
1	Complete	There are different local elevations datum for each site. These are not clearly defined in the OMS manual. All site elevations & operating levels should be converted to Geodetic.	H	NTPC does not wish to change these datum as our systems (SCADA, alarms, water license) are directly tied into the existing datum. We have developed engineering standard ES-3004 to identify the conversion factors for each site.	
2	Complete	Site surveys show that several of the earth structures have spots that are lower than the design elevations. This should be reviewed against freeboard requirements for the dams and topped up as necessary.	M	Every 3 years NTPC undertake crest surveys, if crest elevations are considerably low they are raised.	Crest surveys planned for 2021 will be reviewed against freeboard requirements, top ups will be done if needed.
3	Complete	OMS Manual EPP & ERP were reviewed and found to meet the requirements of CDA. Update contact information.	H	Currently underway, to be completed in 2019	Contact info updates completed May 2020.
4	Complete	The Snare system four development sites need to be clearly posted in the staff house and at each site clearly showing all site structures and access routes. Signage identifying each structure should be installed.	H	Currently underway, to be completed in 2019	Completed 2019.

Figure 16.1: Part of the 2019 Snare DSR Tracking List

17. Operations, Maintenance, Surveillance

Daily operations, preventive and corrective maintenance and surveillance are completed by hydro operations staff. Standard Operating Procedures (SOP) generic to each hydro system and site-specific are developed, reviewed, and updated on a regular basis and include OMS Manuals, Emergency Plans, Dam and Plant Inspections, and Shift Change Procedures. A list of equipment available at each site is also maintained and updated on a regular basis.

Maintainable assets are assigned with maintenance work orders entered in NTPC's computerized maintenance management system, Guide TI. Preventive work orders are calendar-based or meter-based tasks that are automatically generated by Guide TI. Corrective work orders are individually initiated by employees that discover deficiencies related to the performance of the assets and undergo a detailed process flow to ensure execution. While the CMMS system is mostly utilized by the operations division, monthly dam safety inspections and dam instrumentation readings are preventive work orders important to meeting dam safety surveillance requirements. Other examples of important tasks include maintenance of trash racks, headgate intakes, penstocks, surge tanks, powerhouse systems, turbines, and other facilities.

Dam-specific surveillance activities include the dam inspection structure, dam instrumentation readings (piezometers, thermistors, seepage weirs), crest surveys to maintain design elevations, and seepage monitoring.

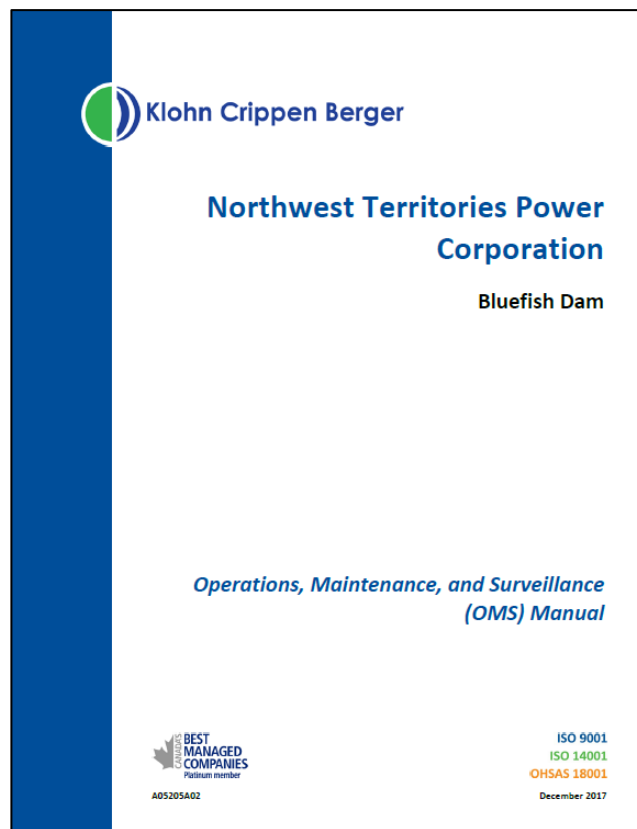


Figure 17.1: Bluefish Dam OMS Manual

18. Emergency & Safety Plans

Each hydro system has Emergency Preparedness Plans (EPP) and site-specific Emergency Response Plans (ERP), and Public Safety Plans (PSP). The Emergency Plans follow the Incident Command System (ICS) – the standard command and control structure for emergency management in Canada that NTPC follows.

Emergency Preparedness Plan details include:

- Emergency Declaration Guidelines and documented procedures.
- Detection, evaluation, and classification of emergencies.
- Breakdown of Responsibilities under the EPP.
- Prevention Procedures.
- Preparedness Procedures.
- Response Procedures.
- Recovery Procedures.

Site-Specific Emergency Response Plan details include:

- Site Details.
- Emergency Contact Lists.
- Emergency Notification Directory.
- Available on-site equipment, off-site equipment, list of contractors.
- Inundation Maps.
- Communication and Site Access information.
- Procedures based on type of emergency (medical, fire, flood, dam breach, etc).

Public Safety Plan details include:

- Potential public interactions with the facilities.
- Potential Hazards.
- Public Safety Awareness: signage, safety booms, audible signals.
- Site Plans, signage locations.

19. NTPC Dam Inspection Structure

There are three types of scheduled inspections for the dams NTPC owns, operates, and maintains which include:

Monthly Inspections:

Dam safety inspections are completed monthly by operations staff who fill out the inspection forms, an example of these is provided in Appendix C of this document. These are sent to the dam safety engineer for review and uploaded to Guide TI, NTPC’s computerized maintenance management system. These inspections are a visual assessment of dam conditions and check for any developing issues on the crests, upstream and downstream sides, and abutments. At applicable dams, instrument readings are performed, and areas of known seepage measured and recorded on the inspection form.

Annual Inspections:

NTPC conducts annual inspections of all dams and appurtenant structures in the spring as soon as conditions allow. This inspection is performed by an experienced engineering and geotechnical consultant along with NTPC engineering staff. Dams are inspected for any signs of distress with extra attention paid to leakage, erosion, slope stability, undue settlement, displacement, cracking, deterioration, and improper functioning of any weirs and drains. Any areas of concern raised by NTPC Operating Staff are also discussed and inspected as required, and the crests of the Forks Dykes are typically surveyed as these dykes are subject to ongoing settlement. An annual inspection report is completed which describes the conditions of the dams, inspection findings and recommendations.

Comprehensive Dam Safety Reviews:

Dam Safety Reviews are the most comprehensive inspections, as most of NTPC dams are classified as high or significant consequence dams, these are conducted every 5-7 years for each separate hydro system. A Dam Safety Review is a systematic review and evaluation of all aspects of design, construction, maintenance, operation, processes, and systems affecting a dam’s safety, including the dam safety management system, and should be based on current knowledge and standards. These are done by experienced third parties and led by a Review Engineer with a strong background in design, construction, performance analysis, and operation of dams. A Dam Safety Review report is completed which proposes recommendations encompassing all elements of a hydro system. Table 19.1 provides a projected schedule of required dam safety reviews for the three hydro systems.

Table 19.1: DSR Projected Schedule

Site:	2021	2022	2023	2024	2025	2026	2027	2028	2029
Snare			S					S	
Taltson	S					S			
Bluefish	S					S			

20. Staff Training

Training around dam safety activities is provided to hydro operators when hired and training records are maintained. Dam Safety Training gives a general overview of dam terminology, failure modes and reasons dam failure can occur, typical issues to look for during inspections, how to properly fill out an inspection form, and an introduction to each of the 19 dam and 8 spillway structures NTPC owns and operates. A Dam Monitoring Guide with basic technical information of each dam, locations of known seepages, and dam characteristics is also provided to operators responsible for completing monthly inspections.

The HSE department provides safety related training such as Work Protection Code Training and Emergency Preparedness and Response Training which is conducted yearly. Operators, Technicians, and Engineering staff working around hydro sites complete relevant training to establish competencies. This includes but is not limited to:

1. NTPC Environmental, Health, and Safety Training
2. Plant and Camp Orientation
3. MSDS
4. Confined Space
5. Working at Heights
6. Site-Specific Standard Operating Procedures
7. Site-Specific Emergency Preparedness Plan and Response Plans
8. Tailboard Meetings
9. Field Level Risk Assessments
10. Dam Safety Training



Figure 20.1: Dam Safety & Emergency Preparedness and Response Training

21. Incident Investigations

NTPC has a framework for Incident Reporting and Investigations and has forms for reporting safety concerns, incident reports, spills, and injuries on Powerline. Incident Reports and Investigations are part of the overall Health & Safety Management System which includes the Health & Safety Policy, Hazard Assessment & Control, Safe Work Practices and Job Procedures, Training and Communication, incident statistics and more. The HSE Director is NTPC's single point of contact for incidents which need to be reported to the Worker's Safety and Compensation Commission (WSCC) such as dangerous occurrences and accidents causing serious bodily harm.

The purpose of health and safety incident investigations is to identify the root, direct, and indirect causes of incidents so that controls can be put in place to prevent future incidents. Incidents are assessed based on the Reasonable Potential for Harm (RPH) from low (minor damage, potential first aid injury), medium (potential for medical treatment injury, medium damage), and high (potential for serious bodily harm, major damage) which determines the appropriate level of investigation.


	Health & Safety Management System Form: Incident Investigation		Page 1 of 5
	Monitor: Director, Health, Safety & Environment		Form #: 10.2
Section A – Incident Details			
Incident date:		Incident location:	
Reported by:		Position:	
Incident title:			
Incident summary:			
Incident type:	<input type="checkbox"/> Near Miss <input type="checkbox"/> Illness <input type="checkbox"/> Environmental	<input type="checkbox"/> First Aid Injury <input type="checkbox"/> Medical Treatment Injury <input type="checkbox"/> Lost Time Injury	<input type="checkbox"/> Property Damage <input type="checkbox"/> Production Loss <input type="checkbox"/> Dangerous Occurrence
Incident rank:	<input type="checkbox"/> Low (potential First Aid Injury, minor property or environmental damage)	<input type="checkbox"/> Medium (potential Medical Treatment Injury, medium property or environmental damage)	<input type="checkbox"/> High (potential Serious Injury or Fatality, major property or environmental damage)
Section B – Investigation Team			
Name		Position	JOHSC
		(Team Lead)	<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
Section C – Interviews			
Witness Name	Position	Date Interviewed	Attached
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
Hard copies of this document are considered uncontrolled. Please refer to the PowerLine for the latest version.			

Figure 21.1: Front Page of NTPC Incident Investigation Form

22. Dam Crest Surveys

Crest surveys are scheduled in the year prior to dam safety reviews for each NTPC dam unless visual inspections warrant that they be completed sooner. Exceptions to this are the Snare Forks Dykes 1,2,3 which are completed annually due to historical settlement from permafrost melt which requires recurring maintenance of the dyke crests. The Forks Dykes are typically surveyed during the annual inspections in early spring. Nonacho dam experienced some settlement at its right abutment shortly after construction so is also surveyed during its annual inspection to ensure no further settlement is occurring. Schedules for each Hydro system are given below and subject to change depending on observations arising from inspections or changing conditions. All crest survey drawings produced by a survey company are reviewed and records from previous years are kept in the Dam Safety SharePoint. The Dam Survey Guide document details datums, benchmark locations, and site-specific survey details such as settlement monitoring points installed at Nonacho and Bluefish dams.

Table 22.1: Dam Crest Survey Schedule

Crest Survey Schedule			
Year	Snare	Taltson	Bluefish
2021	Forks Dykes	Completed	Completed
2022	Completed	Nonacho	
2023	Forks Dykes	Nonacho	
2024	Forks Dykes	Nonacho	
2025	Forks Dykes	Scheduled	Scheduled
2026	Scheduled	Nonacho	

23. Vegetation Management

Mechanical brushing is conducted at each NTPC dam approximately every 3-5 years which is about the time it takes for trees and shrubs to regrow to the point of being excessive (above 3m in height). It is planned to incorporate selective herbicide use by an experienced vegetation management company if a pesticide permit can be approved to reduce the rate of regrowth and control deep-rooted vegetation such as willows, alders, and birch trees.

Trees and brush growing on dams are a safety concern and must be removed for the following reasons:

- They can damage the structural integrity of the dam by penetration of the dam core from root growth, this increases the risk of water leaks (piping of the dam) and erosion which can lead to dam failure and severe environmental consequences.
- Potential to damage the dam by windthrow (tree roots pulling out of the dam face).
- Impede access to structures and instrumentation for safety inspections.
- Block sightlines during visual inspections both for monitoring seepage and assessing structural integrity, excessive vegetation can obscure developing dam safety problems.
- Block sightlines for survey pins in the ground, used as reference points to monitor surface movement of dams and other structures.
- Provide cover for burrowing rodents and other pests.

A basic brushing schedule is provided in Table 23.1 below, this is subject to change depending on observed brush growth and if herbicide use is approved. Dams are assessed annually for vegetation condition and projects are scheduled as required.

Table 23.1: Brushing Schedule

Brushing Historical Schedule & Completed Work				
Year	Snare	Taltson	Bluefish	Time Taken
2016	Snare Forks	Main Dam, Nonacho, North Valley Dam		18 days at Snare (Crew of 4); 10 days at Taltson (Crew of 3).
2017	Snare Cascades, Snare Falls			21 days (Crew of 3).
2018	Snare Rapids, 5B, 4B, 9B.			17 days (Crew of 3).
2019	Snare Forks	Main Dam, Nonacho, North Valley Dam		16 days at Snare (Crew of 4); 9 days at Taltson (Crew of 3).
2020	N/A	N/A	N/A	
2021	Snare Falls (All), Snare Cascades, Snare Rapids (MD), Forks (Strutt, North,)		Bluefish	12 days at Snare (Crew of 7*); 2 days at Bluefish (Crew of 5).
2022	Snare Side Dams + Snare Forks			14 days (Crew of 4)

24. Seepage Monitoring

All known seepage locations around NTPC dams along with monitoring requirements including monitoring frequency, methods, and reporting are documented in the Seepage Monitoring Guide. Some seepage flows and observations are taken monthly by operators on site and recorded on the dam safety monthly inspection checklists shown in Appendix C. Where weirs are not feasible other methods are used to record seepage rates including staff gages, measuring cup and stopwatch estimates, or visual inspections. There are a few locations of non-measurable seepage that are noted and checked visually for any noticeable changes. Areas of seepage and monitoring methods are discussed as part of the dam safety training program for site operators. The observed seepage flow rates or pond water levels are recorded along with reservoir water level elevations in a seepage monitoring spreadsheet maintained by the dam safety group.

