2025 Formal Annual Dam Inspections – Recreational Dams

Final Report

H366322-0000-220-230-0008

2026-02-12

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Disclaimer

This report has been prepared by Hatch for the sole and exclusive use of the City of Nanaimo (the “Client”) for the purpose of assisting the management of the Client in making decisions with respect to the management of the ten City-owned recreational dams (Westwood Lake Dam, Harewood Dam, Old Reservoir No. 1, Upper Colliery Dam, Middle Colliery Dam, Lower Colliery Dam, Witchcraft Lake Dam, and McGregor Creek Dam) and shall not be (a) used for any other purpose, or (b) provided to, relied upon or used by any third party.

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(a) the report being read in the context of and subject to the terms of Consulting Agreement 2821 Dam Inspections and Concrete Condition Assessment between Hatch and the Client dated July 22, 2021 (the “Agreement”), including any methodologies, procedures, techniques, assumptions and other relevant terms or conditions that were specified or agreed therein.

(b) the report being read, with sections or parts hereof read or relied upon in context.

(c) the conditions of the ten dams may change over time or may have already changed due to natural forces or human intervention, and Hatch takes no responsibility for the impact that such changes may have on the accuracy or validity or the observations, conclusions and recommendations set out in this report.

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1. Introduction

The City of Nanaimo (the “City”) retained Hatch Ltd. (“Hatch”) to conduct Formal Annual Dam Inspections (FADI) for 10 City dams as per the BC Dam Safety Regulations. This report summarizes the results of the 2025 FADIs for the recreational dams which were undertaken by Hatch on September 16 to 17, 2025.

The City’s Water and Resources and Water Supply Operations staff are responsible for the management and maintenance of 10 dams. The eight recreational dams are in the southwest end of the City. See **Figure B1** in **Appendix B**.

The majority of the recreational dams are a legacy of early coal mines or power generating operations and the water bodies created by these remaining dams are within the City of Nanaimo or the Regional District of Nanaimo park areas and are used for recreational purposes. McGregor Creek (Linley Valley) Dam was constructed as part of a housing development. The water license and ownership of the McGregor Creek Dam was transferred to the City of Nanaimo on June 10, 2022.

Old Reservoir No. 1 was previously used for the City’s potable water supply but was shut down in early 2014 and drained in January 2020. The future of the reservoir is still to be determined.

The scope of the inspection work included:

- Review of background information, including as-built drawings, rehabilitation records/drawings, previous FADI and dam safety review (DSR) reports, operation, maintenance and surveillance (OMS) manuals, and any available instrumentation records.
    - The 2024 DSR reports are in progress. The draft reports were available for review at the time of the 2025 FADI.
- Meet with City Waterworks Dam Inspectors and engineering staff who perform the daily operation, maintenance and surveillance on the dams. Discussed changes in dam condition or operation since the 2024 FADI and 2024 DSRs (for dams with consequence classification of ‘High’ or above).
- Visit the sites and undertake visual inspections of the dams and compile a photographic record.
- Review of dam safety management strategies including:
    - dam failure consequence classification;
    - operation, maintenance and surveillance;
    - recommendations for dam safety improvements; and

- review and update of the dam safety issues database assembled from previous FADI.

The eight recreational dams inspected are listed below with acronyms to identify the dams and maintain consistency with previous FADI reports:

- WWL - Westwood Lake (and Saddle Dam)
- UCR - Upper Colliery Dam
- MCR - Middle Colliery Dam
- LCR - Lower Colliery Dam
- HAW - Harewood Dam
- WCL - Witchcraft Lake Dam
- No1 - Old Reservoir No. 1 Dam
- MGC - McGregor Creek Dam.

A list of the documentation reviewed is provided in **Appendix A**, figures are presented in **Appendix B**, photographs are included in **Appendix C**, and the Mobile Dam Inspection Database forms from September 2025 are included in **Appendix D**. The following sections of this report document the results of the FADI.

2. Regional Geology

The general geological conditions of the inspected dam sites are based on the review of geological mapping of Vancouver Island (Ministry of Environment BC). **Table 2-1** is a summary of the surficial and bedrock geology.

Table 2-1: Summary of Regional Geology of the Inspected Dam Sites

Dam	Regional Surficial Geology	Regional Bedrock Geology
Westwood Lake Dam (and Saddle Dam) Old Reservoir No. 1 Dam Harewood Lake Dam Upper Colliery Dam Middle Colliery Dam Lower Colliery Dam Witchcraft Lake Dam McGregor Creek Dam	Surficial sediments comprise marine veneers of gravel and sand up to 1.5 m thick. Surficial sediments are underlain by moraine tills with lenses of gravel, sand and silt.	Bedrock belonging to the Nanaimo and Vancouver Groups. Consists of boulders, cobble and pebble conglomerate, coarse to fine sandstone, siltstone, shale, and coal.

3. Dam Safety Program

3.1 Dam Failure Consequence Classification

The Dam Failure Consequence Classifications (DFCC) of the City's dams are determined in accordance with the B.C. Water Sustainability Act Dam Safety Regulation [B.C. Reg 44/2016]. The current classifications of the 8 recreational dams included in this FADI are summarized in **Table 3-1** below. Notably, in 2024, dam classification for the Lower and Middle Colliery Dams were reviewed as part of the Middle Colliery Dam Inflow Design Flood study (Hatch, 2025), which resulted in the classification for Middle Colliery Dam being changed to “Very High”

Table 3-1: Dam Consequence Classification Ratings

Dam	Dam Failure Consequence Classification
Westwood Lake Dam	High
Westwood Saddle Dam	High
Upper Colliery Dam	Significant
Middle Colliery Dam	Very High
Lower Colliery Dam	Very High
Harewood Dam	Significant
Witchcraft Lake Dam	Significant
Old Reservoir No. 1 Dam	Low
McGregor Creek Dam	Significant

3.1.1 Westwood Lake Dam

The current dam classification for Westwood Lake Dam is ‘High’. This has been confirmed most recently in the comprehensive review of the dam classification carried out in the 2024 DSR, with commentary noted as follows. A review of available aerial photography shows that significant development along the downstream reach has occurred since the 2004 inundation study and subsequent 2013 DSR assessment. This has mostly been concentrated in the area between the Westwood Lake Dam and Cathers Lake, above the incised creek channel and likely outside of the impacted area based on the 2004 mapping extents. However, as noted in the 2024 DSR, a formal incremental impact assessment has not been completed for the site, therefore it is recommended that this assessment be carried out. The current standard for assessing loss of life includes using the USBR’s Reclamation Consequence Estimating Methodology, which uses depth and velocity calculated at each residence to determine a fatality rate. This information is not available from the previous study, and as it could impact the classification of the structure, it would be prudent to update the study with a new dam break analysis using a 2D model, and completing a formal incremental impact assessment in order to classify the dam according to the current B.C. Water Sustainability Act Dam Safety Regulation (B.C. Reg. 40/2016, amended B.C. Reg. 32/2023) Dam Failure Consequence Classification guidelines. This would confirm if a classification of “High” is appropriate, and it

would provide information for emergency preparedness plans and evacuation procedures. The Westwood Lake Saddle Dam classification should also be confirmed during this study. These recommendations have been put forward in the 2024 DSR.

3.1.2 Upper Colliery Dam

The current dam classification for Upper Colliery Dam is 'Significant'. A spillway capacity assessment and a damage assessment were completed in 2002. In addition, it appears that dam breach flood inundation study was completed for the Colliery Dams in 2012. The very small size of the reservoir combined with a review of historic aerial photography series in the downstream reach does not appear to show significant changes in development in the recent past. The small size of the reservoir also indicates that the current dam classification is appropriate provided failure of the structure does not trigger a cascade failure of the downstream structures (Old Reservoir No. 1 Dam, Middle Colliery Dam and Lower Colliery Dam). As in the last several FADI reports, it is recommended that checks be performed to determine the potential for a cascade failure caused by the failure of Upper Colliery Dam. If it is found that the downstream structures can safely absorb such a failure, then this should be documented, and no additional assessment need be considered. If it does cause a cascade failure, then additional study is required. To note, the City is currently considering spillway capacity upgrades at the Middle Colliery Dam, which could impact these results by providing additional capacity downstream.

3.1.3 Middle Colliery Dam

The current dam classification for Middle Colliery Dam is 'Very High'. This was confirmed most recently by the 2024 DSR. The Middle Colliery Dam Inflow Design Flood Study report (Hatch, 2025) reviewed past work and completed an updated hydrologic assessment, dam breach assessment, incremental consequence assessment and inundation mapping for the Middle Colliery and Lower Colliery dams. The results of this report confirmed the consequence classification and the results were incorporated in the 2024 DSR.

3.1.4 Lower Colliery Dam

The current dam classification for Lower Colliery Dam is 'Very High', which was confirmed most recently by the 2024 DSR, and studied in the Middle Colliery Dam – Inflow Design Flood Study (Hatch, 2025). The classification for IDF selection was recommended as "High". This reduced the dam classification defined in the previous DSR (2014) and a Dam Breach and Inundation study (2012) that recommended that a dam classification of 'Extreme' be adopted.

3.1.5 Harewood Dam

The current dam classification for Harewood Dam is 'Significant'. Documentation of how this classification was established was not found; however, given the small size of the structure and impoundment as well as a lack of surrounding development, it is expected that this was established through simple inspection and a simplified screening evaluation which is acceptable for a Low or Significant consequence structure. A review of available aerial photography of surrounding area shows that significant development has occurred over the last 10 years to the east of HWY 19, Nanaimo Parkway that could impact the classification of

the dam. A ‘Significant’ DFCC is reserved for dams with a temporary population at risk only, and so the presence of an increasing permanent population downstream of the dam warrants further investigation to determine if there is a permanent population at risk. The outflow from Harewood Dam appears to enter downstream of the Lower Colliery Dam (therefore potentially includes some of the same PAR). It is recommended that further investigation and analysis be considered.

3.1.6 Witchcraft Lake Dam

The current dam classification for the Witchcraft Lake Dam is ‘Significant’. In 2025, Hatch provided a memo to the City (Recommendations for Witchcraft Lake Dam) regarding the classification of Witchcraft Lake Dam. The dam historically experienced a partial breach and there have been further movement of sediment and debris that has formed a sediment plug upstream of the dam. Based on the volume of water above the invert of the dam in Witchcraft Lake and the presence of permanent downstream structures, it is unlikely that a “Low” consequence classification could be justified for this dam. Hatch recommends that a decommissioning plan commensurate with the simplicity of the site be completed for the dam, which will lead to decommissioning works to allow the City to remove the dam from its inventory.

3.1.7 Old Reservoir No. 1 Dam

The current dam classification for the Old Reservoir No. 1 Dam is ‘Low’. When this reservoir was filled in the past, there is potential (as with the Upper Colliery Dam) that a failure of this structure could cause a cascade failure of the Middle and Lower Colliery Dams. However, now that the reservoir has been drained, there is no risk for a cascade failure. This classification rating was approved by BC Dam Safety on February 3, 2021.