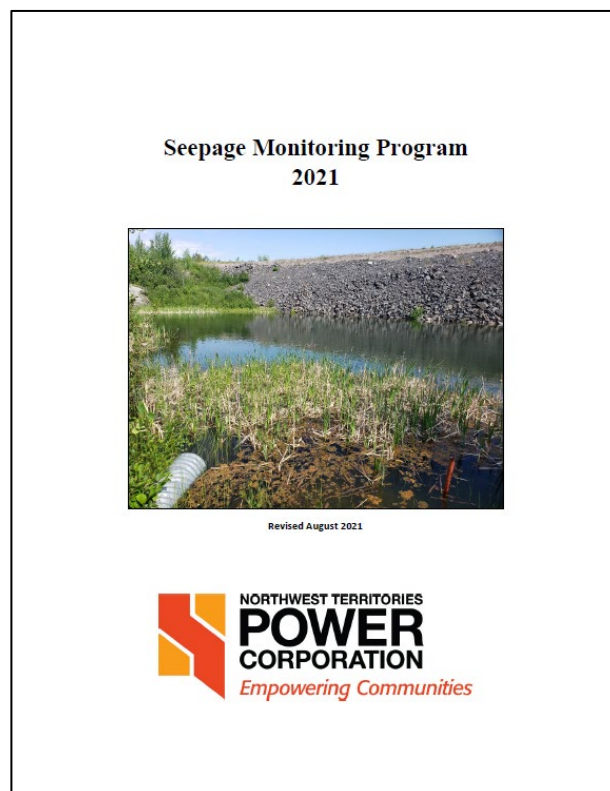


Figure 24.1: Seepage Monitoring Program

25. Reporting Structure

The reporting structure around dam safety activities includes the following:

- **Annual Water License Report** – submitted to the applicable water boards for the Snare, Taltson, Bluefish hydro systems, these reports provide an update on dam safety work for each site, modifications and major maintenance, annual maintenance, environmental, and surveillance network & flow reporting.
- **Dam Safety Reviews** – All dam safety reviews are submitted to the applicable water board by the end of January in the year following the review. These include a cover letter with NTPC’s proposed actions to address the recommendations outlined in the report. Dam Safety Reviews are also distributed and discussed internally.
- **Annual Inspections** – The annual inspection report is similarly submitted to the applicable water board with a cover letter outlining NTPC’s proposed actions.
- **Internal Report on Dam Safety Program** – An annual report on dam safety activities, projects, and program updates is distributed to management and operations staff in the fall.

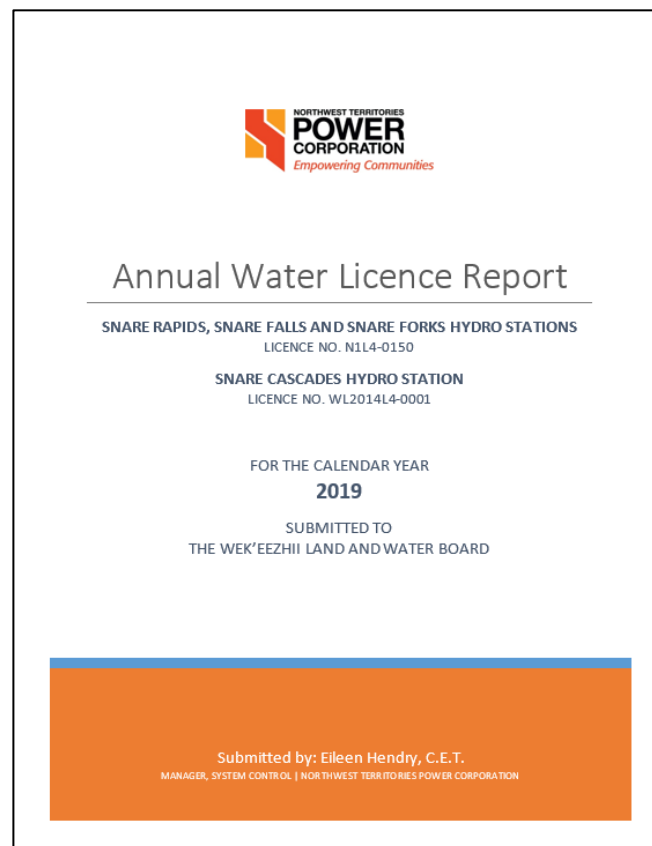


Figure 25.1: Annual Water License Report 2019

26. Dam Risk Assessments

A simple vulnerability-based risk assessment is completed each year which considers hydrotechnical design criteria, geotechnical design criteria, observed conditions and operational reliability of each dam and spillway that NTPC owns and operates. Vulnerability-based risk is a function of consequence index (dam consequence class and NTPC criteria) and vulnerability index made up of:

Hydrotechnical – Design criteria such as freeboard, potential for piping, slope stability, overturning factors of safety, typically these criteria are assessed as part of comprehensive dam safety reviews.

Geotechnical – Design criteria such as foundation, filter material compatibility with CDA recommendations, seismic hazard, typically these criteria are assessed as part of comprehensive dam safety reviews.

Observed Condition – Annual assessment of dam and spillway conditions including crests, slopes, concrete, vegetation, seepages and if any maintenance is required.

Operational Reliability - Annual assessment of when OMS manuals, emergency plans, dam safety reviews, gate and stoplog testing, dam inspections, etc. have last been performed.

The intention of this exercise is to define and work to mitigate risks across the facilities NTPC owns and operates while providing a visual measure of performance in annual internal reports.

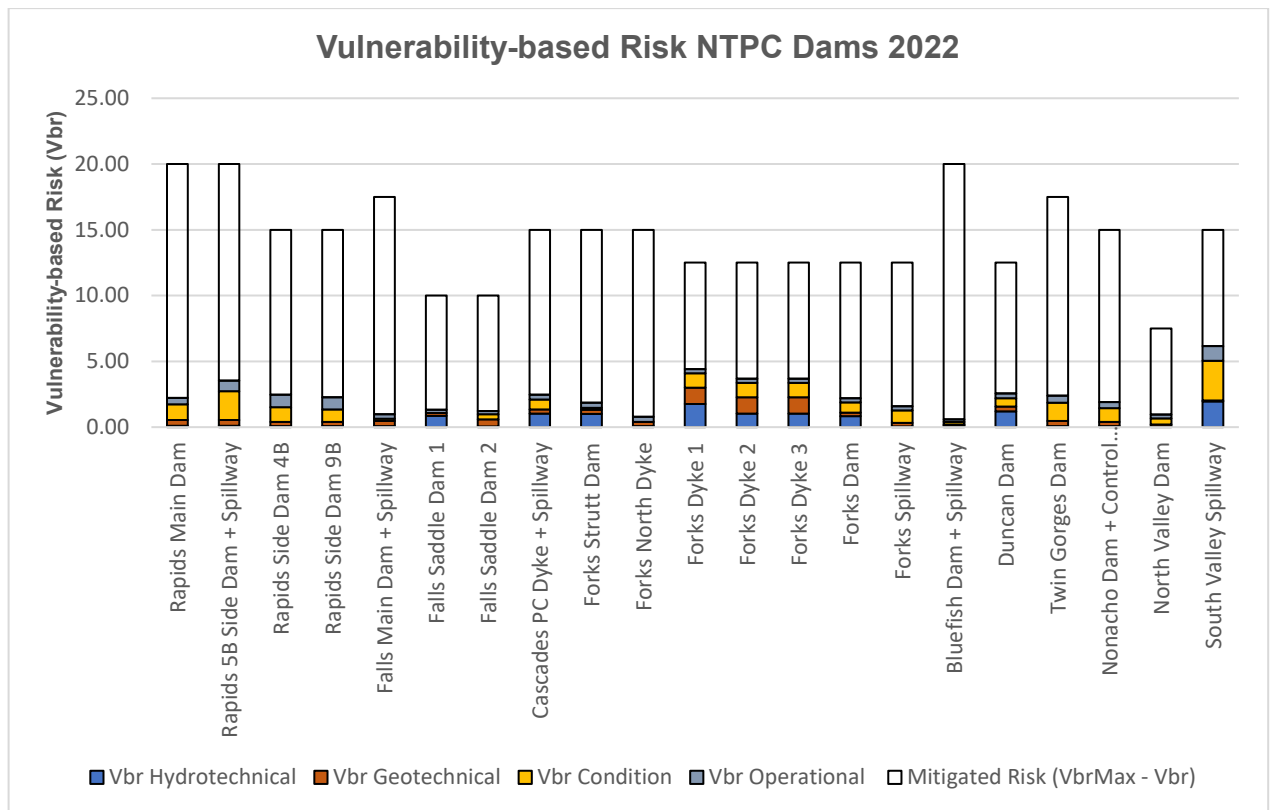


Figure 26.1: Dam Risk Assessment

27. NTPC Dam Safety Documents

Table 27.1 gives a list of important documents that make up parts of the dam safety program, when they were last revised, and where they are located on SharePoint or Powerline.

Table 27.1: NTPC Dam Safety Documents

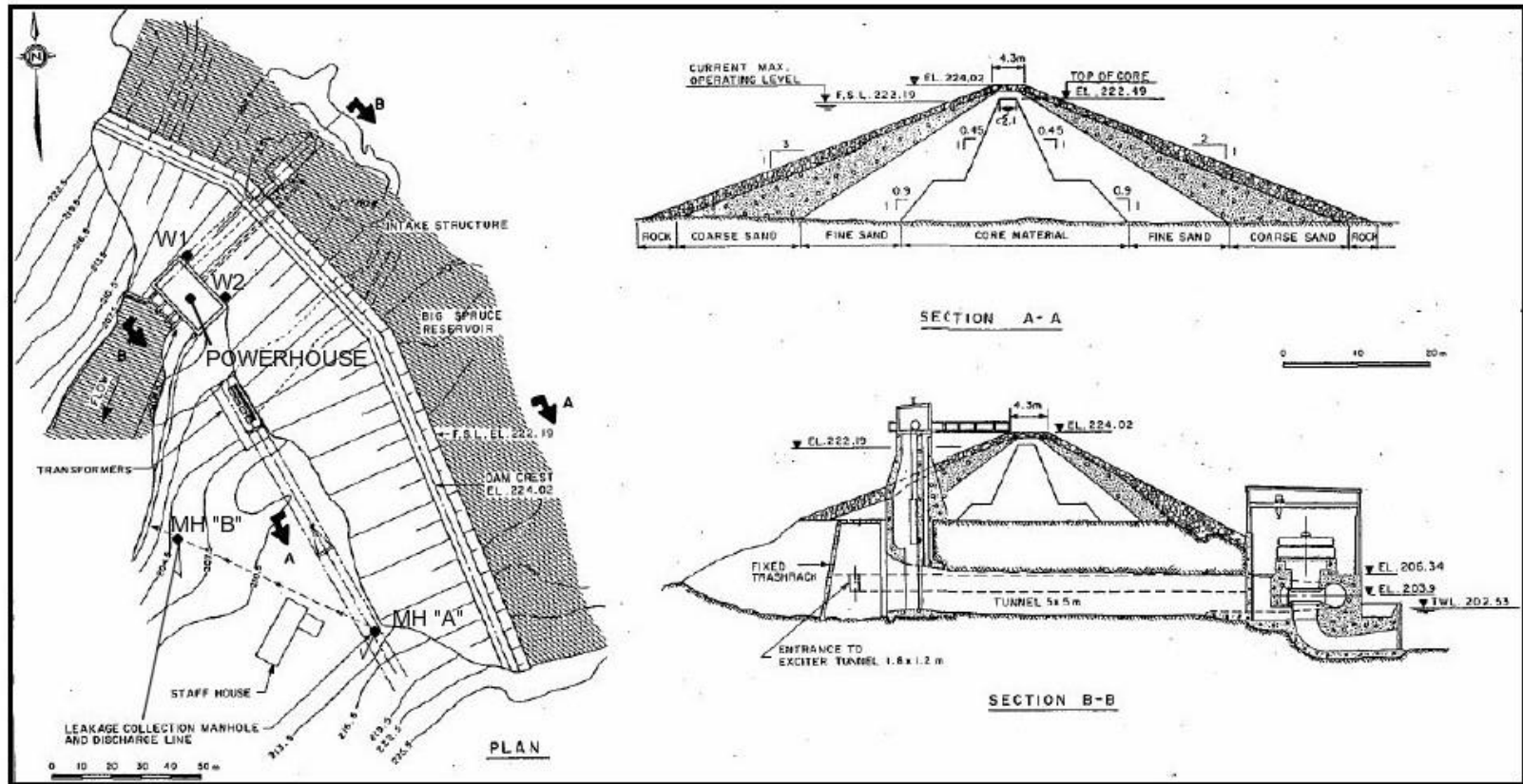
Program Documents:		
Document	Last Revised	Location
Dam Safety Program	2023	Dam Safety - 1. Dam Safety Program Documents - All Documents (sharepoint.com)
Seepage Monitoring Program	2023	
Dam Survey Guide	2022	
Dam Safety Training PPT	2021	
Dam Monitoring Guide	2021	
Annual Updates	2022	
Dam Risk Assessment	2022	
Snare Hydro:		
Emergency Preparedness Plan	2023	Emergency Response Plans NTPC Intranet
Emergency Response Plan	2021	
Public Safety Plan	2023	Dam Safety - Public Safety Plan - All Documents (sharepoint.com)
OMS Manual	2022	Dam Safety - OMS Manuals - All Documents (sharepoint.com)
Taltson Hydro:		
Emergency Preparedness Plan	2022	Dam Safety - Emergency Plans - All Documents (sharepoint.com)

Emergency Response Plan	2021	Emergency Response Plans NTPC Intranet
OMS Manual	2023	Dam Safety - OMS Manuals - All Documents (sharepoint.com)
Bluefish Hydro:		
Emergency Response Plan	2021	Emergency Response Plans NTPC Intranet
Public Safety Plan	2009	Dam Safety - Public Safety Plan - All Documents (sharepoint.com)
OMS Manual	2022	Dam Safety - OMS Manuals - All Documents (sharepoint.com)
Thermistor Monitoring	2021	Dam Safety - 7. Bluefish Instrumentation - All Documents (sharepoint.com)
Piezometer Monitoring	2021	
Settlement Monitoring	2021	
Corrosion Coupons Monitoring	2021	
Dam Inspections:		
Monthly Dam Safety Inspections	2023	Dam Safety - 1. Monthly Dam Inspections - All Documents (sharepoint.com)
Annual Dam Inspections	2022	Dam Safety - 2. Annual Dam Inspections - All Documents (sharepoint.com)
Dam Safety Reviews	2021	Dam Safety - 3. Dam Safety Reviews - All Documents (sharepoint.com)

Appendix A:
Dam Cross-Section Drawings

A.1 Snare Rapids

FIGURE A.1 Rapids Main Dam - Plan & Sections.