In previous FADI reports, Hatch recommended that the structure be considered permanently decommissioned and removed from the City’s portfolio of dams. We understand that the City discussed this option with the BC Dam Safety Office. In the opinion of the Dam Safety Office, the dam cannot be considered decommissioned, as the draining of the reservoir has been accomplished by operating the low level outlet and leaving it open permanently. The Dam Safety Office considered that for the dam to be decommissioned, there would need to be permanent physical alterations (e.g. opening a new outlet in the base of the dam) which do not rely on operable components to maintain drainage. As such, the structure continues to be listed on the Provincial register and considered as a dam, with a consequence classification of ‘Low’.

3.1.8 McGregor Creek Dam

The current classification for the McGregor Creek Dam is ‘Significant’ as per the Consequence Rating Review performed by Lewkowich Engineering Associates Ltd. (LEA) in August 2019, which maintains the consequence classification established at the time of original construction in 2011. Documentation of how this classification was established was not found; however, given the small size of the structure and impoundment, it is expected that this was established through simple inspection and a simplified screening evaluation which is

acceptable for a ‘Low’ or ‘Significant’ consequence structure. Since the water license has been transferred to the City of Nanaimo in June 2022 this classification should be confirmed with an independent analysis. A full dam breach inundation study is likely not warranted for this.

3.2 Operating, Maintenance and Surveillance Manuals

The City has prepared Operating, Maintenance and Surveillance (OMS) manuals for each of their eight recreational dams. The OMS Manuals have been updated relatively recently, from 2023 to 2025. A high-level review of the manuals was performed as part of the FADI and appear to contain the relevant information that is expected in an OMS manual. Copies of the manuals are kept in the City of Nanaimo Public Works and City Engineering libraries. These copies have been distributed to key City personnel and are available electronically for the City Dam Inspectors to access during routine inspections if required. The manuals are updated periodically as required. Excerpts of the Dam Inspection Database (updated records of weekly dam inspections) were provided as part of the 2025 FADI.

3.3 Dam Emergency Plan

The City of Nanaimo maintains a Dam Emergency Plan (DEP) for recreational dams, which was last revised in January 2024. A high-level review of the DEP was completed as part of the FADI, and the contents appeared to be consistent with the requirements of the Dam Safety Regulation.

3.4 Dam Safety Management

The dams in the City’s portfolio are operated in accordance with the City of Nanaimo Dam Safety Management Program document, which was last updated in March 2024. Key updates to this document include the additions of McGregor Creek Dam, the change in operation of the Old Reservoir No. 1 Dam, and the current state of the Witchcraft Lake Dam. The most recent FADI recommendations should continue to be updated annually.

3.5 Surveillance

3.5.1 General

The Very High consequence classification Lower Colliery Dam and Middle Colliery Dam, and High consequence classification Westwood Lake Dam, are inspected on a weekly basis. The significant consequence classification Harewood Dam, Upper Colliery Dam, and Witchcraft Dam and Low consequence classification Old Reservoir No. 1 are inspected monthly. Additional site surveillance occurs after storm events and earthquakes. A more comprehensive inspection is carried out monthly which includes taking instrumentation readings.

The inspectors are equipped with a heavy-duty laptop computer for outdoor use and the information collected during the weekly and monthly inspections is entered directly into the City's Mobile Dam Inspection Database. The most recent weekly and monthly checklists from the database were reviewed by Hatch and have been included in **Appendix D**. It should be noted that the checklists have not been completed at the required frequency due to either not filling them out or potentially uploading issues. This should be resolved.

The City of Nanaimo surveillance and instrumentation reading frequencies were compared against the BC Dam Safety Regulation. The monthly inspection frequency is appropriate for the Significant consequence classification dams as well as the weekly surveillance frequency for the High and Very High consequence classification dams.

The inspection database is a Microsoft Access database which provides an interface for inspectors to input observations. However, there is currently limited capability to export and report data out of the database. For past FADIs, the data out of the database has been provided in the form of screenshots of the most recent observations. However, we have not been able to review a full record of past observations, and it would be impractical to provide screenshots of all past observations. Hatch recommends that the database be updated to add functions to report chronological past data such as inspection report observations in tabular form.

3.5.2 Piezometers and Weirs

As part of the routine inspections, the seepage elevation over the ‘V’ notch weirs are recorded by measuring the flow elevation above the base of the ‘V’ notch. This data is plotted on graphs to help identify trends. It is recommended that the seepage elevations be converted to flow to produce more informative plots that would track better with lake levels and rainfall records and significant changes will be more readily apparent.

Due to the low flow at the weirs, the drawdown is expected to be minimal and the seepage measurements at the weirs are effective at identifying trends.

3.6 Items from Previous FADI and DSR

The outstanding dam safety and maintenance issues/recommendations are updated annually in the FADIs. These items are listed in **Table 5-1** and **Table 5-2** of the report for outstanding Inspection and Surveillance and Dam Safety Issues, respectively.

4. Formal Annual Dam Inspections

Visual inspections of the dams were carried out by Kyle Caithness, P. Eng. (Structural Engineer) and Tim Tuo, P.Eng. (Geotechnical Engineer) from Hatch on September 16-17, 2025. The Hatch inspectors were accompanied by City of Nanaimo staff:

- Jaymie Miller – Lead Supervisor – Waterworks
- Chris Meier – Waterworks Dam Inspector
- Clayton Wallace – Water Resources Section
- Shawna Drinnan – Water Resources Section (September 17 only)

The daily inspection activities and weather conditions are summarized in **Table 4-1**.

Table 4-1: FADI Activity Summary

Date (2025)	Weather	Summary of Inspection Activities
September 16	Temperature: 11°C – 23°C Conditions: Sunny	2:00 PM: Harewood Dam 2:30 PM: Old Reservoir No.1 3:00 PM: Upper Colliery Dam
September 17	Temperature: 16°C – 20°C Conditions: Sunny	8:15 AM: Middle Colliery Dam 9:15 AM: Lower Colliery Dam 11:30 AM: Westwood Dam 1:30 PM: Witchcraft Dam 2:15 PM: McGregor Creek Dam 2:45 PM: Dam Inspections Complete

Weather conditions were favorable for the duration of the inspection and there were no access restrictions to any areas at the dams due to weather.

As part of the review, the main dam structures were inspected as well as the areas immediately upstream and downstream of the dams that were accessible or clearly visible from the dams. Observations from these inspections are documented for each dam in the sections which follow. For the purpose of this report, all location descriptions are oriented in a downstream facing direction. A photographic record of the inspections is included in **Appendix C**.

Prior to entering the dam sites, Hatch completed field visit safety plans to identify potential hazards and City staff provided additional safety information as required for working in the watershed. The condition rating of the various components of the City's dam structures shown in this document will be consistent with the following:

- Satisfactory: Minimal wear or deterioration; like new condition. No repairs required.
- Fair: Normal material wear or deterioration. Functionally adequate for all intended uses.

- Poor: Abnormal material wear, deterioration, or local defects. Components may not fulfill intended uses. Major maintenance or repairs advisable to restore component to a satisfactory condition. If maintenance or repairs are not carried out, the design life of the component may be severely limited, and the component may become unsafe.
- Unsatisfactory: Severe material wear, deterioration, or local defects. Components will not fulfill intended uses. Immediate repair or replacement required. Present situation threatens the structural integrity of the project and represents an unsafe condition.

The major recommendations of this FADI are summarized at the end of this report in **Table 5-1** and **Table 5-2** and have been ranked using a priority rating system described in **Section 5**, which was established independent of the CDA Guidelines.

4.1 Westwood Lake (WWL)

4.1.1 Dam Description

The Westwood Lake Dam is comprised of a Main Dam and Saddle Dam. The Main Dam was constructed in 1907 for electricity generation and consists of an earth fill structure approximately 12 m high and over 100 m long. The dam is currently only used for recreation. Although no construction records exist of the original structure, site investigations have indicated the dam has a puddled clay core with loose sandy silt fill forming the upstream and downstream shells. The upstream face is completed with a concrete face, with facing stone embedded into the concrete over some sections and is sloped at 1.6H:1V. The downstream slope is approximately 2.3H:1V. See **Figures WWL2, WWL3** and **WWL4** in **Appendix B**.

Rehabilitation works in 1978 and 1980 included installation of a seepage collection and filter system, as well as backfilling of the low-level outlet pipes through the dam. A seismic upgrade was also completed in 2007 by means of adding buttress fill on the downstream side.

The Saddle Dam is a 2 m high by 130 m long earthen embankment dam located 250 m east of the main dam and is founded on dense glacial till. The dam was reconstructed in 1992. The original dam was stripped, and the downstream core was removed to expose adequate foundation and core. A compacted sand and gravel downstream shell and cap were placed over the old core and the upstream face was upgraded with cobble and boulder erosion protection. The upstream and downstream slopes are 2H:1V (**Figure WWL5** in **Appendix B**).

The dam outlet channel consists of an excavated trapezoidal channel from the northwest end of the lake connecting McNeil Creek. The lake level is controlled by a broad-crested weir with a 10.5 m wide concrete sill, constructed of grouted boulders and concrete. The channel capacity is 40 m^3/s; it appears that natural cobbles line the channel downstream of the concrete weir and no additional erosion protection is present at this time.

The Westwood Lake Dam and Saddle Dam data is provided in **Table 4-2** and **Table 4-3** respectively.

Table 4-2: Data for Westwood Lake Dam and Appurtenant Structures

Structure	Details
Type of Dam	Earthfill dam with upstream concrete facing and central impervioussco re. Rockfill buttress on downstream face with concrete key trench at downstream toe.
Maximum Height	12.3 m
Crest Length	104 m
Crest Width	5 m (approx.)
Crest Elevation (Main Dam)	164.5 m (from survey in (Water Management Consultants, 2004)) [note that a crest elevation of 164.4 m is reported in the drawings for the siphon (EBA Engineering Consultant Ltd., 2008)]
Upstream Slope	1.6H:1V
Downstream Slope	2.3H:1V
Filter	Filter added between the silt fill of existing dam and new rock buttress to reduce internal erosion
Foundation	Remnants of ravine base soils (saturated loose or soft fill and alluvial deposits.
Erosion Protection	Upstream concrete facing
Spillway and Outlet Channel	Lake level controlled by concrete weir, constructed in the unregulated outlet channel (base width 7 m, side slopes 1V:1H.
Crest Elevation of Concrete Weir on Outlet Channel (acts as Spillway)	162.83 m
Width of Concrete Weir on Outlet Channel	10.5 m
Depth of Concrete Weir on Outlet Channel	0.3 m
Height of Concrete Weir on Outlet Channel	0.15 m
Normal Operating Level	162.6
Full Supply Level (FSL)	162.83 m
Retained Water (Normal Pool)	2,713, 676 m^3
Reservoir Storage Volume at FSL	2,933,960 m^3
Watershed Area	8.35 km^2 (835 ha) (approx.)
Probable Maximum Flood (PMF) Peak Inflow[1]	92 m^3/s
Peak PMF Reservoir Level[2]	163.92 m

Structure	Details
Peak PMF Spillway (Westwood Lake Outlet Channel) Discharge[2]	21 m^3/s
Maximum Spillway Discharge when lake level is at the dam crest elevation	Approximately 40 m^3/s
Freeboard Under PMF[2]	0.58 m
Inflow Design Flood (IDF)	1/3 between the 1,000-year flood and the PMF
IDF Peak Inflow	Unknown
Peak IDF Reservoir Level	Unknown
Peak PMF Spillway (Westwood Lake Outlet Channel) Discharge	Unknown
Low-level Outlet	N/A (old woodstave low-level outlet was removed in 2008)
Dam Failure Consequence Classification	High

Notes:

1 The PMF estimate is based on the HEC-HMS model results from Westwood Lake Dam Inundation Study (2004)

2 Based on the reported values in Westwood Lake Dam OMS (2024) by subtracting the reported freeboard of 0.58 m from the crest elevation of 164.5 m.

Table 4-3: Data for Westwood Lake Saddle Dam

Structure	Details
Type of Dam	Earth fill (impervious internal core)
Maximum Height	2 m
Crest Length	130 m
Crest Width	3 m (approx.)
Crest Elevation	164.2 m
Catchment Area	See main dam
Upstream Slope	2H:1V
Downstream Slope	2H:1V
Retained Water	2,713, 676 m^3
Spillway	No spillway at dam; lake level controlled by unregulated outlet channel on Westwood Lake
Dam Failure Consequence Classification	Significant
Inflow Design Flood (IDF)[1]	1/200 to 1/1,000-year AEP

Notes:

1 The Inflow Design Flood (IDF) for the Saddle Dam is not documented in the OMS Manual 2024. As per BC Dam Design and Construction Guidelines, for significant consequence dams, IDF of less than 1/1,000-year AEP flood must be pre-approved in writing by the Dam Safety Section (DSS).

4.1.2 Instrumentation

Piezometers were reportedly installed in the main dam in 1978 but are no longer functional. A 'V' notch weir is located downstream of the toe of the dam (**Photograph WWL 9**) as well as an adjacent weir located inside a concrete housing for a fisheries siphon. Water levels are measured at this weir as part of City's scheduled routine inspections.

4.1.3 Formal Inspection

The Westwood Lake Dam (and Saddle Dam) was in similar condition to that reported during the previous inspections. Visual inspections were performed on the crest, upstream and downstream slopes of the main dam and saddle dam. In addition, the spillway and spillway bridge were reviewed. The following observations were made during the Westwood Dam inspection:

4.1.3.1 Main Dam

4.1.3.1.1 Upstream face

- The upstream face of the dam that is comprised of grouted stones was in fair condition. Some erosion of the mortar between stones and minor stone dislodgment is apparent. Inspection of this material has been added as a routine maintenance item in the OMS Manual.

- The upstream face of the dam that is comprised of concrete panels was in fair condition. Some concrete cracking and spalling were observed near concrete panel joints and along the waterline (**Photograph WWL 4**). Some localized grouting repairs were performed, but these repairs have not remained intact in most cases. The concrete panels are not relied upon for impoundment; therefore, repairs are considered a maintenance item and should be undertaken if erosion of the slope occurs.

- The concrete lined upstream face of the dam exhibits a few long persistent cracks along the face above the waterline over almost all the concrete panels with a width of 2-5 mm (**Photograph WWL 3**). This could be due to the dam settlement; however, the width of cracks did not change from the 2020 FADI. Since the concrete facing is not part of the water barrier system, this is not considered a dam safety concern. Nevertheless, the cracks in the upstream concrete face should continue to be monitored for signs for potential seepage or piping. Since these are facing elements, repairs are considered a maintenance item to prevent acceleration of the deterioration and are not affecting the performance or safety of the earth dam at this time.

4.1.3.1.2 Crest and Abutments

- The dam crest is a gravelled surface and was found in good condition during the inspection. There was no signs of cracks, settlement, or sinkholes on the dam crest (**Photograph WWL 6**). No signs of erosion or unusual conditions were observed at the abutments of the dam during the site visit.

- Medium to large sized trees exist at both the left and right abutments **(Photograph WWL 2)**. Tree roots propagating towards the upstream face could introduce seepage paths through the embankment. Tree removal is likely to encounter public resistance. In the interim, the downstream dam face in the vicinity of existing trees should be monitored for signs of bulging, zones of dense vegetation, and visible seepage.

4.1.3.1.3 Downstream Face and Toe

- The downstream face of the dam was observed to be in satisfactory condition and is overlain by a surficial layer of gravel and cobbles up to 300 mm maximum nominal diameter. Tree and brush growth was noted near the crest at the left and right abutments.
- A water level of approximately 3 cm was measured through the 'V' notch weir at the toe of the dam. There are three weirs installed near the toe, one collects dam seepage, and there are two additional outlets, one discharging water from the Westwood Lake syphon, and the other associated with storm drainage from an adjacent residential development, which was constructed after the dam's original construction.
- As previously noted, large and medium sized trees are located on the downstream face near the right and left abutments. Large tree roots can cause stability and seepage issues in the dam as well as form a preferential flow path that could lead to piping. It is recommended that these trees be removed for this reason. Trees were also noted close to the interface of the dam and abutments, including a large tree with overhanging roots at the left side of the downstream toe. Vegetation control measures should include clearing any trees and other vegetation a minimum of 3 m beyond the abutment and dam toe.
- The buried Department of Fisheries pipe that runs through the embankment dam to discharge water downstream of the dam's toe had been exposed due to heavy mountain bike use in the area. The eroded area has been replaced and backfilled with a new ditch culvert, providing an access to the abutment. It is recommended that this area be monitored for future erosion if mountain bike traffic continues.

4.1.3.2 Saddle Dam

4.1.3.2.1 Upstream Face

- The upstream slope of the Saddle Dam was in satisfactory condition at the time of the inspection and was covered with overgrown grass and vegetation. Some erosion protection consisting of rockfill is visible although it appears minimal. There were no significant indications of existing erosion on the crest or upstream face except for one area noted below. A vegetation clearing program at the upstream and downstream slopes and toe is in place and performed regularly. Wood debris had accumulated along the upstream face at the waterline (**Photographs WWL 13 and 14**) and is understood to be removed annually by the City.

- Some light furrowing due to surface runoff was observed on the upstream slope in areas where the public also seems to have accessed the reservoir from the crest (**Photograph WWL 14**). These areas should be monitored as part of the routine inspections. The erosion did not appear to be significantly changed from previous FADI inspections.

4.1.3.2.2 Crest and Abutments

- The crest of the Saddle Dam is a gravelled surface and was found to be in satisfactory condition at the time of inspection (**Photographs WWL 11 and WWL 13**). There were no signs of cracks, settlement, or sinkholes on the majority of the dam crest.
- The right and left abutments are in satisfactory condition. Tree and brush vegetation overgrowth was observed. Trees along the upstream crest and within 3 m of the downstream crest should be removed. No signs of erosion or unusual conditions were observed near the abutments of the dam.

4.1.3.2.3 Downstream Face and Toe

- The downstream slope of the Saddle Dam was in satisfactory condition at the time of the inspection and was covered with grass and some rounded gravel and cobbles. Some vegetation including bushes and small-medium trees are encroaching on the downstream toe (**Photograph WWL 12**). No holes, cracking, slumps, wet spots, or signs of instability were observed on the downstream face or toe.

4.1.3.3 Reservoir

- An active public trail system runs around the perimeter of the lake which provides access to view the reservoir. The reservoir is also used by the public for recreation (swimming, kayaking, etc.).
- The reservoir level is currently measured using the concrete steps of the main dam. The City is considering the installation of a level gauge in the reservoir which should allow for more precise measurements and facilitate measurement in windy conditions.

4.1.3.4 Miscellaneous

- The concrete sill at the outlet channel was viewed from a public walking trail bridge and from the floor of the channel (**Photograph WWL 15**). No water was flowing over the weir during the inspection. The channel floor was observed to be large rockfill overlain by a concrete apron extending upstream and downstream of the bridge. Cobbles line the channel downstream of the bridge where the rock/concrete lip terminates.
- The left and right abutment of the outlet concrete sill was visible and appeared to be on overburden. Some minor wood debris accumulation was noted.
- The left abutment of the pedestrian bridge over the outlet channel was observed to have adequate erosion protection and consist of a veneer of soil over bedrock, covered by a thin coat of concrete. The right abutment of the pedestrian bridge consists of organic soils, and bedrock was not visible in the inspection. There is potential for this soil to erode

if flow increases through this channel. Slope protection is recommended at this abutment if erosion increases.

- The inlet channel is cobble and boulder lined with steep soil banks and a pedestrian bridge. Stacked bags of concrete (dam sacks) were observed under each bridge abutment. A large tree was observed directly at the left abutment of the pedestrian bridge which should be monitored as it may cause dam sack displacement and increase scour susceptibility **(Photograph WWL 16)**.
- Minor undermining/erosion was observed beneath and downstream of the dam sacks under the left bridge abutment, up to 0.2 m to 0.3 m beneath and up to 1 m around the downstream edge **(Photograph WWL 16)**. The current level of monitoring is considered sufficient. Consideration for additional grouting and scour protection should be considered if undermining continues.
- There was wood debris (branches and some logs) accumulated in the outlet channel at the concrete sill. These should be periodically removed from the channel.
- Minor undermining/erosion was observed in the outlet channel downstream of the channel step beneath the dam sacks **(Photograph WWL 17)**. Riprap which seemed to be placed along the channel step to protect the dam sacks, was found to be partly dispersed. It is recommended to repair the riprap along the outlet channel step to protect the dam sacks from further undermining.
- One handrail bolt on the siphon outlet structure is the wrong material and is corroding due to dissimilar metals contact. This bolt should be replaced but is not considered a safety concern.

4.1.3.5 Public Safety

- The Westwood Lake Dam and Appurtenant structures are located within the Westwood Lake Park public trail system. The area is well used by hundreds of walkers and runners daily while the reservoir is also used for recreation by the public.
- There were no significant public safety risks observed at the Main Dam or the Saddle Dam.
- Recommendations to protect against erosion and undermining at the pedestrian bridge abutments in the inlet and outlet locations are summarized in **Section 4.1.3.4**.
- Dam Safety signage as described in the BC Dam Safety Regulation Section 11 was not observed during the inspection. Dam safety signage should be installed at each side of the dam crest.

4.1.4 Recommendations

The following surveillance/rehabilitation work is recommended for Westwood Lake Dam (and Saddle Dam) as shown in **Table 4-4**. Some of these items are carried over from previous FADIs.