RAPIDS MAIN DAM

A.2 Snare 5B Spillway and Dam

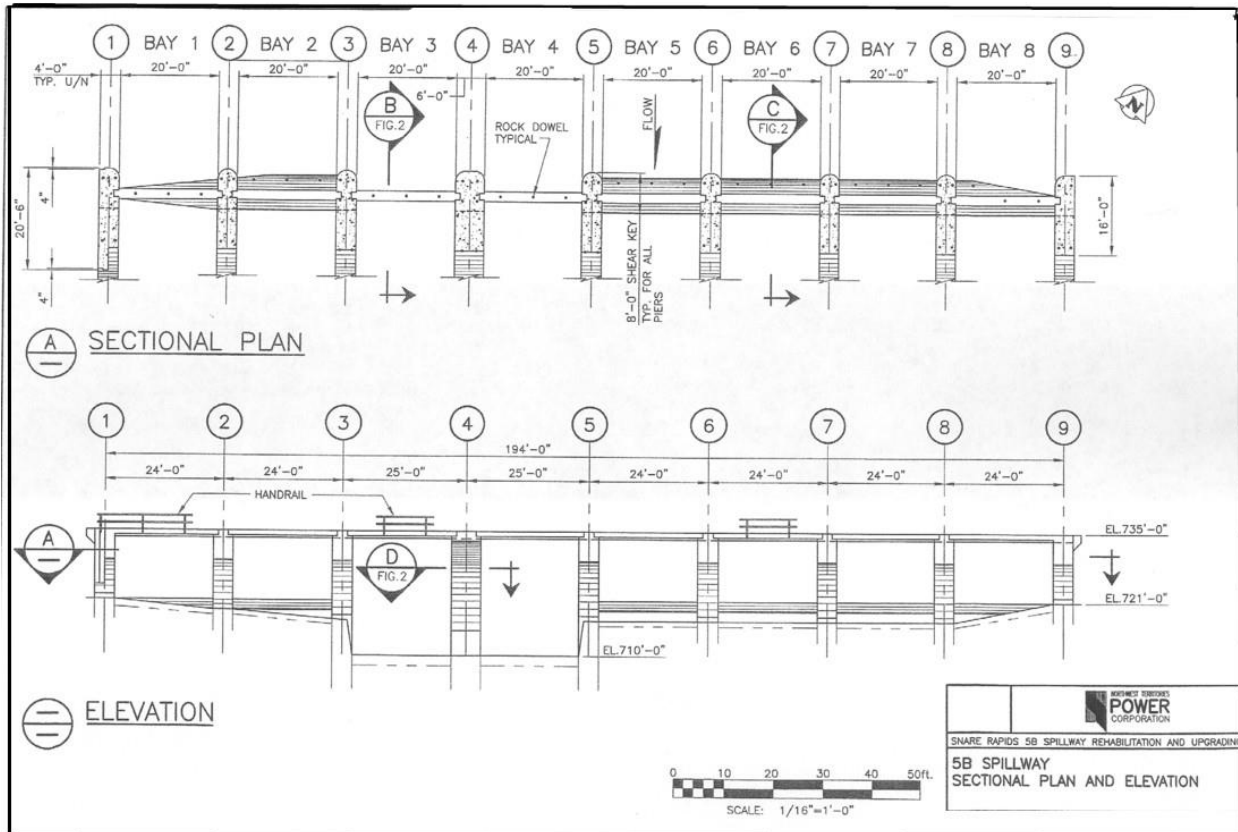


Figure A.2.1 5B Stoplog Spillway; Plan & Profile

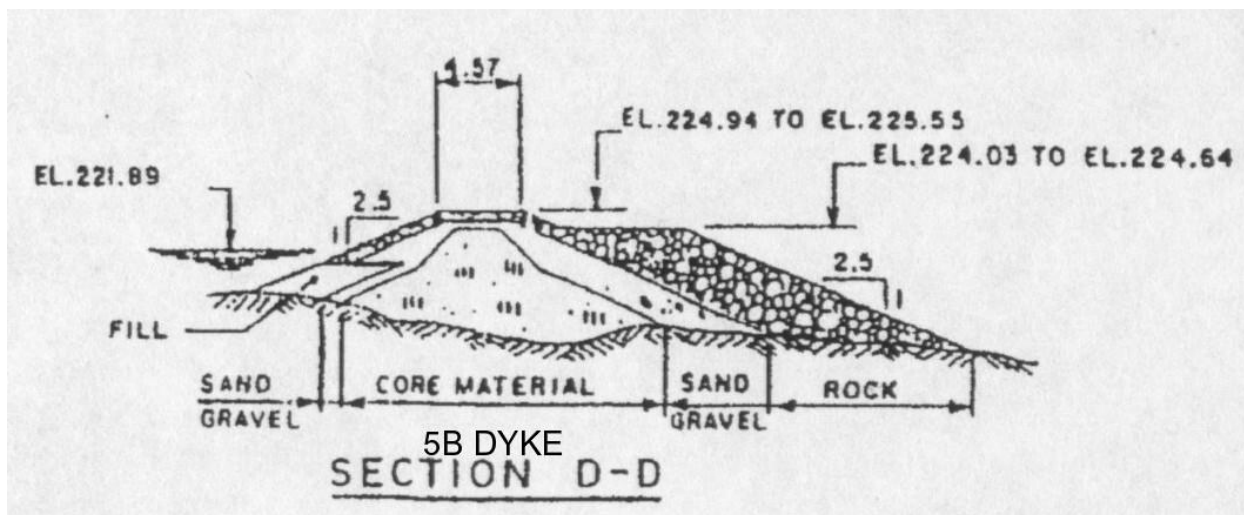
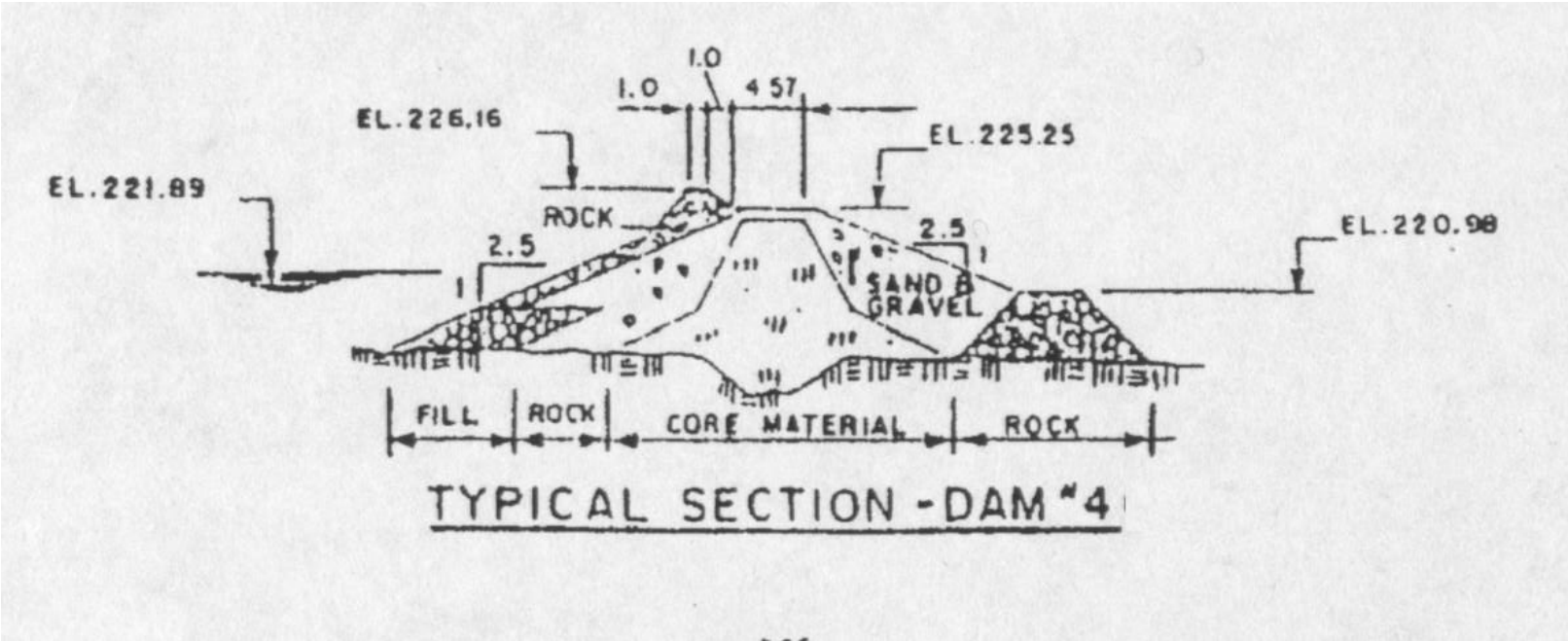


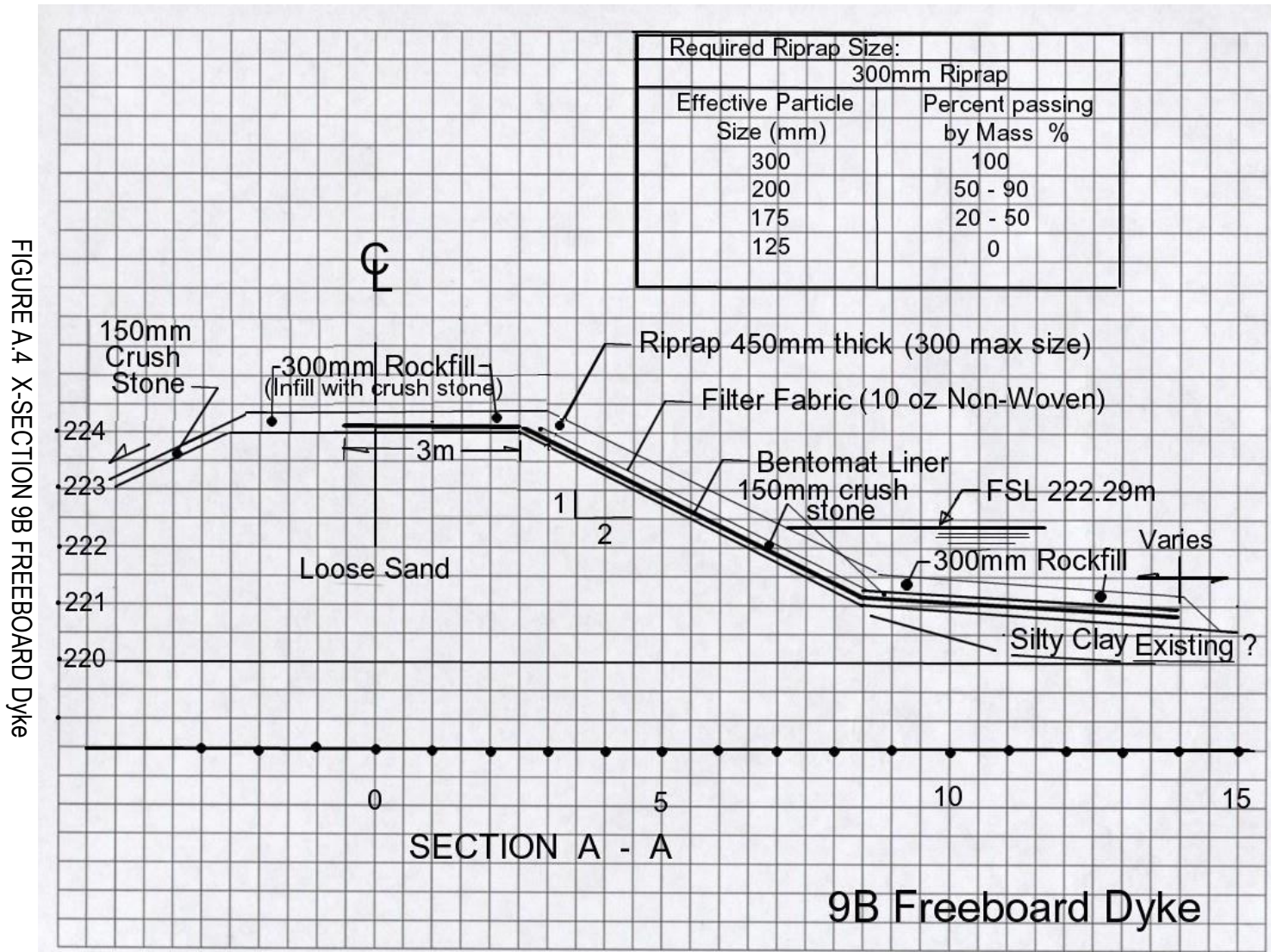
Figure A.2.2 5B X-Section Zoned Earthfill Dyke

A.3 Snare 4B Dam Section

Figure A.3 X-Section of Dam 4

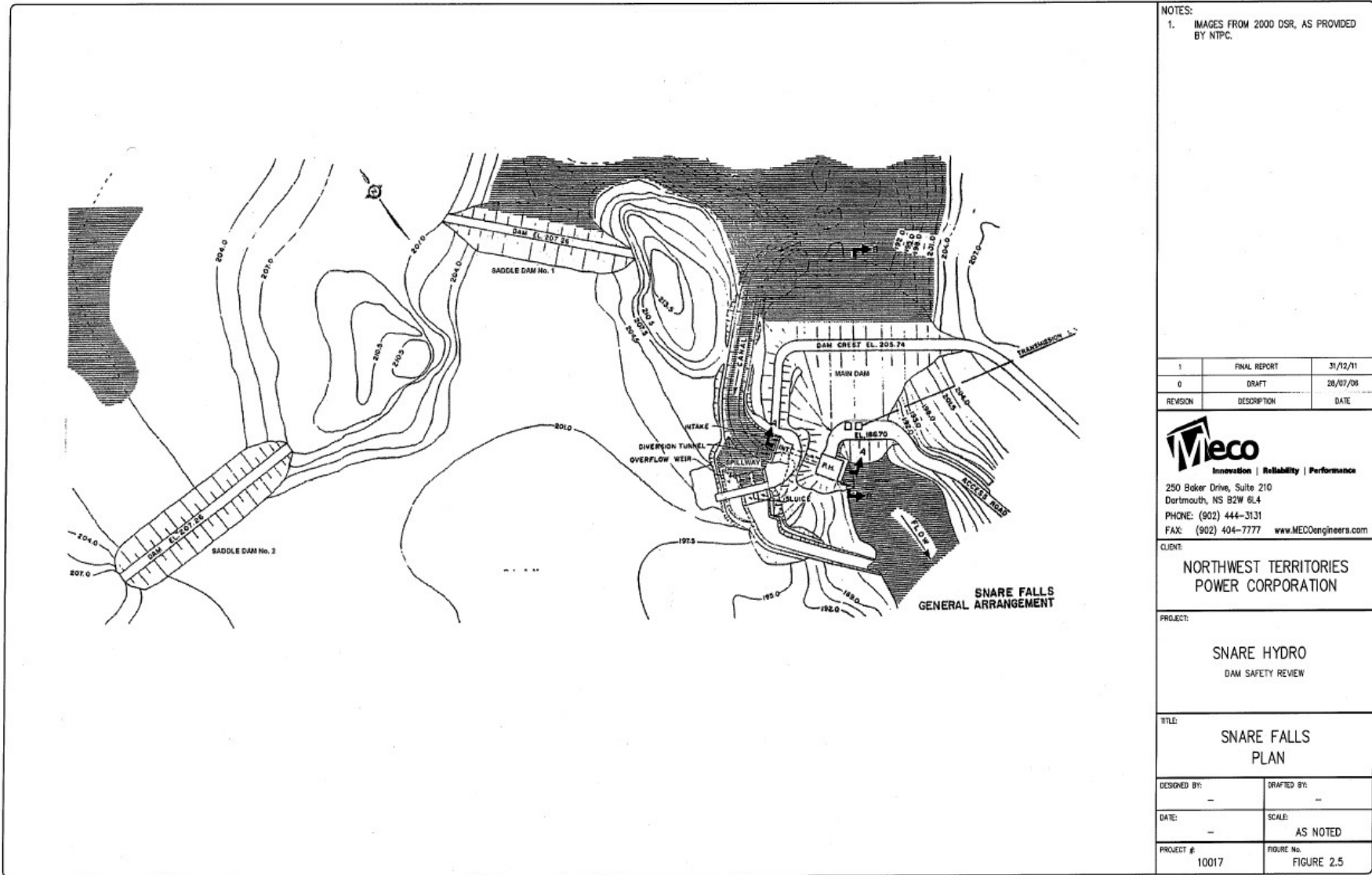


A.4 Snare 9B Dam Section



A.5 Falls Dams Location

1/3/2012 2:58:34 PM O:\PROJECTS\10017 Snare System DSR\CAD\Figures\FIGURES BASED ON OLD DSR\Figures\Figure 2.5-Snare Falls Main Dam.dwg



NOTES:
1. IMAGES FROM 2000 DSR, AS PROVIDED BY NTPC.

1	FINAL REPORT	31/12/11
0	DRAFT	28/07/08
REVISION	DESCRIPTION	DATE

Meco
Innovation | Reliability | Performance
250 Baker Drive, Suite 210
Dartmouth, NS B2W 6L4
PHONE: (902) 444-3131
FAX: (902) 404-7777 www.MECOengineers.com

CLIENT:
**NORTHWEST TERRITORIES
POWER CORPORATION**

PROJECT:
**SNARE HYDRO
DAM SAFETY REVIEW**

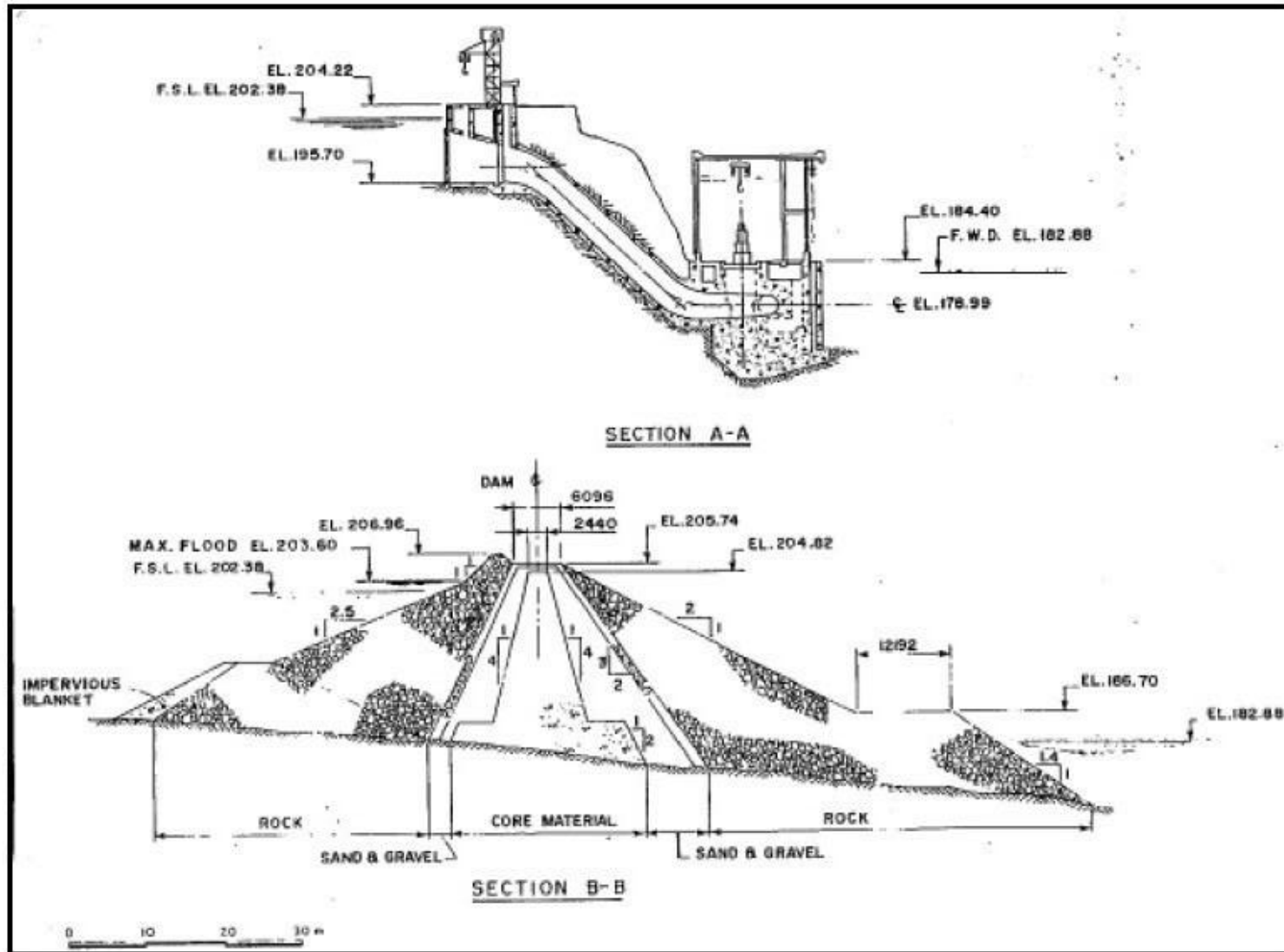
TITLE:
**SNARE FALLS
PLAN**

DESIGNED BY: -	DRAFTED BY: -
DATE: -	SCALE: AS NOTED
PROJECT # 10017	FIGURE No. FIGURE 2.5

Figure A.5: Snare Falls plan view

A.6 Snare Falls Main Dam Section

FIGURE A.6 Snare Falls X-Sections Main Dam.



A.7 Snare Falls Side Dam #1 Section

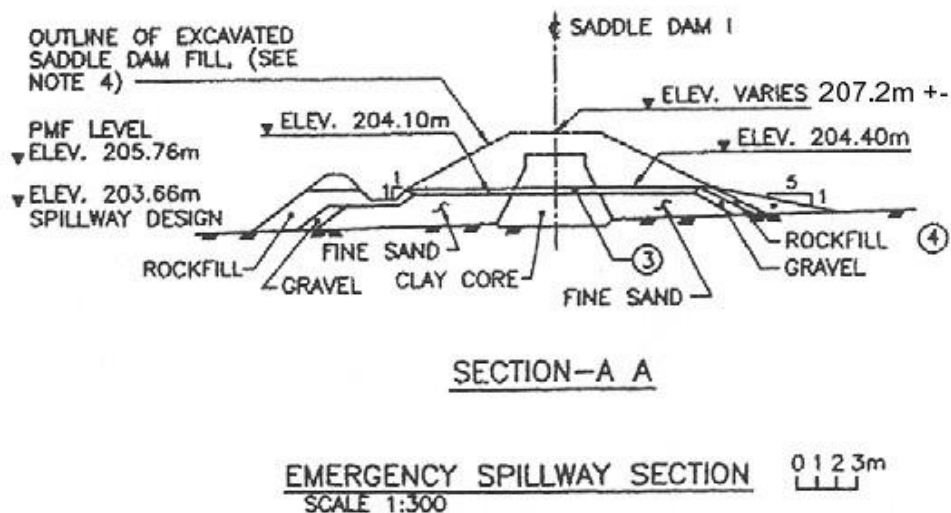
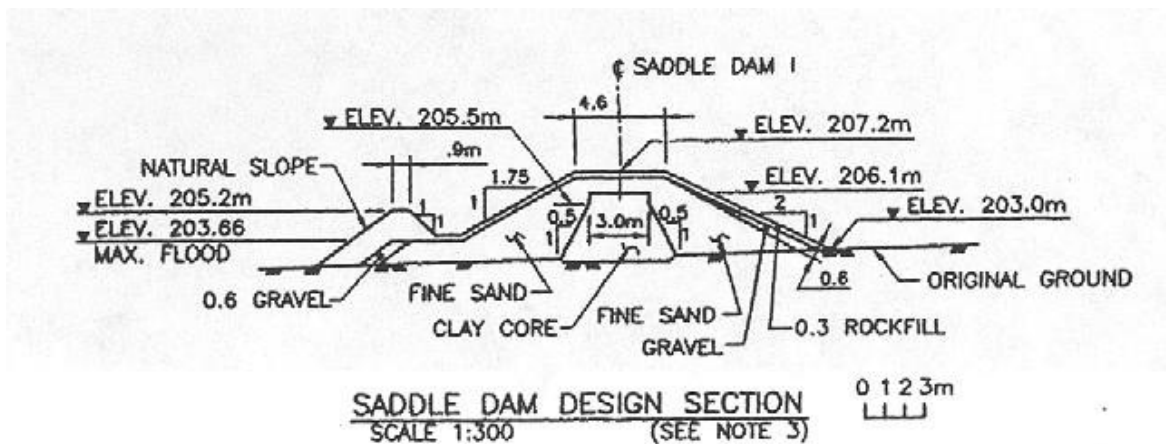
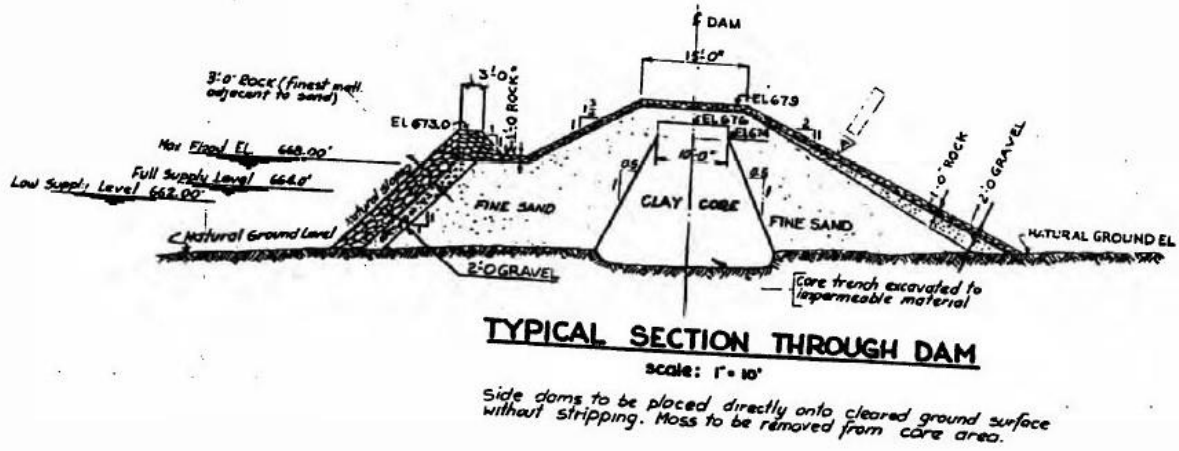


FIGURE A.7
2003 Modifications to Falls Side Dam #1
Emergency overflow Spillway

A.8 Snare Falls Side Dam # 2 Section

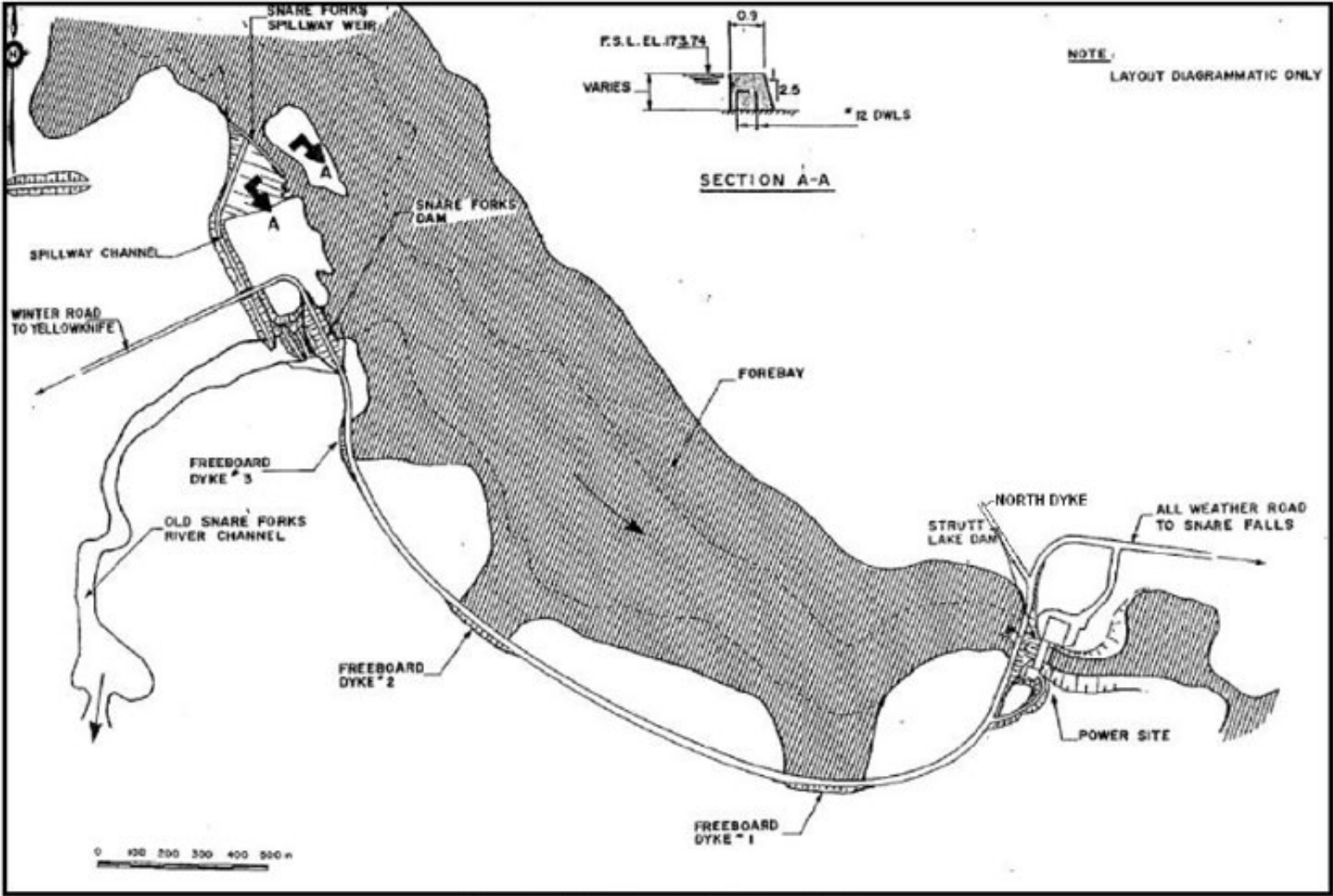


Ref Dwg: Montreal Engineering
NCP - 13899 Rev A
Side Dams 1 & 2, Plan & Section
Dated Aug 18 1959

SNARE FALLS

Figure A.8 Snare Falls Side Dams "As Built"