Table 4-4: Westwood Lake Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
WWL 1.01	Replace missing hardware at 'V' notch weir.	2020 FADI
WWL 1.02	Repair erosional damage at the left bridge abutment at inlet channel. Extend the length of dam sacks downstream and backfill the erosional scarp behind the dam sacks.	2021 FADI
WWL 1.03	Vegetation control measures should include clearing any trees and other vegetation a minimum of 3 m beyond the abutment and dam toe for both main dam and saddle dam.	2023 FADI
WWL 1.04	Repair the riprap along the outlet channel step to protect the dam sacks from further undermining.	2023 FADI
WWL 1.05	Install dam safety signage on each side of the crest.	2025 FADI
Recommendations to close		
	The area where the buried Department of Fisheries pipe is exposed due to mountain biking and hiking activities to protect the pipe from damage by the public by backfilled.	2023 FADI

4.2 Old Reservoir No. 1 (R01) Dam

4.2.1 Dam Description

Old Reservoir No. 1 is separated from the Upper Colliery Dam by the Nanaimo Lakes Road. The only significant inflow into the reservoir was via a raw water piped inflow from South Fork Dam that was shut down in January 2014 and the reservoir is no longer used as a potable drinking water source. A new, above ground closed concrete reservoir was built and commissioned in 2014 to replace the open concrete-lined Old Reservoir No. 1.

The reservoir was permanently dewatered in January 2020 and was recently downgraded to a consequence classification of "Low", but the future use of the reservoir is still to be determined. A plan is required to address the long-term future of the dam. As noted previously, the dam could be removed from the fleet of dams if there are no plans to refill the reservoir.

The dam that previously retained the reservoir is a mass concrete gravity dam originally built around 1910. It has a maximum height of approximately 11.5 m at its lowest foundation level and is 40 m long with a near vertical upstream face and a downstream face sloping at about 0.45H:1V. The dam location is shown in **Figures B6** and **B7** and the details are shown in **Figure B8** in **Appendix B**.

Nominal steel reinforcement is embedded in both faces. The dam was substantially remediated in 1996, including a new reinforced dam crest (utilized as a high strength beam) and the installation of 21 – 36 mm diameter Dywidag thread bar anchors grouted into bedrock to provide the required factor of safety for earthquake stability.

At the same time as the dam was remediated, stabilization of the right bank rock slope immediately downstream of the spillway was performed. The rock face is friable sandstone interbedded with shale, siltstone, and shale/siltstone with coal seams dipping into the abutment at about 10-20 degrees. The rock slope was anchored with a pattern of 25 mm diameter, 3.5 m long passive dowels and covered with a layer of shotcrete and steel mesh.

The spillway is located close to the right abutment of the dam and is constructed as an integral part of the dam. The spillway section comprises a 2.8 m wide broad crested weir with the sill set at 1.2 m below the dam crest. The spillway chute is stepped to provide some energy dissipation before reaching a flip bucket at the base of the chute. The capacity of the spillway has been estimated at approximately 6.5 m^3/s at the onset of overtopping. A 250 mm diameter pipe is permanently open to release any rainfall the accumulates in the reservoir. Refer to **Table 4-5** for more detail regarding the dam.

Table 4-5: Data for Old Reservoir No. 1 Dam

Structure	Details
Type of Dam	Concrete Gravity Dam
Maximum Height	11.5 m (approx.)
Crest Length	40 m
Crest Width	1.5 m (approx.)
Catchment Area	Local catchment area only (64,000 m^3 storage volume)
Upstream Slope	Varies, but near vertical
Downstream Slope	Varies (vertical at crest to about 0.45H:1V below)
Inlet and Outlet Works	Inlet pipes have been decommissioned and fills only by local catchment Outlet pipes through main body of dam
Spillway	Unregulated cascading concrete spillway controlled by filling from local catchment area
Dam Failure Consequence Classification	Low

4.2.2 Instrumentation

There is a ‘V’ notch weir located beyond the downstream toe of the dam used to measure dam seepage. The weir was dry during the inspection. The reservoir level at Reservoir No. 1 is no longer monitored due to the permanent dewatering of the reservoir.

4.2.3 Formal Inspection

The Old Reservoir No. 1 was visually inspected by walking along the crest and downstream face of the dam. No significant changes were noted compared to the 2024 FADI. The following site inspection observations were made:

4.2.3.1 *Concrete Dam*

- The dam was reviewed from the walkway along the crest to the overflow spillway, the drained reservoir, and the downstream toe. The concrete was generally in good condition. Delamination of the mortar parget coating along the spillway walls was apparent, especially along the upstream face and inside walls of the crest walkway which appears to have been used as a water channel. Drawing PW-66860101, sheet 100 notes this area as an “Emergency Water Supply Channel”.
- The downstream face of the dam has some leaching stains, minor spalling, and cracking; however, the cracks are minor and are not a dam safety concern at this time. Moss growth was noted on the downstream face which might have indicated minor seepage, however as the reservoir is dry no active seepage was observed (**Photograph R01 3**).
- A shotcrete type material appears to have been applied on the lower portions of the upstream face and showed mild erosion. In some areas where the deterioration is greatest, an embedded welded-wire fabric type of material is exposed and showing signs of corrosion.
- The mechanical equipment for the old intake system is heavily corroded (**Photograph R01 4**); however, this would only become an issue if the dam was to return to service and the existing intake was to be re-used. Corrosion was also noted on the angle supports for the right water supply intake operating platform.
- One timber board was missing from the gate well platform along the centre of the dam crest. Since this dam is a private site with no significant public presence, this is not considered an issue.

4.2.3.2 *Spillway*

- The spillway has been coated with a shotcrete material, which appears to be intact with minimal deterioration and is in fair condition **(Photograph R01 3)**.
- The spillway walls showed signs of cracking and calcite leaching.
- A 250 mm diameter, low-level drainage pipe is used to drain any precipitation that accumulates in the reservoir. The low-level drainage pipe sump should be cleaned annually to avoid a build up of debris and ensure water is flowing. Water was flowing out of this pipe at a rate of approximately 5 L/min
- The spillway discharge channel includes a steel culvert embedded in a concrete headwall. The concrete headwall is experiencing some cracking, but this does not pose any immediate concerns given the uncertain future function of the reservoir.

4.2.3.3 *Abutments*

- The right abutment is a rock wall covered with a layer of shotcrete and topped with vegetation (**Photograph R01 5**). Weep holes were observed in the downstream right abutment wall. They were dry at the time of the inspection. City personnel indicated that prior to draining the reservoir, significant drainage would occur out of these drainage

locations. The rock slope above the shotcrete wall appeared to be in similar condition as previous FADIs. The condition of the right abutment is considered satisfactory given the potential for decommissioning of the reservoir and limited access to the dewatered reservoir.

- The left abutment is a grassy slope (**Photograph R01 6**) in good condition.

4.2.3.4 Downstream Face and Toe

- No settlement, displacement, sinkholes, boils, or slope movement was observed on the downstream side of the dam. The surface on either side of the downstream channel is graded with gravel.
- Clear water flow was observed coming out through the 1.2 m-diameter culvert. The pipe rests on bedrock and appears in satisfactory condition, with minor undermining noted on the left side but in similar condition as observed in the 2024 FADI. The outflow channel is protected by sparse rockfill. A more robust protection system would be required for greater flows; however, is not considered necessary at this time given the drained state of the reservoir and potential for future decommissioning.
- The 'V' notch weir was dry at the time of the site visit. The catchment area for this weir is likely not sufficient to capture all drainage from the rock wall drains. This is not considered necessary for improvement at this time considering the drained state of the reservoir and potential for future decommissioning.

4.2.3.5 Reservoir

- Minor concrete delamination of the reservoir floor and slopes is occurring. Some cracking of the concrete slope and floor cover with vegetation growth was noted.
- The southeast portion of the reservoir consists of subvertical slopes with surficial shotcrete facing. The shotcrete was observed to be in fair condition.

4.2.3.6 Public Safety

- In general, this site has a low level of public interaction as it is a private area and it is monitored by CCTV cameras.
- Old Reservoir No. 1 is secured by a fence around the perimeter of the reservoir which restricts public access to the area. Vehicle access to the area requires passing through a gate which also restricts access.
- The downstream side of the dam is protected by fencing, but the fence can be circumvented, and public presence has occurred periodically, including minor vandalism in the past. During the site visit, domestic garbage such as cans were observed downstream of the dam suggesting public presence in the area.
- The dewatered nature of the reservoir makes falling from the dam a more serious safety issue, but given the small public presence, it is recommended this public usage be monitored before any control measures are added/upgraded.

- Some damages were observed in wooden handrail and access stairs at the downstream side of the dam **(Photograph R01 6)**. It is presumed the repair is not necessary considering potential decommissioning of the dam in future. These are more worker safety deficiencies, as the public is not supposed to be within this area.

4.2.4 Recommendations

Hatch understands that the City has enquired with the Dam Safety Office about officially decommissioning the Reservoir 1 Dam. The Dam Safety Office indicated that although the dam is currently operated with the valve fully opened (thus not allowing any water to accumulate in the reservoir), it cannot be decommissioned unless a permanent alteration (not subject to future operating changes) is made to physically allow water to bypass the dam. This can be accomplished by opening new holes through the structure or modifying the existing outlet pipes.

A decommissioning plan is required for the dam if a future decommissioning is preferred by the City. In general, no surveillance/rehabilitation work is recommended for Old Reservoir No. 1 Dam in its current dewatered state. Until the dam is decommissioned, it is recommended to continue the annual cleaning of the low-level drainage pipe sump to avoid a build up of debris and ensure water is flowing. In addition, CCTV camera surveillance should continue to monitor any public access.

4.3 Harewood Dam (HAW)

4.3.1 Dam Description

Harewood Dam is located to the southeast of the Chase River system and discharges into the Chase River downstream of the Lower Colliery Dam. The dam is a concrete gravity structure constructed in 1911 to store water for the coal mining industry in the City. The dam is about 34 m long, approximately 3.4 m high, with a crest width of 0.9 m. The dam consists of a vertical upstream face and a downstream face inclined at 72 degrees. A shallow sloping, earth fill bench approximately 11.7 m wide extends downstream from the concrete dam to a 1.9 m high rock wall. A low-level outlet is set into this wall and the bench appears to provide backfill over the outlet. The low-level outlet pipes are capped with the upper outlet containing a small valve for fisheries purposes. The outlet was once controlled by an upstream sluice gate, but the gate stem is bent and distorted and is inoperable. The LLO consists of two capped pipes that are exposed through a small concrete wall downstream of the downstream toe. A steeply sloped, approximately 1.8 m high stacked rock buttress retaining wall flanks the outlet pipes.

A two-bay spillway is incorporated into the crest of the dam near the right abutment. The inlet bays measure approximately 1.2 m wide by 1.3 m high and are separated by a 0.6 m thick centre wall. Stoplogs, which had been fastened into the base of the bays, have been permanently removed. Discharge through the spillway is contained within a concrete chute measuring 1.36 m wide, 10.6 m long and 0.6 m wall height. Beyond the chute, there is a small discharge channel. The spillway capacity has not been determined. See **Figures B9**

and **B10** in **Appendix B** for the details of the dam and **Table 4-6** for the dam data.