A.9 Snare Forks Dams Location

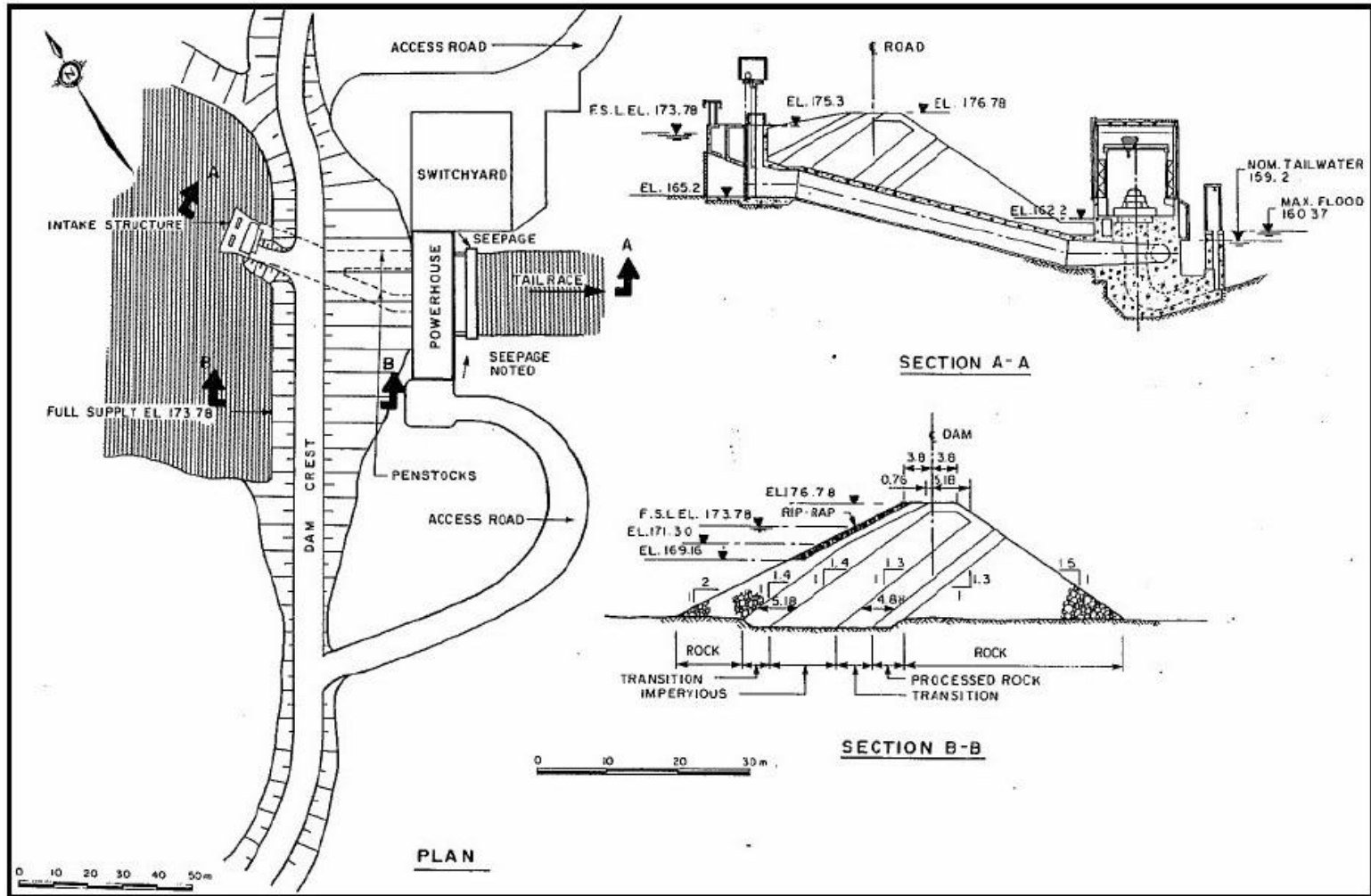


Snare Forks General Layout & Spillway Section

Figure A.9: Snare Forks Dam plan view

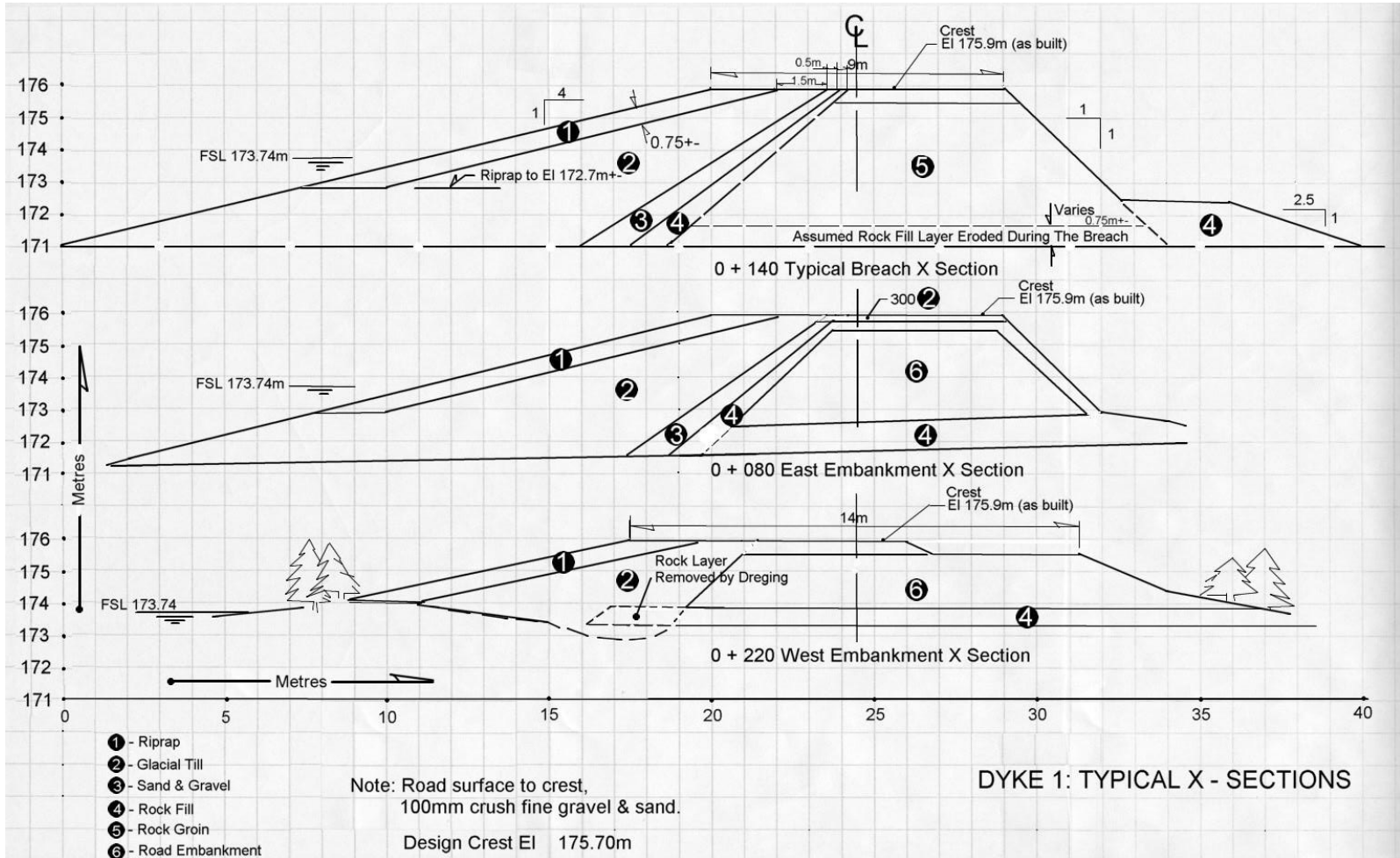
A.10 Snare Forks Strutt Dam Section

FIGURE A.10
STRUTT LAKE DAM
PLAN & X - SECTIONS



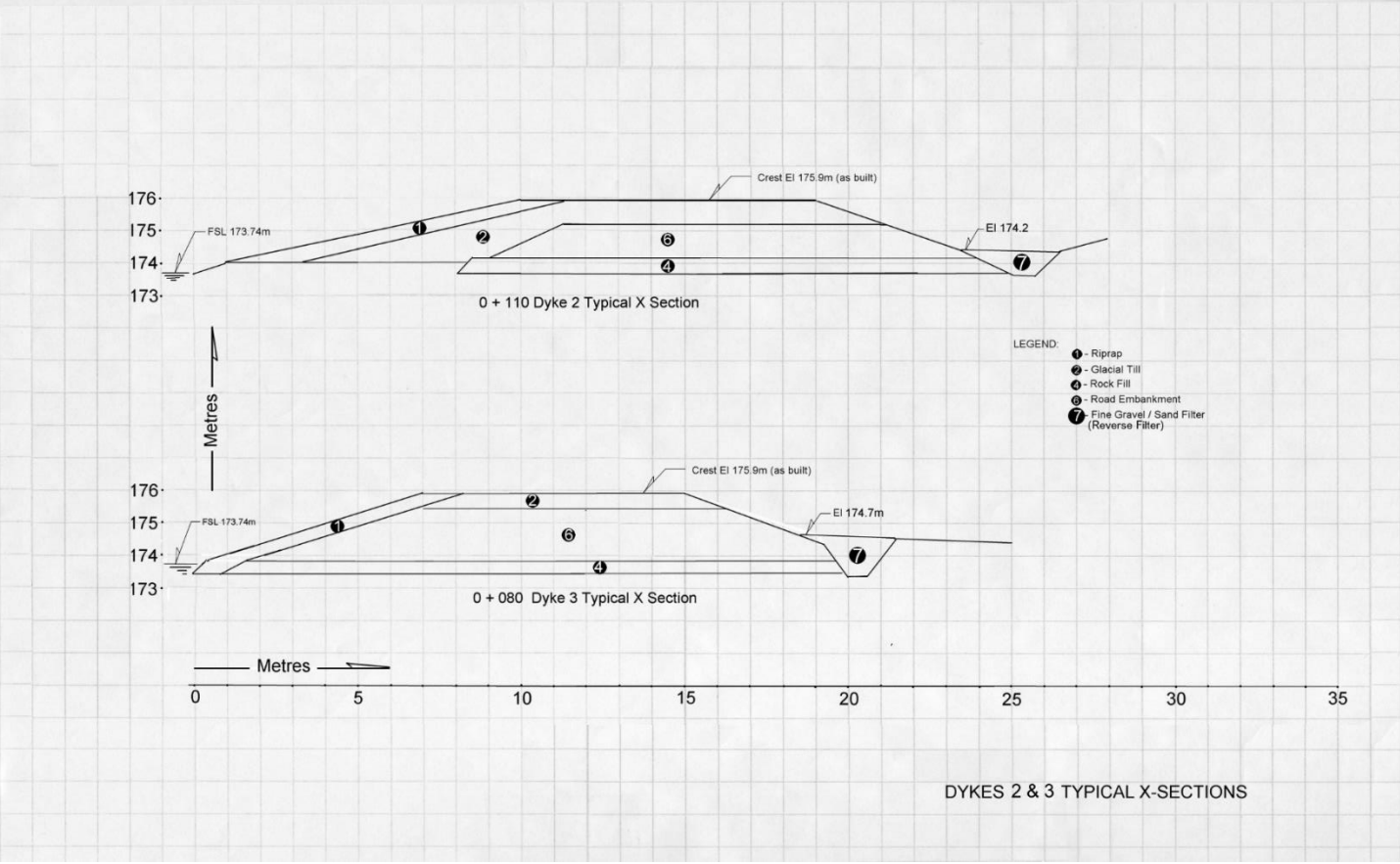
A.11 Forks Dyke 1 Sections

FIGURE A.11 Dyke 1 X-Sections



A.12 Forks Dyke 2 & 3 Sections

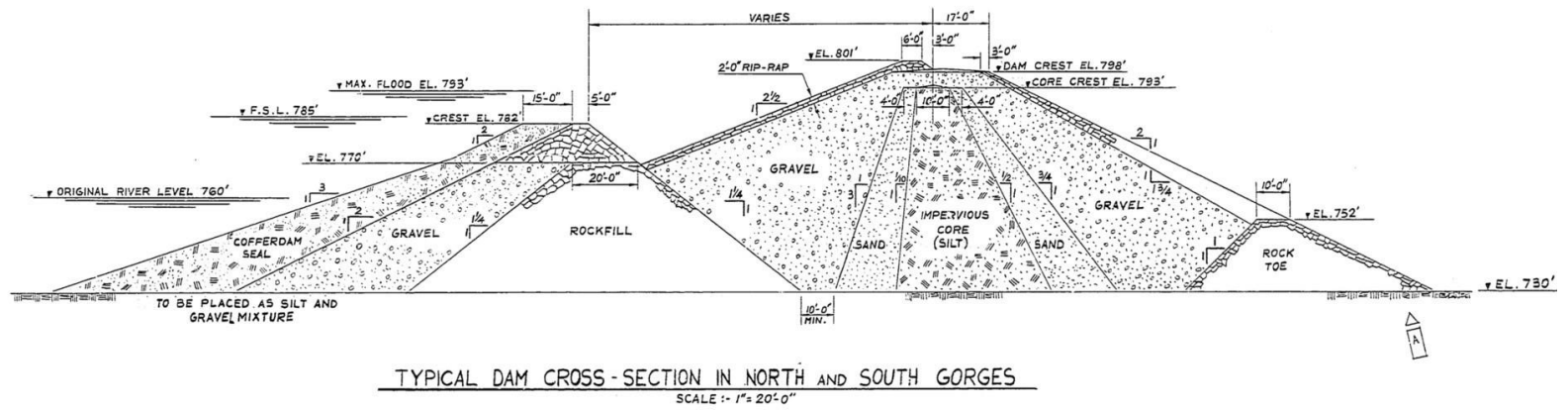
Figure A.12 Dykes 2 & 3 X-Sections.



DYKES 2 & 3 TYPICAL X-SECTIONS

A.13 Taltson Dams Sections

FIGURE A.13 Twin Gorges
Dam X - Section



TALTSON DAM
NORTH & SOUTH GORGES
X - SECTION

A.14 Nonacho Dam

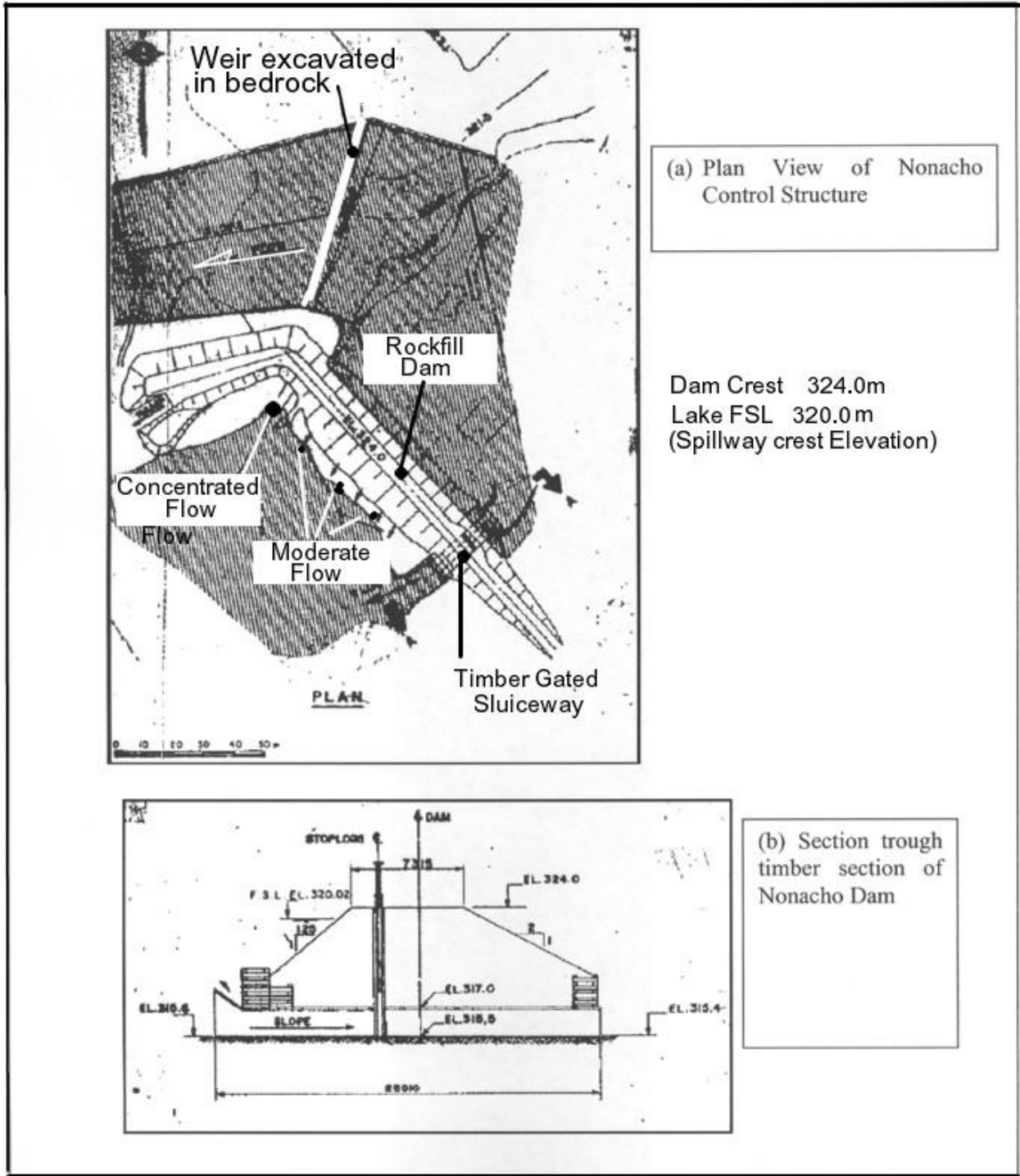
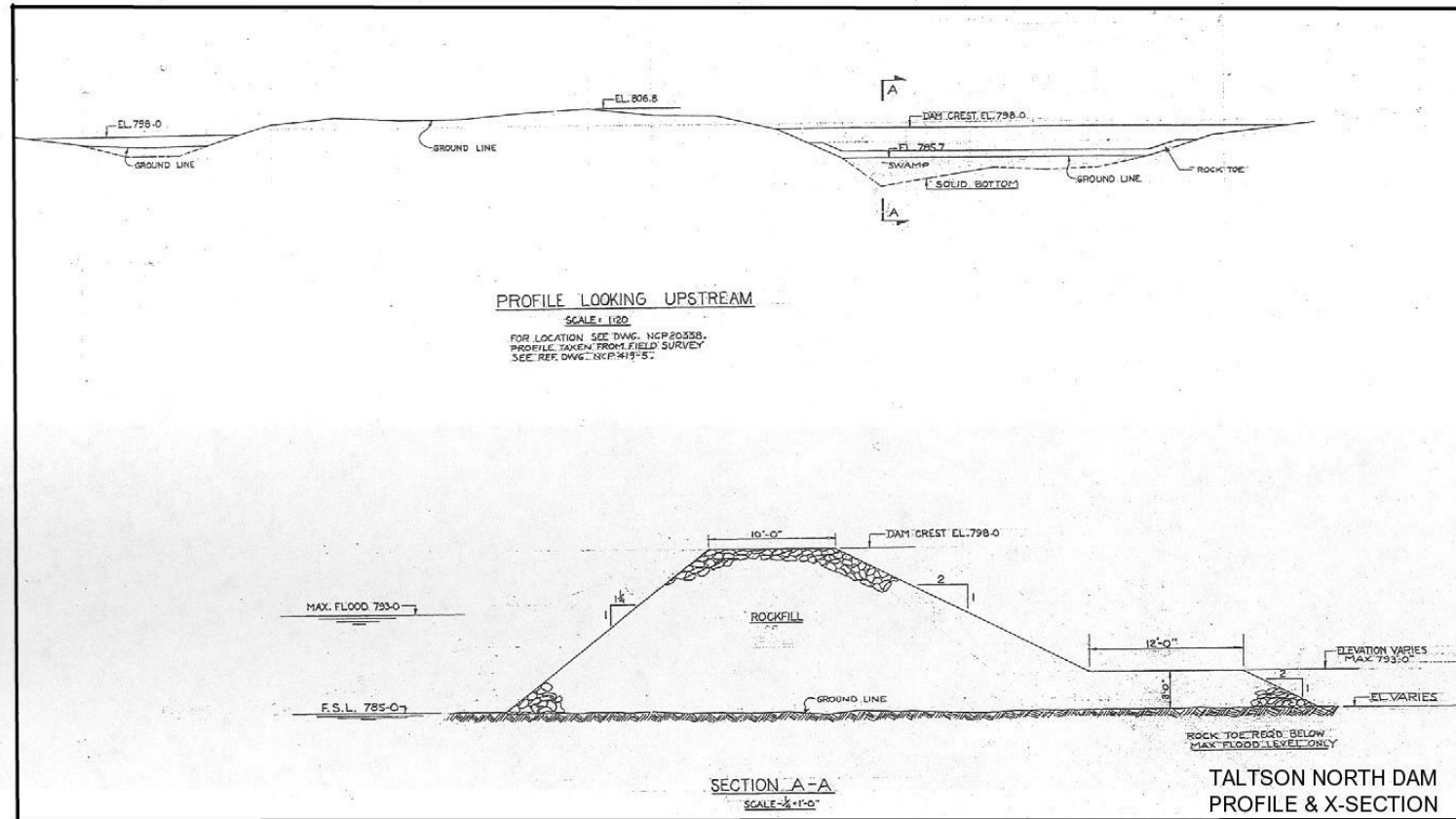


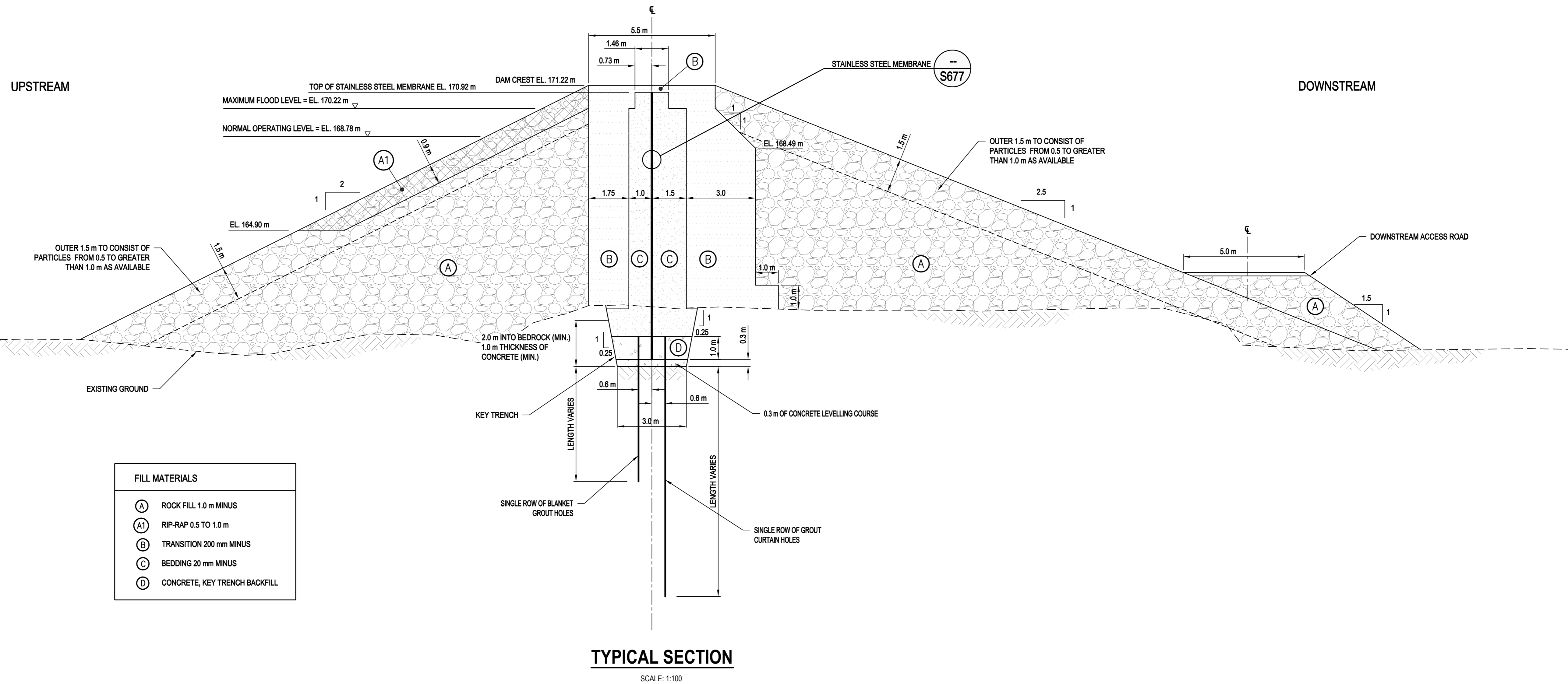
Figure A.14 Nonacho Plan and Timber Sluiceway Cross-Section

A.15 Taltson North Valley Dam

Figure A.15 North Valley
Dam. PROFILE & X-
SECTION

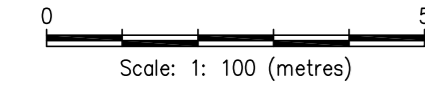


A.17 Bluefish Dams



FILL MATERIALS	
(A)	ROCK FILL 1.0 m MINUS
(A1)	RIP-RAP 0.5 TO 1.0 m
(B)	TRANSITION 200 mm MINUS
(C)	BEDDING 20 mm MINUS
(D)	CONCRETE, KEY TRENCH BACKFILL

NOTE:
TOP OF BEDROCK NOT SHOWN.
BASED ON EXISTING BOREHOLE DATA, DEPTH OF OVERBURDEN UNKNOWN BEYOND VICINITY OF DAM CENTERLINE.
ACTUAL OVERBURDEN QUANTITY TO BE DETERMINED AND COMPENSATED FOR THROUGH SURVEY DURING CONSTRUCTION.



NUM	DATE	DWN	CKD	APR	DESCRIPTION	NUM	DATE	APR	DESCRIPTION
1	MAY 26/11	DRG	CKG	CKG	Addition of Normal Operating Level, Grout hole length (varies)	11	MAY 26/11	CKG	RE-ISSUED FOR CONSTRUCTION
						10	OCT 29/10	CKG	ISSUED FOR CONSTRUCTION
						F	MAR 11/10	CKG	RE-ISSUED FOR TENDER
						E	FEB 9/10	CKG	ISSUED FOR DISCUSSION
						D	NOV 16/09	CKG	ISSUED FOR TENDER
						C	OCT 21/09	EH	ISSUED FOR REVIEW
						B	OCT 13/09	EH	ISSUED FOR REVIEW
						A	SEPT 23/09	EH	ISSUED FOR REVIEW

PERMIT TO PRACTISE
EBA ENGINEERING CONSULTANTS LTD.
Signature: *[Signature]*
Date: May 26, 2011
PERMIT NUMBER: P 018
NWT/NU Association of Professional Engineers and Geoscientists



CLIENT
NORTHWEST TERRITORIES POWER CORPORATION
EBA Engineering Consultants Ltd. *eba*

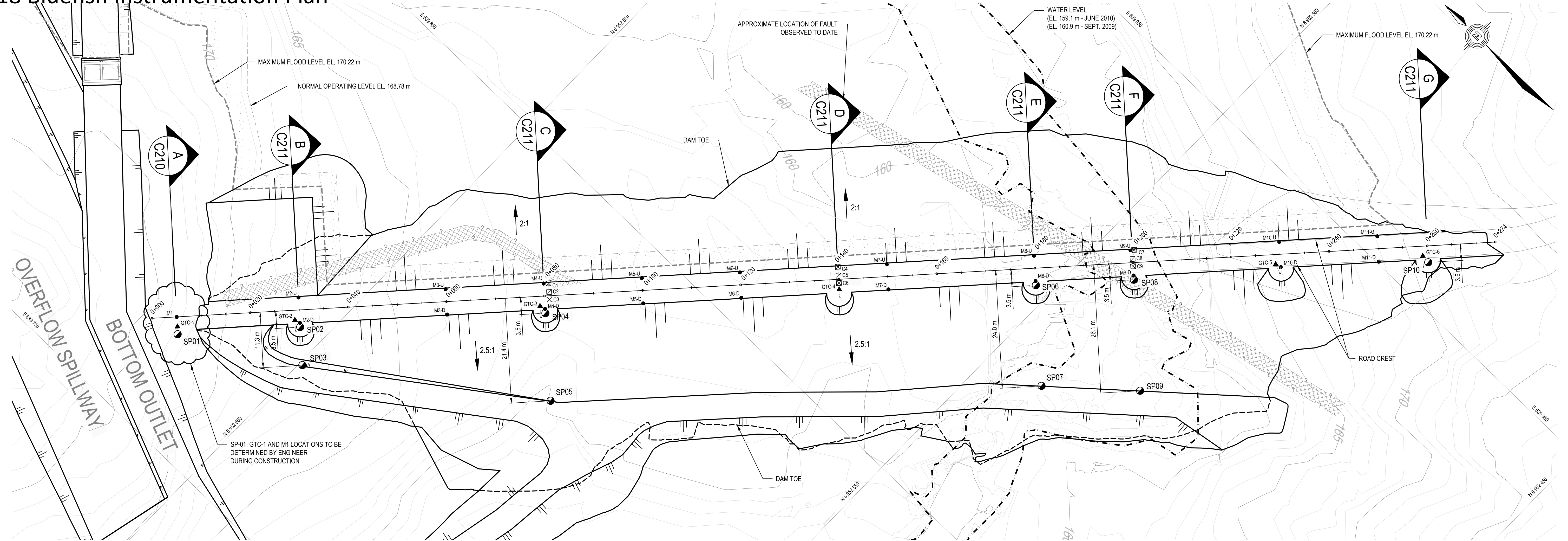
ISSUED FOR CONSTRUCTION

REPLACEMENT DAM AND SPILLWAY
BLUEFISH HYDRO, NT

DAM - TYPICAL SECTION

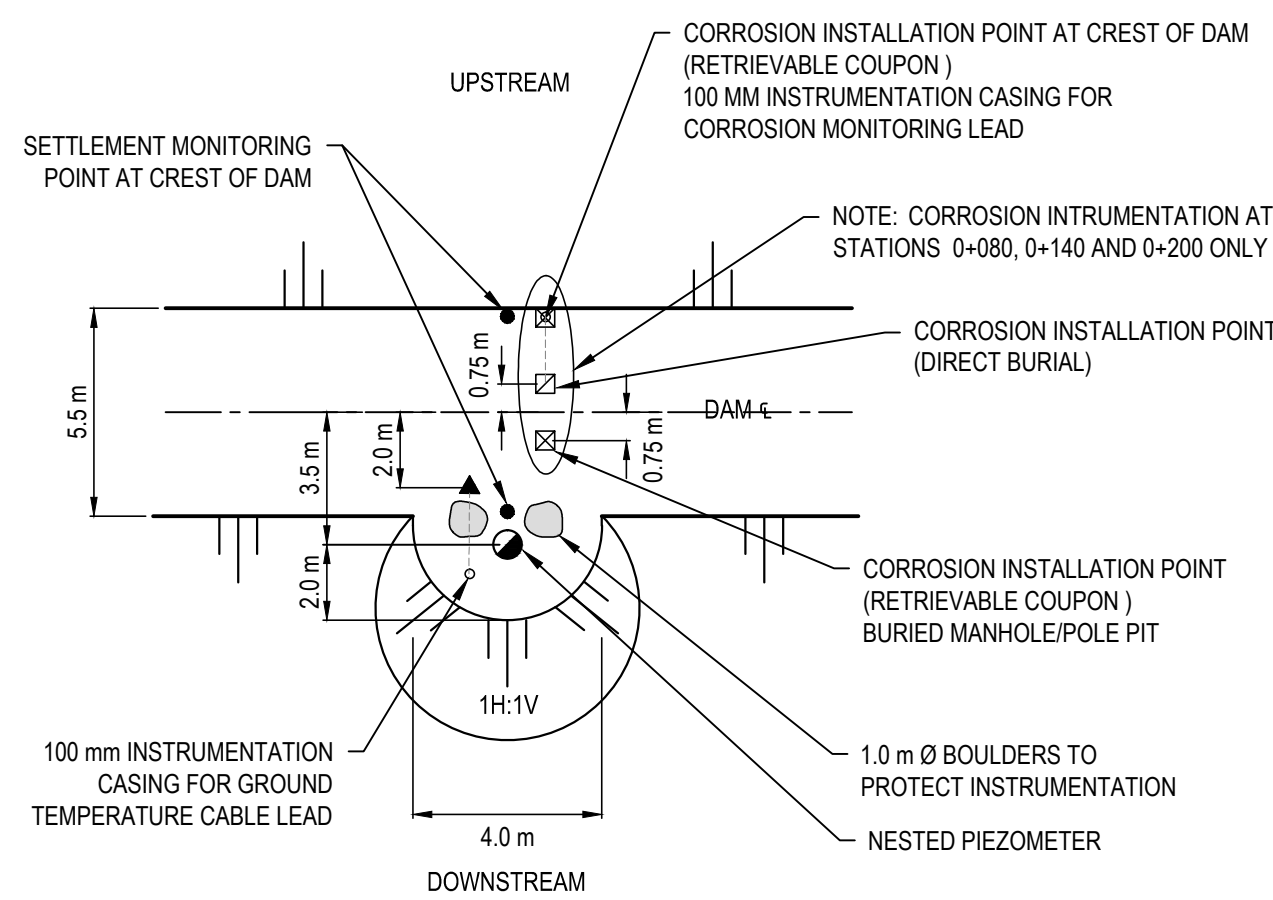
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
E14101129.004	EDM	CKG	KWJ	1	C202
DATE:	SHEET No.	DWN	APP	STATUS	
April 2011	2 of 11	DRG	CKG	11	