Table 4-6: Data for Harewood Dam

Structure	Details
Type of Dam	Concrete Gravity Dam
Maximum Height	3.4 m (approx.)
Crest Length	34 m (approx.)
Crest Width	0.9 m (approx.)
Retained Water (Normal)	32,000 m^3 (based upon water license)
Spillway Capacity	Unknown
Upstream Slope	Vertical
Downstream Slope	Near vertical
Outlet Works	Low level outlet (not operated) Uncontrolled open channel concrete spillway (formerly controlled by stop logs)
Spillway	Unregulated spillway controlled by filling from local catchment area
Dam Failure Consequence Classification	Significant

4.3.2 Instrumentation

The only instrumentation at Harewood Dam is a 'V' notch weir that is located downstream of the LLO and rock wall to record monthly seepage measurements through the dam (**Photograph HAW 9**). During the 2025 FADI inspection, a minimal amount of water was pooled behind the weir, with no flow over the weir.

4.3.3 Formal Inspection

The Harewood Dam was in similar condition to that reported during the 2024 FADI. Visual inspections were performed by walking the crest of the dam, abutments, and areas downstream of the dam. The spillway was not spilling water and was dry and free of any large debris; however, the chute slab was covered in a loose layer of sticks, leaves, and other vegetation debris. The following observations were made during the inspection:

4.3.3.1 Concrete Dam

- The upstream vertical face of the concrete dam was in poor condition but was only visible above the waterline. Cracking and calcite staining were observed along the entire length of the dam. However, due to the low reservoir level that the dam operates under, these cracks are not considered a major dam safety concern at this time.

- The sloping downstream face of the concrete dam was found to be in similar condition to the upstream side (**Photograph HAW 7**). Several locations showed crack widths between 5 and 10 mm. It is recommended that the crack propagation continued to be monitored and that any observed seepage be documented, particularly at the lower

sections of the dam (**Photograph HAW 8**). One large spall was also noted on the downstream face of the dam; no seepage was noted coming through this area.

- The downstream face of concrete dam was clean at the time of inspection. It is recommended that pressure washing and cleaning of the dam face should continue on an as-needed basis.
- No seepage was observed on the downstream side of the concrete dam.

4.3.3.2 Spillway

During the inspection, the concrete overflow spillway was observed to be in poor condition.

- The crest of the dam has several areas of severe delamination of the concrete surface in the top 50 mm of the concrete in the area surrounding the spillway; this was noted in particular at the suspended slab spanning over the spillway in previous FADIs. However, new concrete was placed in this location to prevent further erosion in concrete deck at the left spillway bay. It is noted that most of this cracking is above the maximum water level, and it is not a major dam safety issue at this time. It is recommended that all heavy equipment be prevented from crossing the spillway bridge. It should be noted that a guardrail with signage was installed on the dam crest at both abutments to limit heavy load crossing of the bridge and allows only for pedestrian traffic but no vehicles.
- The spillway piers are experiencing some wide cracking and the spillway walls have developed some vertical cracks and opening of joints (**Photograph HAW 12**). At the time of this inspection, the water level was below the spillway sill elevation and the spillway concrete chute was dry. The City should seal a vertical construction joint on the left side of the chute wall where some water seepage was observed during the 2019 FADI. Seepage from the spillway walls continues to be monitored as part of routine inspections.
- Some minor erosion was noted at the base of the chute walls. This erosion should be monitored in future FADIs to determine if it is increasing in depth and size.
- At the time of the inspection, the base of the spillway slab concrete slab was exposed. The concrete slab was in fair condition with some erosion but no major spalls noted (**Photographs HAW 5** and **HAW 6**).
- It is noted that City staff repaired the downstream end of the spillway chute to prevent further undermining and soil erosion in 2020 (**Photograph HAW 6**).
- There is minimal rock at the end of the spillway chute to dissipate the energy and prevent further scour under the slab and downstream of the spillway. It was recommended in the FADI 2021 report that 300 mm diameter riprap be installed for channel protection downstream of the spillway chute. This has not been completed as of the 2025 inspection. The riprap should extend the width of the spillway plus 0.5 meters on each side, and extend approximately 10 m downstream, at a minimum (**Photograph HAW 11**).

4.3.3.3 *Abutments*

- The left abutment is on overburden and the right abutment is on bedrock. No seepage, cracking, or signs of movement were observed at the left and right abutments.
- The exposed rock at the right abutment appears competent and the contact is strong.
- At the left abutment, a fir tree near the crest was recently removed by the City. Vegetation should continue to be cleared within three meters of dam crest, abutments, and toes.

4.3.3.4 *Downstream Face and Toe*

- The downstream toe of the concrete dam is buttressed by an overburden bench supported by a rockfill retaining wall. During the 2021 FADI, a small depression was observed on the bench approximately one meter to the left of the spillway channel wall approximately two meters downstream of the concrete dam toe. The depression was measured to be 0.35 m in diameter and 0.15 m deep. City personnel indicated that it was from a rotten cedar stump removal. It is recommended to monitor this depression and, if the depression changes or worsens, rehabilitate it by excavating and backfilling with compacted granular filter material. No change to this area was observed during the 2025 FADI inspection.
- Several trees are located on the downstream bench between the concrete dam and the rock wall. The composition of the bench or its contribution to dam stability are not fully understood; therefore, it is not recommended to remove these trees at this time.

4.3.3.5 *Low Level Outlet and Rock Wall*

- The stacked rock retaining wall flanking the LLO was observed to be in poor to satisfactory condition (**Photograph HAW 13**) with some loose unstable rocks and moss covering the face of the wall.
- A small wet area and pooled seepage was observed immediately downstream of the rock wall. The seepage appeared rust-stained.
- City personnel mentioned that the upstream valves on the LLO failed a long time ago. The LLO pipes have since been capped and have a small (approx. 25 mm or 1 in. dia.) outlet (**Photograph HAW 13**). City personnel noted that this is tested annually and has been functional in the most recent test.

4.3.3.6 *Reservoir*

- At the time of the inspection, no water was flowing over the spillway and the reservoir level was approximately 10 cm below the spillway concrete slab invert. A visual review of the reservoir and surrounding basin area was made from the crest of the dam.
- Numerous trees and vegetation surrounding the reservoir edge and minor erosion along the left shoreline, but in general, it was clear of debris and there were no signs of landslide scars or undercutting along its slopes.

4.3.3.7 Public Safety

- Harewood Dam is accessible from a residential development and has a public presence in the area of the dam. Gates with “Danger - Keep Out” signs have been installed at either side of the dam crest to deter pedestrians and cyclists from crossing the concrete crest of the dam. The crest is exposed to water on the upstream side and drops off 3.5 m on the downstream side.
- The remnants of handrail sleeves on the upstream face of the dam were observed, but there has not been any type of handrail system in place in recent years.
- There are some public safety hazards that should be assessed at this site. These include fall hazards along the top of the main dam and fall/trip hazards from the spillway bridge.
- Dam Safety signage as described in the BC Dam Safety Regulation Section 11 were not observed during the inspection. Dam safety signage should be installed at each side of the dam crest.

4.3.4 Recommendations

The following surveillance/rehabilitation work is recommended for Harewood Dam as shown in **Table 4-7**. Some of these items are carried over from previous FADIs.

Table 4-7: Harewood Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
HAW 1.01	Address identified public safety issues (i.e., missing handrail and fall hazards around dam). The City should also consider moving towards a more Formal Public Safety around Dams program based on the recommendations in the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. This would involve performing a public safety risk assessment and developing a formal public safety management plan for each site that is open to the public. This would help the city to understand public safety risks in a systematic priority-based process that will allow an overall reduction of liability and is defensible to the public. Observations at the site indicate that the public presence is relatively light and overall hazards are relatively low; therefore, this process does not have to be an immediate priority and should be considered as part of future initiatives.	2017/2018 FADI
HAW 1.02	Scour protection should be placed at the exit side of the spillway chute. It is recommended that a 300 mm diameter rock (riprap) blanket that is 3 m wide by 8 m long by 0.6 m high be placed downstream of the spillway chute, underlain by a minimum 400 gr/m^2 non-woven geotextile. 2022 Revision: Place 300 mm median diameter riprap blanket with underlying filter which extends 0.5 m beyond the spillway wingwalls and is minimum 10 m long.	2015 FADI/ 2018 FADI (Modified 2022)
HAW 1.03	Perform detailed concrete condition assessment of dam and spillway structures and subsequent repairs.	2015 FADI

Item	Description	Reference
	2021 Revision: This condition assessment should also provide recommendations on what repairs would need to be made to maintain long term operability of the dam given the reduced maximum operating level compared to original design.	
HAW 1.04	Repair the stacked rock wall and remove moss.	2018 FADI
HAW 1.05	Seal cracks along the bottom portions of spillway wall and slab to prevent seepage.	2019/2021 FADI (Updated 2023)
HAW 1.06	Clear vegetation and debris from channel downstream of rock wall.	2020 FADI
HAW 1.07	Install dam safety signage on each side of the crest	2025 FADI
Recommendations to close		
	N/A	

4.4 Upper Colliery Dam (UCR)

4.4.1 Dam Description

The Upper Colliery Dam is the furthest upstream dam in a series of three cascading dams along the Chase River. The Upper Colliery Dam is believed to have been constructed between 1911 and 1930. The spillway and twin culverts underneath Nanaimo Lakes Road divert the Chase River around the Old Reservoir No.1. The Upper Colliery Dam is comprised of two types of water retaining structures. The main (right) dam is a reinforced concrete upstream retaining wall (buttressed on the upstream side) and a downstream supporting earth fill embankment. This structure is 5.5 m high and 64 m long. The embankment (left) dam is a low earth fill embankment approximately 2.5 m high and 33 m long and retains approximately 0.3 m of water above the spillway invert. Together, these structures impound a small reservoir of about 60,000 m^3 of water.

The spillway is located within the left (embankment) dam and includes a free overflow rectangular concrete flume that discharges into two 1.8 m diameter corrugated steel pipe culverts buried beneath Nanaimo Lakes Road. The spillway is under capacity due to the restricted capacity of the flume but also due to the throttling effect of the culverts. See **Figures B11** and **B12** in **Appendix B** and **Table 4-8** for the Upper Colliery Dam data.

Table 4-8: Data for Upper Colliery Dam

Structure	Details
Type of Dam	Earth filled dam with impervious homogeneous materials with upstream concrete cut-off wall
Maximum Height	5.5 m (earth fill) to 2.5 m (concrete)
Crest Length	64 m (earth fill) to 33 m (concrete)
Storage Volume	60,000 $m^{3.}$
Spillway Capacity	Unknown
Outlet Works	Low level outlet into Old Reservoir No. 1
Spillway	Unregulated open channel concrete spillway
Dam Failure Consequence Classification	Significant

4.4.2 Instrumentation

There is a level sensor installed at the Upper Colliery Dam from which readings are transferred into the SCADA system and monitored at the Public Works Department (**Photograph UCR 15**). As part of the Chase River flood warning system, a level sensor is installed at a tributary creek at a bridge on Lincoln Road upstream of the dam. An instrument to measure flow ("FlowDar") is installed in the spillway channel.

4.4.3 Formal Inspection

The Upper Colliery Dam was in similar condition to that reported during the 2024 FADI. Visual inspections were performed by walking the crest of the buttress dam, spillway slab and chute walls, upstream slopes, and discharge culverts. The spillway invert was wet with some standing water on the chute slab and it was free of major debris at the time on inspection. The following observations were made during the inspection:

4.4.3.1 Spillway

- At the time of the inspection, there was some small debris and a few millimeters of clear water over the base of the concrete spillway slab (**Photograph UCR 4**) and the slab was visible. Some plant and tree debris was present on the spillway slab at the time of inspection. The concrete slab was generally in fair condition with several spalls of varying sizes noted, primarily originating at or around the centreline. The largest spall found was approximately 700 mm long x 100 mm wide. No significant erosion or cracking was found during the inspection. It is recommended to keep this area clean for the annual inspection.

- The concrete spillway was generally in fair condition with several cracks noted along each spillway wall. The cracks range in size from 1.5 mm to 4 mm maximum width. Two of these wider cracks are found along construction joints respectively close to the spillway level gauge and close to a culvert. These cracks should continue to be monitored to see if they increase in length or size over time.

- The culverts at the exit end of the spillway (at Nanaimo Lakes Road) were free and clear of debris. The top of the left culvert appears deformed on the downstream end, which may be due to impact damage (**Photograph UCR 16**). This damage should be monitored in future FADIs to assess whether the damage is progressing.
- The downstream end of the culverts were not assessed during the 2025 FADI; however, the 2021 FADI noted some undermining of the culverts on the downstream side of Nanaimo Lakes Road. It is recommended that this area continue to be monitored to see if the erosion of the supporting material continues to advance. If it continues, then the area under the culvert should be backfilled to try to seal off the seepage path and to support the end of the culvert.
- During the 2021 FADI, one of the joints in the left culvert was noted to be separating, leaving a gap between the adjacent culvert sections. This could in part be due to the downstream section of the culvert settling faster than the upstream section due to the undermining issue at the downstream end. It is recommended that this separation continue to be monitored and if it continues to increase, reinforcing of the material under the culvert on the downstream side may be required.
- The slopes above the spillway wingwalls exhibit signs of erosion and slope movement due to poor runoff control and protection (**Photograph UCR 11 and UCR 12**). The slope should be regraded and hydroseeded. A temporary coir-mesh should be utilized to provide temporary erosion protection until vegetation is established. Some regrading has been completed over previous years. The area should continue to be monitored.
- The wingwalls on the upstream side of the spillway were noted to be in fair condition with only minor calcite staining and cracking. It is recommended that this continue to be monitored to determine if the cracks are advancing over time.

4.4.3.2 Main (Right) Dam – Upstream Concrete Buttress Wall

- At the time of the inspection, the concrete buttress wall was in similar condition to that reported in previous FADIs.
- The concrete walls of the dam have experienced extensive damage from freezing and thawing and were observed to be in poor condition. The freeze thaw damage was covered with a mortar parging that has failed and it is debonding over large areas (**Photograph UCR 3**).
- There was a large crack (caused by tree root damage) observed in the wall near the south end which has been there for a long time according to City staff (**Photograph UCR 17**). The tree that caused this damage has since been removed. but it is recommended the crack continue to be monitored. A depression in the ground adjacent to the old tree trunk behind the concrete wall was also noted during the site visit which could indicate that its roots are rotten. This depression had a depth of about 0.25 m and length of up to 1 m. It is recommended to level the ground surface behind the wall to

avoid water accumulation at the location of this depression and facilitate surface runoff away from the wall.

- Large vertical and horizontal cracks along with large spalls were observed along the buttress portion of the wall. Some vegetation growth was noted at the base of the vertical crack. It is recommended this vegetation be removed.
- Routine inspections should be performed to ensure the wall condition does not deteriorate rapidly and a detailed condition assessment and subsequent repairs should be undertaken. It is recommended that heavy vehicles and trucks be prevented from driving directly adjacent to the concrete wall to limit the surcharge on the concrete. Parking blocks currently separates the adjacent road from the concrete wall area (**Photograph UCR 13**).
- Vegetation growth was noted at various areas around the abutments of the dam. Clearing of this vegetation should be included as part of routine maintenance for the dam and completed on a continuous basis.

4.4.3.3 Left (Embankment) Dam

- The embankment between the spillway and main (right) dam consists of vegetated slopes (**Photograph UCR 9**). Minor shoreline erosion was observed. The waterline is partially covered by bulrushes.
- During the site visit, on the downstream side of the concrete spillway's left wrap-around wingwall, the soil backfill showed some signs of settlement and displacement as previously reported in the 2021 FADI.
- Sign of undermining was noted in camera pole foundation at left abutment of the main dam. The void underneath the foundation should be backfilled and slope erosion in this area should be monitored **(Photograph UCR 14)**.

4.4.3.4 Reservoir

- The reservoir area upstream of the dam and spillway is relatively small.
- A low-level outlet valve is operational if the City ever needs to drain the Upper Chase River reservoir.

4.4.3.5 Public Safety

- Upper Colliery Dam is located at the south end of Colliery Dam Park adjacent to Nanaimo Lakes Road. This park has a very high public presence with many daily users which are engaged in activities such as fishing, walking or dog walking. The lake is stocked with fish, which encourages fishing from the shoreline.
- A fence was installed along the headwall adjacent to the culverts and down both sides of the spillway chute walls to address the public safety hazards (**Photograph UCR 4**).

- Following the site visit, the City installed chain link fencing (approximately 1 m high) along the concrete buttress dam to further enhance public safety at the site while still allowing for fishing activities from behind the fencing (**Photograph UCR 13**).
- Parking blocks were installed along the length of the dam access to prevent cars from driving from the shoulder pull-out and fully into the dam area (**Photograph UCR 13**).
- Dam Safety signage as described in the BC Dam Safety Regulation Section 11 were not observed during the inspection. Dam safety signage should be installed at each side of the dam crest.

4.4.4 Recommendations

The following surveillance/rehabilitation work, as noted in **Table 4-9**, is recommended for Upper Colliery Dam. Some of these items are carried over from previous FADIs.

Table 4-9: Upper Colliery Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
UCR 1.01	Address identified public safety hazards (i.e., fall hazards along buttress wall and spillway chute walls). Consider developing a public safety management plan for this structure in accordance with the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. It is expected given site observations that such a plan would not require a large number of additional control measures be installed but would help the City better understand public safety risk at the site and reduce overall liability. As with HAW 1.01 this process does not have to be an immediate priority and should be considered as part of future initiatives. See HAW 1.01 for more detail.	2017/2018 FADI
UCR 1.02	Perform detailed concrete condition assessment of dam and spillway structures and provide subsequent repair details.	2015 FADI
UCR 1.03	Install pins on either side of major buttress wall crack to monitor crack width. Clear the vegetation at the base of the vertical crack along the buttress wall.	2017/2021 FADI
UCR 1.04	Reinstate eroded material under the downstream end of the culverts and protect eroding slope at culvert outlet with geotextile and riprap after vegetation removal and regrading.	2020/2021 FADI
UCR 1.05	Regrade slopes around the spillway wingwalls and provide coir-mesh and hydroseed to establish protective vegetation. Construct drainage swales along the crest of the wingwalls to collect and discharge runoff. Fill the void beneath the spillway headwall on the right abutment.	2022 FADI
UCR 1.06	Level the ground surface behind the right dam wall to avoid water accumulation at the location of the observed depression to facilitate surface runoff away from the wall.	2023 FADI
UCR 1.07	Backfill the area of camera pole foundation to prevent further undermining and slope erosion.	2023 FADI
UCR 1.08	Install dam safety signage on each side of the crest	2025 FADI

4.5 Middle Colliery Dam (MCR)

4.5.1 Dam Description

The Middle Colliery Dam is in the southern part of the City and was originally constructed around 1910 to provide water for coal washing operations in the City. The dam is about 50 m long and 12.5 m high and is comprised of a 0.6 m thick concrete cut-off wall close to the upstream side. The upstream concrete cut-off wall is supported by earth fill shells situated both upstream and downstream of the core. The upstream shell (upstream of the cut-off wall) has a slope of 1.5V:1H, initiating approximately 2 m below the concrete wall crest, and likely consists of rock fill. The downstream shell has a nominal 2H:1V slope that was rebuilt in 1980. During rehabilitation in 1980, the crest was raised 0.3 m by adding a 0.3 m thick extension, and a gravel filter drain was installed to intercept seepage. An additional drain was installed near the right abutment in 1992 to intercept concentrated seepage observed. A 'V' notch weir located at the downstream toe is used to monitor seepage. See **Figure B13** and **Figure B14** in **Appendix B** for general layout and cross section of the MCR Dam.

The spillway is located on the left abutment and is separated from the dam by a concrete wall. The spillway entrance is divided by a central pier. The spillway is a free-overflow rectangular concrete structure that discharges over bedrock and into an unlined channel situated along the left groin of the dam. The spillway capacity is approximately 62 m^3/s with lake level at the dam crest elevation of 88.3 m (no freeboard), but no field measurements have been taken to confirm this capacity. The spillway flows are uneven across the spillway crest, which is most visible at low flows. The current dam consequence classification of Very High requires that the spill capacity be able to pass a flood "2/3 between the 1,000-year flood and the PMF" with adequate freeboard protection. The recent Inflow Design Flood Study (Hatch Ltd., 2025) calculated the "2/3 between the 1,000-year flood and the PMF" event to have a peak inflow of 145 m^3/s, and demonstrated that during this event, the reservoir level would surcharge to El. 89.08 m, or approximately 0.78 m above the dam crest. The study also demonstrated that the dam is overtopped by 0.31 m during the 1,000-year flood event, representing a significant deficiency in flood capacity.

Middle Colliery Dam data is provided in **Table 4-10.**

Table 4-10: Data for Middle Colliery Dam

Structure	Details
Type of Dam	Rock/Earth fill dam comprised of rockfill on the upstream face and semi-impervious materials on the downstream side with upstream concrete cut-off wall.
Maximum Height	13.0 m
Crest Length	50 m
Crest Width	Approximately 5 m as per drawings
Crest Elevation	88.3 m (ranges from 88.3 m to 89 m)
Top of Concrete Core El.	88.3 m

Structure	Details
Upstream Slope	1.5H:1V (initiating approximately 2 m below the top of the wall)
Downstream Slope	2H:1V
Filter	None. No classic filter downstream of the core.
Foundation	Variable, however, it is believed that the original embankments and concrete cutoff wall were constructed on bedrock.
Erosion Protection	Upstream concrete core wall.
Spillway Invert Elevation	86.2 m (ranges from 85.8 m to 86.2 m, based on sectional figure provided in the OMS (City of Nanaimo, 2023)).
Reservoir Storage Volume	120,000 m^3 at a water elevation of 86.48 m (i.e., “normal pool”, or 0.28 m higher than the main spillway crest) based on the storage curve provided in the OMS (City of Nanaimo, 2023).
Inflow Design Flood (IDF)	2/3 between the 1000-year flood and the PMF
IDF Peak Inflow	145 m^3/s
Peak IDF Reservoir Level	89.08 m
Watershed Area	20.2 km^2
Low-level Outlet	N/A (the existing woodstave LLO has been abandoned).
Spillway	Unregulated open channel concrete spillway discharging to a concrete walled channel on exposed rock. Channel is 49.6 m long. Spillway width is 12.2 m, excluding a central concrete pier. The channel width downstream varies.
Dam Classification	Very High

4.5.2 *Instrumentation*

Instrumentation consists of ultrasonic sensors to measure water levels at the crest of the spillway. The instrumentation is relayed back to the City’s SCADA system where a high-water level alarm has been created.