A.18 Bluefish Instrumentation Plan



INSTRUMENTATION PLAN

SCALE: 1:400



TYPICAL DETAIL - INSTRUMENTATION PAD

PIEZOMETER LAYOUT						
PIEZOMETER	STATION	OFFSET	SURFACE ELEV.	TIP ELEV.	NORTHING	EASTING
SP-01A*	0+005	3.5 m	174.0	166.5	6952672.0	639769.9
SP-01B*	0+005	3.5 m	174.0	154.5	6952672.0	639769.9
SP-02A	0+030	3.5 m	171.2	165.5	6952655.0	639788.3
SP-02B	0+030	3.5 m	171.2	159	6952655.0	639788.3
SP-03A	0+030	11.3 m	169.0	165.5	6952649.3	639783.0
SP-03B	0+030	11.3 m	169.0	158	6952649.3	639783.0
SP-04A	0+080	3.5 m	171.2	160.5	6952621.1	639825.0
SP-04B	0+080	3.5 m	171.2	153.5	6952621.1	639825.0
SP-05A	0+080	21.4 m	163.5	158.5	6952607.9	639812.9
SP-05B	0+080	21.4 m	163.5	152.5	6952607.9	639812.9
SP-06A	0+180	3.5 m	171.2	160	6952553.2	639898.4
SP-06B	0+180	3.5 m	171.2	152.8	6952553.2	639898.4
SP-07A	0+180	24.0 m	163.0	156	6952538.1	639884.5
SP-07B	0+180	24.0 m	163.0	150.5	6952538.1	639884.5
SP-08A	0+200	3.5 m	171.2	156	6952539.6	639913.1
SP-08B	0+200	3.5 m	171.2	149.9	6952539.6	639913.1
SP-09A	0+200	26.1 m	162.0	154.5	6952523.0	639897.7
SP-09B	0+200	26.1 m	162.0	149.5	6952523.0	639897.7
SP-10A	0+260	3.5 m	176.5	168.5	6952499.0	639957.3
SP-10B	0+260	3.5 m	176.5	162.5	6952499.0	639957.3

* LOCATION TO BE DETERMINED BY ENGINEER DURING CONSTRUCTION

SETTLEMENT MONITORING POINT LAYOUT				
SETTLEMENT POINT	STATION	OFFSET	NORTHING	EASTING
M1*	0+005	0.0 m	6952674.6	639772.3
M2-D	0+030	2.74 m	6952659.4	639792.4
M2-U	0+030	-2.74 m	6952655.7	639788.9
M3-D	0+060	2.74 m	6952639.1	639814.4
M3-U	0+060	-2.74 m	6952635.3	639810.9
M4-D	0+080	2.74 m	6952625.5	639829.1
M4-U	0+080	-2.74 m	6952621.7	639825.6
M5-D	0+100	2.74 m	6952611.9	639843.8
M5-U	0+100	-2.74 m	6952608.1	639840.3
M6-D	0+120	2.74 m	6952598.4	639858.5
M6-U	0+120	-2.74 m	6952594.6	639855.0
M7-D	0+150	2.74 m	6952578.0	639880.5
M7-U	0+150	-2.74 m	6952574.2	639877.0
M8-D	0+180	2.74 m	6952557.6	639902.5
M8-U	0+180	-2.74 m	6952553.8	639899.0
M9-D	0+200	2.74 m	6952544.0	639917.2
M9-U	0+200	-2.74 m	6952540.3	639913.7
M10-D	0+230	2.74 m	6952523.7	639939.2
M10-U	0+230	-2.74 m	6952519.9	639935.7
M11-D	0+250	2.74 m	6952510.1	639953.9
M11-U	0+250	-2.74 m	6952506.3	639950.4

* LOCATION TO BE DETERMINED BY ENGINEER DURING CONSTRUCTION

CORROSION MONITORING POINT LAYOUT							
POINT NUMBER	STATION	OFFSET	NORTHING	EASTING	COUPON ELEVATION		
					A	B	C
C1	0+080	-2.6 m	6952624.85	639829.81	160.2 m	-	-
C2	0+080	-0.75 m	6952623.51	639828.61	168.0 m	165.0 m	162.0 m
C3**	0+080	0.75 m	6952622.40	639827.59	TOP OF KEYTRENCH		
C4	0+140	-2.6 m	6952584.79	639873.14	161.7 m	-	-
C5	0+140	-0.75 m	6952583.45	639871.94	168.0 m	165.0 m	162.0 m
C6**	0+140	0.75 m	6952582.34	639870.93	TOP OF KEYTRENCH		
C7	0+200	-2.6 m	6952543.79	639917.52	157.2 m	-	-
C8	0+200	-0.75 m	6952542.73	639915.99	168.0 m	165.0 m	162.0 m
C9**	0+200	0.75 m	6952541.62	639914.98	TOP OF KEYTRENCH		

** AS-BUILT ELEVATIONS OF TOP OF KEYTRENCH CONCRETE WILL BE REVIEWED AS INSTRUMENTS ARE INSTALLED

GROUND TEMPERATURE CABLE LAYOUT					
GTC POINT	STATION	OFFSET	NORTHING	EASTING	BEAD LAYOUT
GTC-1*	0+005	2.0 m	6952673.04	639770.99	1.2 m intervals until elevation 154.8 m
GTC-2	0+029	2.0 m	6952656.78	639788.56	168.78m, 1.0 m intervals until 5.0 m below keytrench
GTC-3	0+079	2.0 m	6952622.84	639825.28	168.78m, 1.0 m intervals until 5.0 m below keytrench
GTC-4	0+140	2.0 m	6952581.39	639870.02	168.78m, 1.0 m intervals until 5.0 m below keytrench
GTC-5	0+229	2.0 m	6952521.02	639935.42	168.78m, 1.0 m intervals until 5.0 m below keytrench
GTC-6	0+259	2.0 m	6952500.66	639957.45	168.78m, 1.0 m intervals until 5.0 m below keytrench

* LOCATION TO BE DETERMINED BY ENGINEER DURING CONSTRUCTION

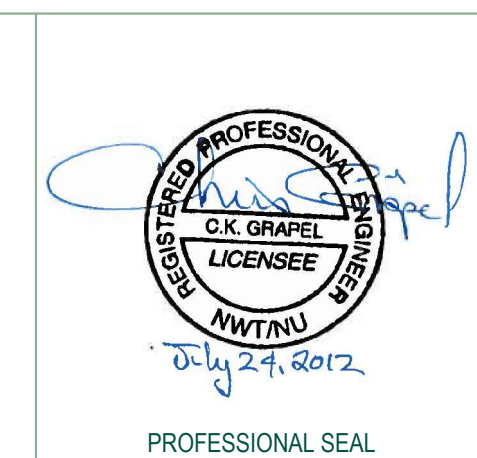
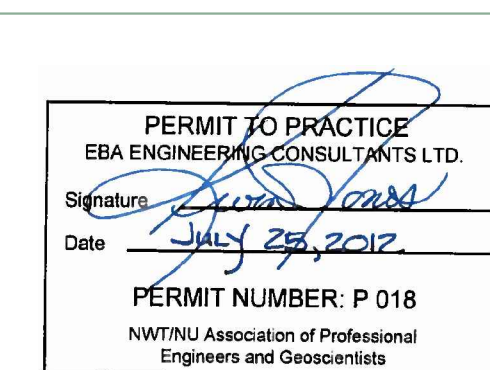
ISSUED FOR CONSTRUCTION

- LEGEND:
- SP-03 NESTED PIEZOMETER LOCATION
 - M2-U SETTLEMENT MONITORING POINT LOCATION
 - GTC-1 GROUND TEMPERATURE INSTALLATION POINT
 - C2 CORROSION MONITORING INSTALLATION POINT (DIRECT BURIAL)
 - C1 CORROSION MONITORING INSTALLATION POINT (RETRIEVABLE COUPON)
 - INSTRUMENTATION CASING LOCATION

NOTES:

- DATUM: UTM ZONE 11 NAD 83, METRE; CENTRAL MERIDIAN 117d W
ELEVATIONS ARE GEODETIC. CONVERSION TO PREVIOUS DATUM: GEODETIC + 17.15 m
- SURVEY DATA PROVIDED BY SUB-ARCTIC SURVEYS LTD.
BASE SURVEY PLAN PROVIDED JULY 30, 2008 AND FEBRUARY 2009; FILE NO.: 08-092-NT.
ADDITIONAL BATHYMETRY AND TOPOGRAPHY SURVEY PROVIDED OCT. 19, 2009;
FILE NO.: 09-012-04-NT-COMPILED. DETAILED SURVEY WITHIN DAM FOOTPRINT AND COFFERDAM LOCATION PROVIDED OCT. 30, 2009; FILE NO.: 09-012-04-DAMSITE.
ADDITIONAL RIVER BOTTOM SURVEY JUNE 4, 2010; FILE NO.: 09-012-06-COMPILED-NORTH.
ADDITIONAL BEDROCK SURVEY MAY 11, 2011. ADDITIONAL RIVER CHANNEL SURVEY JUNE 20, 2011. FILE NO.-Z-SECTIONS CLOUDED AREA.
- 3.1.0 m CONTOUR INTERVAL

NUM	DATE	DWN	CKD	APR	REVISIONS	DESCRIPTION	NUM	DATE	APR	DESCRIPTION	DRAWING STATUS
3	APR 23/12					Revise Corrosion and GTC Layout	13	JULY 25/12	CKG	RE-ISSUED FOR CONSTRUCTION	
2	FEB 8/12	DRG	CKG	CKG		Additional Instrumentation added, Updated Channel Survey	12	FEB 17/12	CKG	RE-ISSUED FOR CONSTRUCTION	
1	JUNE 26/11	DRG	CKG	CKG		Dam Alignment Rotated, Addition of GTC Instrumentation	11	JUNE 26/11	CKG	RE-ISSUED FOR CONSTRUCTION	
							10	OCT 29/10	CKG	ISSUED FOR CONSTRUCTION	
							F	MAR 11/10	CKG	RE-ISSUED FOR TENDER	

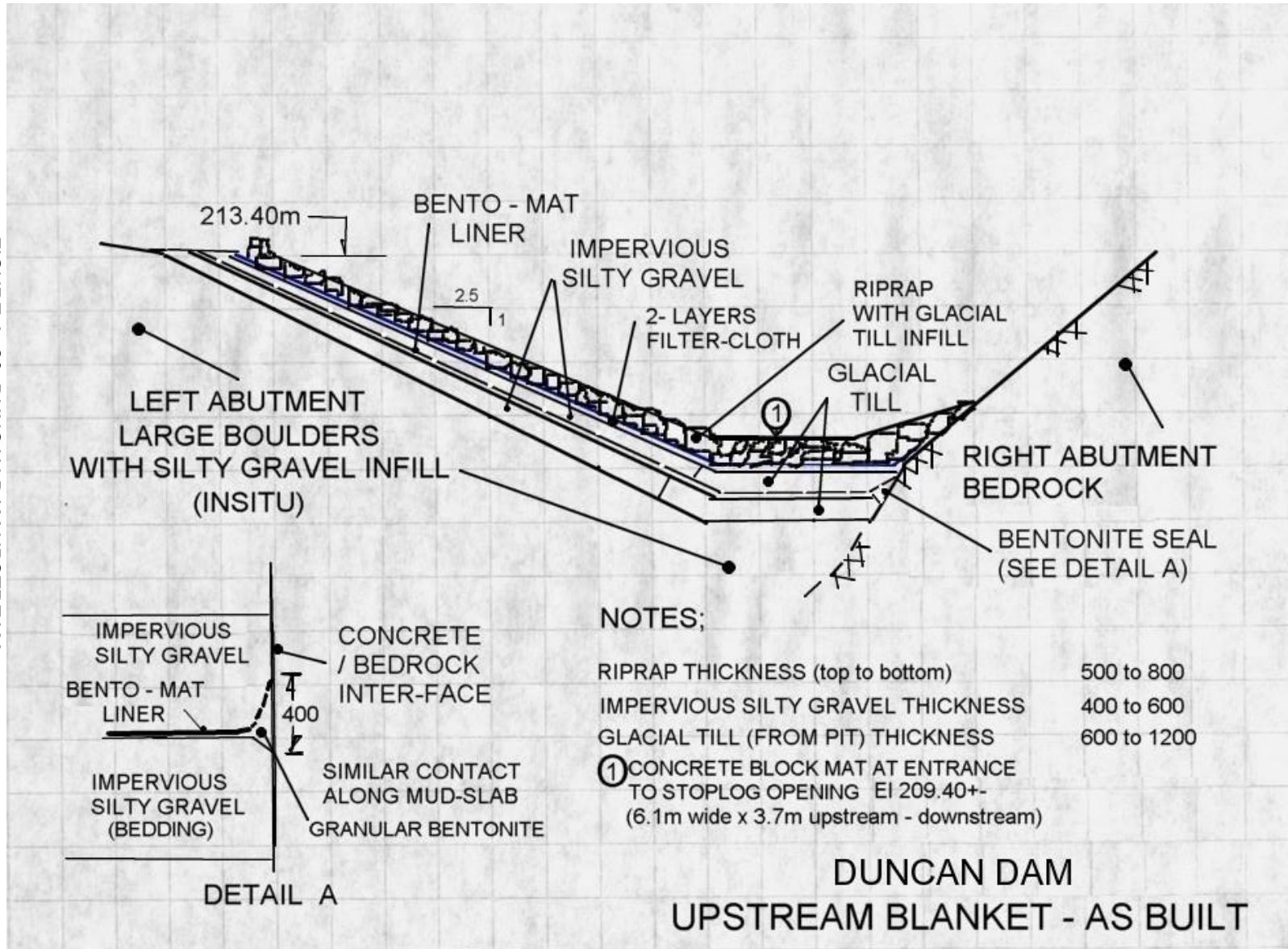


REPLACEMENT DAM AND SPILLWAY BLUEFISH HYDRO, NT					
INSTRUMENTATION - PLAN					
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
E14101129.004	EDM	CKG	KWJ	3	C209
DATE:	SHEET No.	DWN	APP	STATUS	
February 2012	9 of 13	DRG	CKG	13	

A.20 Duncan U/S Blanket As-Built

FIGURE A.20 DUNCAN DAM UPSTREAM BLANKET.