Additional instrumentation includes a ‘V’ notch weir located at the downstream toe to measure seepage through the toe of the dam during routine monitoring by City staff. In past years, there has been seepage observed downstream of the weir which appears to be circumventing the weir. At the time of inspection, there was no water flow over the ‘V’ notch weir at the toe of the dam.

Two standpipe piezometers (BH25-01 and BH25-02) were installed as part of the geotechnical investigation in April 2025. The City currently completes manual readings of these piezometers on approximately a monthly basis. This practice should be continued and a record of past piezometer readings should be added to the dam file. Review of the limited data collected to date indicates expected response in these piezometers. The City can consider installing pressure transducers in the standpipe piezometers to automate data acquisition.

4.5.3 *Formal Inspection*

The Middle Colliery Dam was in similar condition to that reported during the 2023 FADI and 2024 DSR inspection. The following observations were made during the inspection.

4.5.3.1 *Upstream Face*

- The concrete dam wall on the upstream face above the water level has experienced extensive surface erosion and was in poor condition during the site visit.
- The portion of the concrete wall exposed to wet/dry cycles had major concrete deterioration estimated at up to 100 mm in depth in some areas. The bottom portion of the concrete dam wall was below the waterline and appeared to be in similar condition to the deteriorated concrete surface above (**Photograph MCR 1**).
- Several cracks were identified along the upstream face during the condition assessment. It is recommended that these cracks be monitored regularly and that pins be installed to measure the growth of the crack over time.
- Though the eroded face of the concrete is up to 100 mm deep in some areas, the surface erosion at this stage is not considered to be a major dam safety issue. It is recommended that the surface be monitored and if further erosion is observed in the future, then the entire surface should be patched with a repair mortar to limit the deterioration.

4.5.3.2 *Crest and Abutments*

- The crest was in satisfactory condition at the time of inspection. There were no signs of cracks, settlements, or sinkholes on the dam crest.
- Bedrock was exposed on both right and left abutments (**Photographs MCR 9** and **MCR 11**). No signs of unusual conditions could be observed at this time at the abutments of the dam. Vegetation should continue to be cleared within 3 m of the abutments.
- The left abutment under the spillway bridge (adjacent to the level gauge) shows erosion and degradation of the concrete pier, resulting in a concrete-rock contact that appears partially unbonded and in poor condition (**Photograph MCR 5**).
- At the upstream side of the right abutment, some deterioration of the concrete was observed in the upstream face and where it bonds to the bedrock. The contact was in fair condition. Under the bridge, some minor cavitation was observed similar to that observed on the left side of the bridge. It is recommended to patch both the left and right abutment areas.

4.5.3.3 *Downstream Face and Toe*

- The downstream toe of the dam was vegetated with grass and was in good condition during the inspection with no signs of sinkholes and piping. Cobbles and boulders corresponding to the downstream shot rock blanket were present near the slope toe.
- Seepage from the embankment is collected and monitored by one ‘V’ notch weir located in the concrete housing at the toe of the dam (**Photographs MCR 13 and MCR 14**).
- In the 2019 FADI, it was recommended that the foundation surrounding the ‘V’ notch weir be sealed using low pressure grout to cut-off seepage flows coming from under the ‘V’ notch weir. No significant seepage has been observed through this righthand channel

during the inspection. A review of the weir monitoring data completed as part of 2022 FADI indicates that the weir is responsive to changes in the reservoir elevation. If possible, weir measurements should be obtained during or immediately after precipitation events to confirm the influence of runoff on weir measurements. The existing automatic data acquisition system was not functional at the time of the site visit and should be repaired. Consideration could be given to grouting the foundation if it is determined that weir measurements are due to runoff and not dam seepage.

- During the inspection, seepage was observed emerging from between rocks on the right-side spillway wall (**Photograph MCR 22**) at a rate of approximately 15 L/min. This seepage is not currently being collected by the seepage weir. Rust-stained deposits were observed on the rock where seepage is flowing, indicating that this condition has likely been ongoing. Due to the location of the seepage, it may be impractical to access and record flows while the spillway is flowing. However, visual observations of the seepage flows in this location should be completed when the spillway is dry. The seepage rates should be observed for any changes, or any indications of muddy seepage.

4.5.3.4 Spillway

- The reservoir level was below the crest of the spillway at the time of the inspection and the spillway slab was primarily dry. A wet area was observed during the 2022 FADI in the downstream section of the spillway while no flowing water was noted in the rest of the spillway. During this site visit the spillway was largely dry, but the same wet area was observed.

- The underside of the spillway bridge deck (particularly on the left bay) was observed to have extensive concrete deterioration and heavily corroded reinforcing bars were exposed in a large area of the concrete slab (**Photograph MCR 4**). Other portions of the underside of the bridge were delaminated, indicating further heavy rebar corrosion in these areas and likely future spalling. The bridge was assessed by Herold Engineering in 2022, and their recommendation was that no vehicle traffic is allowed on the bridge until the deck is rehabilitated or replaced. No restrictions have been placed upon pedestrian traffic, and once the deck is rehabilitated the bridge's load capacity has been assessed as 8 tonnes. A sign has been installed to inform the public of the vehicle restriction.

- A 45° crack was observed at the top corners of the centre spillway pier on the downstream edge, likely due to bearing stresses from the spillway bridge. This crack should continue to be monitored to document any increase in the length or size (**Photograph MCR 18**).

- Some undermining was noticeable at the base of the upstream pier nose (**Photograph MCR 19**). This area should be filled with repair concrete or low-pressure grout to eliminate the undermining of the pier and to prevent further advancement of the deterioration.

- Extensive cracking and spalling were observed at the right spillway pier underneath the bridge deck on the upstream side. Some undermining of the wall in this area was evident as a wet zone was noted downstream of the sill and major concrete deterioration was noted at the base of the wall (**Photograph MCR 20**). It is recommended that this area be repaired with a low-pressure grout to fill the voids between the upstream dam face and the spillway wall and sill.

- Undermining, spalling, and cracking were observed at the left spillway pier underneath the bridge deck (**Photograph MCR 21**). It is recommended that this area be repaired with a low-pressure grout to fill the voids.

- Cracks were observed at several locations along each of the two spillway walls. It is recommended that these cracks be sealed to prevent any seepage through the concrete. The majority of the wall sections downstream of the bridge were otherwise noted to be in fair condition, with minor erosion noted in some areas at the base of the walls where they are subjected to flowing water. However, this erosion is not considered to be a major dam safety concern at this time and only needs to be monitored to ensure the concrete does not deteriorate further. Some undermining of the right wall at the downstream end was noted; this should be inspected in future FADIs to monitor any progression of damage. Additionally, the right spillway wall is in poor condition immediately downstream of the bridge, with significant erosion and spalling. This is not currently considered to be a major dam safety concern but should be monitored to ensure the concrete does not deteriorate further.

- The concrete wall on the left side of the spillway chute does not extend to the end of spillway chute. As reported in previous 2015 FADI, this has resulted in significant erosion of natural soils from the left embankment at the lower portion of the spillway channel. A riprap protection and some geotextile were placed on the left soil slope of the spillway to protect it from future high flows (**Photograph MCR 15**). This new protection should be monitored as part of routine inspections to confirm it is functioning adequately.

- The staff gauge and SCADA system is on the right side of the spillway, but there is a “lip” in the form of a concrete sill preventing water from flowing over the spillway invert in this area – instead, it flows through the left side where the original concrete sill appears to have been removed down to the uneven bedrock surface below. As a result, the invert is slightly lower on the left side of the spillway than on the right side.

4.5.3.5 Reservoir

- A visual review of the reservoir and surrounding basin area was made from the crest of the dam. No concerns were noted.

- There is no safety or debris boom upstream of the spillway structure.

4.5.3.6 Public Safety

- Middle Colliery Dam is the located near the centre of Colliery Dam Park. This park has a very high public presence with hundreds of daily users. Recreational activities include swimming, walking/jogging, dog walking (off-leash area), picnicking, and fishing. The lake is stocked with fish, which encourages fishing from the shoreline.
- Chain-link fence has been installed at the downstream edge of the crest, and along the left abutment. The fencing appeared to be in good condition at the time of the inspection.
- The rock outcrop on the left shore immediately upstream of the spillway also provides access to the potentially dangerous spillway. There is minimal signage warning the public of the hazards. It is understood that the public may be resistant to additional public safety control measures such as signage and fencing and therefore this should be considered in the design to minimize the impact to park users while mitigating the identified hazards. New signage was erected recently prohibiting vehicles from using the spillway bridge.
- Dam Safety signage as described in the BC Dam Safety Regulation Section 11 was observed on the right abutment (**Photograph MCR 23**). Dam safety signage should also be installed in a prominent position on the left abutment.

4.5.4 Recommendations

The following surveillance/rehabilitation work, as summarized in **Table 4-11**, is recommended for Middle Colliery Dam. Some of these items are carried over from previous FADIs.