X-SECTION



Appendix B: Dam Photos

Dam Photos:

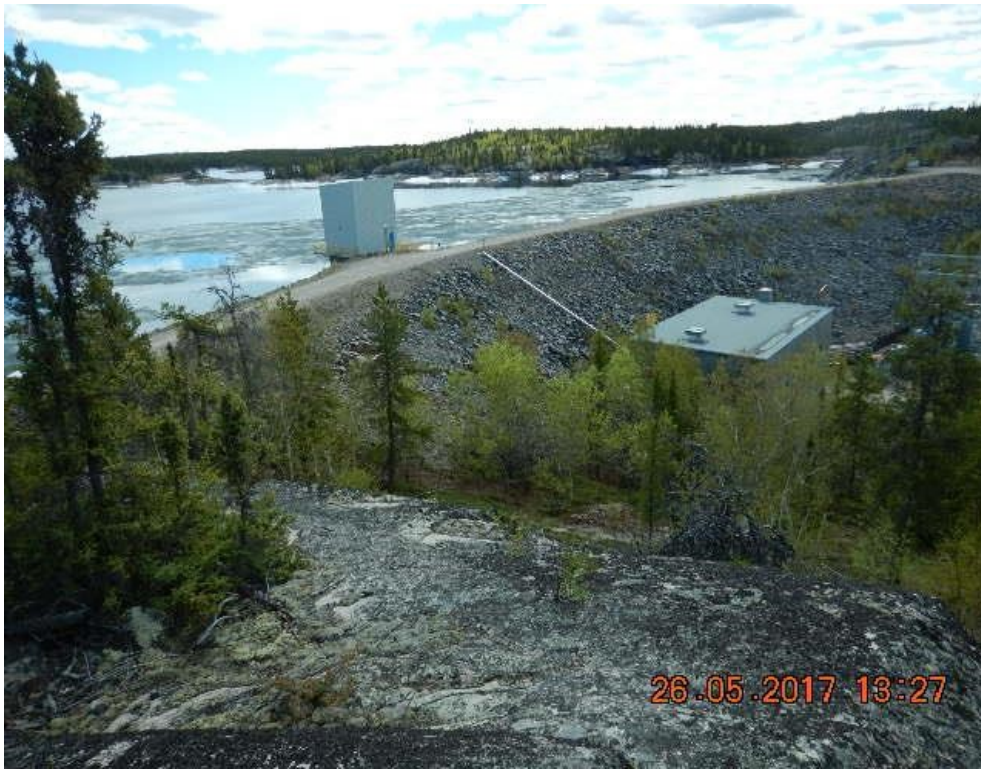


Figure D.1: Snare Rapids Main Dam Downstream



Figure D.2: Snare Rapids Main Dam Upstream



Figure D.3: Snare Rapids Main Dam seepage monitoring weir behind powerhouse



Figure D.4: Snare Rapids seepage monitoring meter (inside the powerhouse)



Figure D.5: Snare Rapids Main Dam LB seepage collecting well



Figure D.6: Snare 5B Spillway & Dam



Figure D.7: Snare 5B seepage monitoring weir



Figure D.8: Snare 4B Dam



Figure D.9: Snare 9B Dam



Figure D.10: Snare Falls Main Dam



Figure D.11: Snare Falls spill gates



Figure D.12: Snare Falls Side Dam # 1



Figure D.13: Snare Falls Side Dam # 2 Downstream



Figure D.14: Snare Falls Side Dam # 2 Upstream



Figure D.15: Snare Cascades Spillway & Power Canal



Figure D.16: Snare Forks Strutt Dam & Powerhouse



Figure D.17: Snare Forks Dyke 1



Figure D.18: Snare Forks Dyke 1 Upstream



Figure D.19: Snare Forks Dyke 2



Figure D.20: Snare Forks Dyke 3 & Main Dam



Figure D.21: Snare Forks North Dyke



Figure D.22: Snare Forks Spillway



Figure D.23: Snare Forks Dyke 1 seepage weir



Figure D.24: Snare Forks DS of Forks Main Dam pond level monitoring gauge



Figure D.25: Snare Forks seepage monitoring at Forks Main Dam Downstream



Figure D.26: Nonacho Dam



Figure D.27: Nonacho Dam aerial view



Figure D.28: Nonacho intake structure



Figure D.29: Nonacho Intake Downstream



Figure D.30: Nonacho Spillway



Figure D.31: Taltson North Valley Dam



Figure D.32: Taltson Main Dam



Figure D.33: Taltson Main Spillway



Figure D.34: Taltson Spillways 2



Figure D.35: Taltson Spillway 3



Figure D.36: Taltson Main Dam & Powerhouse



Figure D.37: Taltson Main Dam RB seepage monitoring heated shack



Figure D.38: Taltson seepage monitoring HMI inside the powerhouse



Figure D.39: Bluefish Dam



Figure D.40: Bluefish Dam aerial view



Figure D.41: Bluefish Spillway



Figure D.42: Bluefish bottom outlet structure



Figure D.43: Bluefish Piezometers & Thermistors



Figure D.44: Bluefish Dam Downstream seepage monitoring location



Figure D.45: Duncan Dam

Appendix C:
Dam Safety Monthly Inspection Forms

**INSPECTION CHECKLIST
SNARE RAPIDS – RAPIDS MAIN DAM**

Inspector:						Date Inspected:					
Weather:						Forebay Elevation:					
Temperature:						Estimated Precipitation last 24hrs:					
Thermistor reading:											
1	2	3	4	5	6	7	8	9	10	11	12

Directions: Mark “X” in Yes or No Column.

If “Yes” describe in the Comments Column: State size (depth, width, length).

1.0 Dam Crest	Yes	No	Comments/Observations:
1.1 Depression or Settlement?			
1.2 Ruts / Potholes?			
1.3 Sinkholes?			
1.4 Longitudinal Cracks?			
1.5 Crack Perpendicular to Dam Axis?			
1.6 Excessive Vegetation?			
2.0 Upstream Slope	Yes	No	Comments/Observations:
2.1 Riprap Depression or Slough?			
2.2 Beaching or Erosion?			
2.3 Sinkholes?			
2.4 Longitudinal Cracks?			
2.5 Cracks Perpendicular to Dam Axis?			
2.6 Excessive Vegetation?			

3.0 Downstream Slope	Yes	No	Comments/Observations:
3.1 Depression or Slough?			
3.2 Longitudinal Cracks?			
3.3 Cracks Perpendicular to Dam Axis?			
3.4 Animal Burrows?			
3.5 Bulging?			
3.6 Seepage or Wet Areas?			
3.7 Slope Erosion?			
3.8 Sinkholes?			
3.9 Excessive Vegetation?			

4.0 Downstream Toe	Yes	No	Comments/Observations:
4.1 Soft / Wet Areas?			
4.2 Any Visible Seepage?			
If Yes; estimated flow (L/min)? _____			
Water quality (clear / cloudy)? _____			
Any Visible Boils?			
4.3 Excessive Vegetation?			

5.0 Right Abutment Contact	Yes	No	Comments/Observations:
5.1 Any Run-off Erosion?			
5.2 Visual Differential Movement?			
5.3 Any Cracks?			
5.4 Any Seepage?			
5.5 Excessive Vegetation?			

6.0 Left Abutment Contact	Yes	No	Comments/Observations:
6.1 Any Run-off Erosion?			
6.2 Visual Differential Movement?			
6.3 Any Cracks?			
6.4 Any Seepage?			
6.5 Excessive Vegetation?			
7.0 Leakage Specific			
7.1 Digital Weir Reading (inside the plant)	Digital Gage Reading: _____ Estimated Flow (L/min): _____		
7.2 Turbidity of Water.	Clear or Cloudy? _____		
7.3. Seepage flow rate (at riverbank D/S of the plant; use measuring cup/stopwatch).	Reading (L/min): _____ Clear or Cloudy? _____		
7.4 “Toe Well” at Left Abutment.	Clear or Cloudy? _____		

Other Comments & Observations: Right – Left when looking Downstream.

Signature of Inspector: _____

Appendix D: Water Licenses

Water Licenses

The following figures show the latest water license agreements or amendments for the Bluefish, Snare, and Taltson hydropower systems. Water License agreements are with the Mackenzie Valley Land and Water Board (Bluefish, Taltson) and Wek'eezhii Land and Water Board (Snare).



7th Floor - 4922 48th Street,
P.O. Box 2130, Yellowknife, NT X1A 2P6

Tel: 867-669-0506 Fax: 867-873-6610
www.mvlwb.com

Northwest Territories Power Corporation

Water Licence MV2020L4-0005

Pursuant to the *Waters Act* and the *Waters Regulations*,
the Mackenzie Valley Land and Water Board grants this Water Licence to:

Northwest Territories Power Corporation

(Licensee)

of 4 Capital Drive, Hay River, NT X0E 1G2

(Mailing Address)

hereinafter called the Licensee, to proceed with the following undertaking, subject to the annexed definitions and conditions contained therein:

Location:	Bluefish Power Generation Facilities
Water Management Area:	WMA 01
Purpose:	Power
Type:	Type A
Quantity of Water <u>not to be exceeded:</u>	55 cubic metres (m ³)/second
Effective Date	April 3, 2021
Expiry Date	April 2, 2046

Mavis Cli-Michaud Chair,
Mackenzie Valley Land and Water Board

Amanda Gauthier, Witness

Approved by:

Honourable Shane Thompson
Minister of Environment and Natural Resources

Figure D.1: Bluefish Water License Agreement 2021



Box 32, Wekweètì, NT X0E 1W0
Tel: 867-713-2500 Fax: 867-713-2502
(Main)

#1-4905 48th Street, Yellowknife, NT X1A 3S3
Tel: 867-669-9592 Fax: 867-669-9593
(BHPB & Diavik)

Pursuant to the *Mackenzie Valley Resource Management Act* and Regulations, the Wek'èezhì Land and Water Board, hereinafter referred to as the Board, hereby grants to:

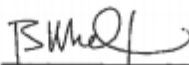
Northwest Territories Power Corporation
(Licensee)

of **4 Capital Drive, HAY RIVER, NT X0E 1G2**
(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the *Northwest Territories Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence Number:	<u>N1L4-0150</u>
Licence Type:	<u>A</u>
Water Management Area:	<u>NORTHWEST TERRITORIES 01</u>
Location:	Within the Snare River Watershed: Snare Rapids (Lat. 63°31' and Long. 116°00') Snare Falls (Lat. 63°26' and Long. 116°11') Snare Forks (Lat. 63°20' and Long. 116°20') <u>NORTHWEST TERRITORIES</u>
Purpose:	<u>TO STORE AND DIVERT WATER FOR HYDROELECTRICAL PURPOSES</u>
Quantity of water <u>not to be exceeded</u> :	<u>Snare Rapids - 52.8 cubic metres per second Snare Falls - 50.9 cubic metres per second Snare Forks - 82.0 cubic metres per second</u>
Effective Date of Licence:	<u>MAY 30, 1999</u>
Effective Date of Licence Amendment:	<u>MAY 1, 2013 (AMENDMENT #1)</u>
Expiry Date of Licence:	<u>MAY 29, 2024</u>

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.


Witness - Mr. Brett Wheeler


Chair - Ms. Violet Camell-Blondin
Wek'èezhì Land and Water Board

APPROVED BY


Minister of Indian and Northern Affairs Canada

Figure D.2: Snare Rapids, Falls, Forks Water License Amendment 2013



Box 32, Wekweèti, NT X0E 1W0
Tel: 867-713-2500 Fax: 867-713-2502

#1-4905 48th Street, Yellowknife, NT X1A 3S3
Tel: 867-765-4592 Fax: 867-765-4593
www.wlwb.ca

Pursuant to the *Mackenzie Valley Resource Management Act* and Regulations, the Wek'èezhìi Land and Water Board, hereinafter referred to as the Board, hereby grants to:

Dogrib Power Corporation
(Licensee)

of P.O Box 1567 100 Borden Drive Bay 25, Stanton Plaza Yellowknife, NT X1A 2P2
(Mailing Address)

Hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the *Waters Act* and Regulations made there under and subject to and in accordance with the conditions specified in this licence.

Licence Number: W201414-0001 (Renewal of MV200314-0014)

Licence Type: A

Water Management Area: NORTHWEST TERRITORIES 01

Location: Snare Cascades, Snare River Basin, NT
63° 25.3' N and 116° 13.2' W

Purpose: STORAGE AND DIVERSION OF WATER FOR A
HYDROELECTRIC POWER UNDERTAKING AND
ASSOCIATED USES

Description: CLASS 1 HYDROPOWER GENERATION

Effective Date of Licence: SEPTEMBER 5, 2014

Expiry Date of Licence: MAY 29, 2024

This Licence issued and recorded at Yellowknife, NT includes and is subject to the annexed conditions.

Wek'èezhìi Land and Water Board:

Witness – Mr. Ryan Fequet

Chair – Ms. Violet Camsell-Blondin

APPROVED BY:

Minister of Environment and Natural Resources

Figure D.3: Snare Cascades Water License Agreement 2014



**Mackenzie Valley Land and Water Board
Water Licence**

Pursuant to the *Mackenzie Valley Resource Management Act* and Regulations, the Mackenzie Valley Land and Water Board, hereinafter referred to as the Board, hereby grants to:

Northwest Territories Power Corporation
(Licensee)

of 4 Capital Drive, Hay River, NT X0E 1G2
(mailing address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the *Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence number:	<u>MV2011L4-0002</u>
Licence type:	<u>A</u>
Water management area:	<u>Northwest Territories 01</u>
Location:	<u>Taltson River Basin, Northwest Territories 61°40'N, 109°56'W and 60°25'N, 110°24'W</u>
Purpose:	<u>Storage and Diversion of Water for Hydroelectric Generation Purposes</u>
Description:	<u>Class 4 Hydropower Generation</u>
Effective date of licence:	<u>August 31, 2012</u>
Expiry date of licence:	<u>August 30, 2027</u>

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.

Mackenzie Valley Land and Water Board

Handwritten signature of Mavis Cui-Michaud in blue ink.

Mavis Cui-Michaud, Chair

Handwritten signature of Amanda Gauthier in blue ink.

Amanda Gauthier, Witness

Approved by

Handwritten signature of Honourable Robert C. McLeod in blue ink.

Honourable Robert C. McLeod
Minister Environment and Natural Resources

Figure D.4: Taltson Water License Agreement 2012

Appendix E:
Dam Safety Training Record

Hydro operations staff receive dam safety training that provides an overview of dam design and terminology, the Snare Forks Dyke 1 failure, how to complete dam inspections and issues to be aware of, and details about each dam and spillway NTPC owns. Table E provides a training record of when these training sessions have been completed. The presentation should be updated and given as a refresher every 5 years or sooner if required.

Table E: Dam Safety Training Record

Date:	Instructor:	Attendance:
2021-08-05	J. Tennant / B. Harrison	S. Christensen, R. Sutherland, N. Anderson, N. Gordon, A. Love, J. St. Croix, E. Hendry, B. Whitford.
2022-02-16	J. Tennant / B. Harrison	N. McBride, C. Welna, J. Cazon, J. Taggart.
2022-07-02	J. Tennant	B. Noksana
2022-07-06	J. Tennant	S. Brennan
2023-02-23	J. Tennant	A. Spink, C. Turnbull, B. Kaglik