Table 4-11: Middle Colliery Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
MCR 1.01	Address identified public safety issues (i.e., fall hazards along chute walls, consider adding some signage). Consider developing a public safety management plan for this structure in accordance with the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. Given the site observations, this dam and Lower Colliery Dam are likely the most critical candidates for this type of assessment. Public presence and interaction is high, there are several identifiable unmitigated public safety hazards, and there is a high degree of public concern that will complicate any further public safety controls put in place. For these reasons, having a formal public safety assessment completed would allow the City to understand their risk as well as identify the key low impact/publicly palatable control measures to effectively mitigate this risk.	2017/2018 FADI
MCR 1.02	Repair/replace the spillway bridge to enable continued long-term use. Any capital work should be deferred (if possible) until the spillway upgrade study is complete and a concept is selected.	2021 FADI (Updated in 2023 and 2025)
MCR 1.03	Repair the area surrounding the 'V' notch weir by low pressure grouting of the bedrock to capture seepage flows.	2018 FADI (Modified 2022)

Item	Description	Reference
	2022 Revision: Repair the automatic data acquisition system for the weir and monitor weir measurements in response to precipitation events. Consideration could be given to grouting the foundation if it is determined that weir measurements are due to runoff and do not capture dam seepage.	
MCR 1.04	All undermining and cavitation at interface of concrete bedrock/soil should be repaired by low-pressure grout/concrete fill. This includes the spillway bridge pier upstream nose at the base and the right and left spillway walls at the upstream end.	2020 FADI
MCR 1.05	Seal the smaller concrete cracks in the spillway walls using Xypex concrete waterproofing or other equivalent materials depending on the severity of damage.	2021 FADI
MCR 1.06	Install pins at major cracks on the upstream dam face to monitor movement of the cracks over time. Continue to monitor upstream face of concrete as part of annual inspections and consider repaired if deterioration advances significantly.	2021 FADI
MCR 1.07	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	2021 FADI
MCR 1.08	Install Dam Safety signage on left abutment in a visible location when approaching the dam.	2025 FADI
Recommendations to close		
	Based on the assessment from the 2024 DSR, the lack of debris on the reservoir, and the width of the spillway bays, no debris boom is recommended at this time. The spillway upgrade study should provide more insight on the future arrangement of the spillway and the need for a boom. MCR 1.01 may find that a boom is still needed for public safety.	2023 FADI

4.6 Lower Colliery Dam (LCR)

4.6.1 Dam Description

The Lower Colliery Dam is the farthest downstream of the series of dams on the Chase River cascade system. The Lower Colliery Dam was constructed in 1910 to supply water for the nearby Harewood Colliery during production which ended around 1945. The dam is now part of the recreational area called Colliery Dam Park.

The dam is an earth/rock fill structure about 77 m long and 23.3 m high with about a 10 m wide crest. The Lower Colliery Dam is considered as a Large Dam as it is higher than 15 m. The dam is comprised of an upstream concrete cut-off wall supported by upstream and downstream earth fill shells. The 300 mm-thick concrete cut-off wall forms the upstream face at normal lake level. The upstream shell has a slope of 1.8H:1V and is likely composed of a coarse granular material, but the nature of the fill is unconfirmed. The downstream shell, comprised of loose cinders, slag, or sand and gravel over rock fill, has a nominal slope of 1.6H:1V and has experienced some minor slumping and settlements. In 1930, a stabilizing berm comprised of gravelly sand was added on the downstream slope at a slope of 2H:1V.

An extended apron area is located immediately to the left of the spillway, where members of the public can enter the reservoir via an installed set of steps. See **Figure B15** in **Appendix B** for plan and cross sections of the LCR dam.

In 1980, a gravel filter drain was installed below the downstream shell to intercept seepage through the dam and abutments. Construction included a stabilization berm for the lower downstream slope and backfilling of the low-level outlet pipes through the dam.

The original (main) spillway is located on the right abutment and is separated from the dam by a concrete wall which forms the left side of the concrete spillway. The spillway is a rectangular, concrete lined channel that is split at the upstream end and converges into a single channel downstream. The spillway is a free overflow structure that discharges downstream over a steep bedrock slope. The spillway capacity is approximately 55.0 m^3/s with a water level at the dam crest elevation of 73.4 m (Golder Associates, 2014).

An auxiliary spillway was constructed in 2016 to increase the flood routing capacity of the reservoir. The auxiliary spillway is located south of the main spillway and consists of a labyrinth weir that discharges to Harewood Creek before reaching the Chase River. The main spillway remains in place and serves as the primary spillway, while the auxiliary spillway crest overtops during storm events and associated high water levels within the reservoir. The auxiliary spillway has a maximum capacity of 127.7 m^3/s with a water level at the dam crest elevation of 73.4 m. Both spillways are required to pass the IDF event.

The auxiliary spillway also includes a secant pile wall and pedestrian bridge. The secant wall is approximately 29.4 m long and consists of a row of concrete piles with steel ‘I’ beam reinforcement that forms a continuous retaining structure. The core of the secant wall is approximately 900 mm thick covered with riprap on the upstream face. Details of the auxiliary spillway are shown on **Figures B16** and **B17** in **Appendix B**. LCR Dam data is summarized in **Table 4-12**.

A Worthington TuffBoom consisting of 14-3.05 m (10 ft.) long boom sticks connected with a 5/16-inch diameter chain was installed as part of the 2016 auxiliary spillway installation. The boom initially was installed to span across the entrances of both the main and auxiliary spillways and was anchored to a buried concrete block in the extended apron area on the left bank of the spillway (the chain passes through the concrete facing of the lower, reservoir access area) and a soil anchor on the right. Due to vandalism by members of the public, the original debris boom was cut. Following this damage, the left anchor location was relocated to the right wall of the main spillway, meaning that the boom temporarily only protected the auxiliary spillway. However, the boom has recently been restored to its original location where it now protects both spillways. Due to public pressure, two large gaps were left in the boom to allow debris to pass, meaning that the boom allows smaller debris to flow over the spillways (**Photograph LCR 2**).

Table 4-12: Data for Lower Colliery Dam

Structure	Details
Type of Dam	Earth fill dam with upstream concrete cut-off wall face
Maximum Height	23.3 m
Crest Length	77 m
Crest Elevation	73.4 m (Ranges from 73.0 – 75.2 m)
Top of Concrete Core Elevation	Same as crest
Upstream Slope	Variable, backfill average 2H:1V
Downstream Slope	Upper part: 1.6H:1V and lower part: 2H:1V
Main Spillway	Unregulated open channel concrete spillway
Main Spillway Crest Elevation	71.6 m
Auxiliary Spillway	Labyrinth weir free overflow concrete spillway. Low-level sluice gate and stoplogs within concrete weir. Discharges to Harewood Creek.
Auxiliary Spillway Crest Elevation	72.1 m
Foundation	Conglomerate bedrock
Erosion Protection	Upstream concrete cutoff wall facing above the normal water level.
Reservoir Storage Volume	121,640 m^3 at a water elevation of 71.80 m (i.e., 0.20 m higher than the main spillway crest) based on the 2003 survey completed by Aquacoustics.
Inflow Design Flood (IDF)	1/3 between the 1000-year flood and the PMF
IDF Peak Inflow	121 m^3/s
Peak IDF Reservoir Level	73.03 m (note: this is updated in the 2024 DSR by taking the peak inflow from the IDF study (Hatch Ltd., 2025) and interpolating within the final spillway rating curve to find the corresponding water level (Golder Associates, 2016))
Watershed Area	20.2 km^2
Low-level Outlet	N/A (the existing woodstave LLO has been abandoned). A 1067 mm diameter sluice gate is embedded in the labyrinth weir which can be used to draw the reservoir down to the sluice gate's invert elevation of 69.3 m for emergency repairs and maintenance
Dam Failure Consequence Classification	Very High

4.6.2 Instrumentation

Instrumentation consists of ultrasonic sensors to measure water levels at the crest of the spillway. The instrumentation is relayed back to the City's SCADA system where a high-water level alarm has been created. Additional instrumentation includes a 'V' notch weir located at the downstream toe of the dam to measure seepage through the toe of the dam during routine monitoring by City staff. At the time of inspection, the water flow over the 'V' notch weir at the toe of the dam was about 3 cm of clear flow.

Two flush-mount well covers are visible in the dam crest. Hatch understands that these were installed in the 2014 geotechnical investigation. As discussed in the 2024 DSR, the piezometers are likely to be dry due to their installation depth. However, the City should resume reading the piezometers to ensure that they are functional. Readings from this piezometer may be extremely valuable following a seismic event or potential damage to the concrete core wall.

4.6.3 Formal Inspection

The Lower Colliery Dam was in similar condition to that reported during the 2024 DSR. Visual inspection was performed by walking the crest of dam, abutments, and areas downstream of dam.

4.6.3.1 Main Dam

4.6.3.1.1 Upstream Face

- The concrete walls on the upstream face of the dam have experienced damage in some areas and were found to be in poor condition overall.
- The concrete face of the upstream wall adjacent to the spillway in the area where the steps are located was found to be in fair condition except at the vertical wall joints, where significant cracks were found, and the wall was noted to be tilting away from the dam towards the reservoir (**Photographs LCR 7 & LCR 8**). It is recommended that the vertical cracks have pins installed to measure the movement of the wall over time and the angle of inclination of the wall should also be documented. If the wall continues to tilt further upstream, reinforcing measures would need to be installed to prevent the wall from experiencing a failure and releasing the embankment material into the reservoir. Significant undermining of the wall at the base was noted in previous FADIs, with one void measured up to 2 m deep directly adjacent to the spillway. This area was underwater at the time of the inspection.
- In the upstream wall area to the left of the main spillway, the soil has generally settled up to 0.25 m below the top of the concrete upstream face (**Photograph LCR 7**).
- The left section of the upstream face was observed to have areas of minor spalling up to 50 mm in depth as well as some minor cracking observed in several locations. Calcite deposits were noted along the entire length of the concrete surface. It is recommended that the spalls and cracking continue to be monitored in this area although it is not considered a major dam safety concern at this time. Undermining of the wall in this area did not appear to be overly extensive, though much of the wall was underwater at the time of the inspection, making it difficult to confirm.
- The upper concrete retaining wall that runs from the left abutment to the spillway on top of the main cut-off wall was found to be in fair condition with some minor erosion and spalling observed along the top portion of the concrete. No remediation work is required at this time.

- The aesthetic rock retaining wall on the left abutment was noted to have eroded and been undermined at the base of the large tree on the left abutment of the concrete wall (0.3 m tall, 0.3 m deep, and 1.2 m wide). A second eroded zone was observed approximately 3 m to the left of this area and was 3 m long, 0.5 m high, and 0.5 m deep (**Photograph LCR 23**).
- Three depressions were noted near the upstream face during the 2020 FADI, however those depressions were determined to remain from previously removed concrete signage foundations.

4.6.3.1.2 Crest and Abutments

- The crest was observed to be in satisfactory condition at the time of inspection. The crest of the dam is composed of an asphalt surfaced pedestrian pathway and grass surfacing.
- There are several medium trees growing on the crest near the concrete core wall (towards the upstream side of the crest, near the left abutment). Growth of these trees poses a risk of damaging the core wall.
- There was no significant signs of cracks, settlements, or sinkholes on the dam crest, except for a reported borehole at the crest of the dam from a geotechnical investigation that was surface patched with asphalt. As noted in the 2019 FADI, Hatch believes that the borehole was backfilled with excessive bentonite materials which swells when it absorbs moisture. This should continue to be monitored through routine inspections, no significant movement was noted during the inspection.
- As noted in **Section 4.6.3.1.1**, undermining of the aesthetic retaining wall at the left abutment was observed.
- The upstream side of the right abutment, to the right of the auxiliary spillway, was loosely armored with riprap ranging from 0.1 to 0.3 m in size, extending for at least 10 m from the walkway towards the log boom anchor point. For notes on the downstream side of the right abutment, refer to **Section 4.6.3.2**.
- No other signs of erosion or unusual conditions were observed at the abutments of the dam.
- The City is removing the vegetation annually as part of their maintenance program.

4.6.3.2 Downstream Face and Toe

- The downstream face and toe of the dam was cleared of vegetation at the time of inspection (**Photograph LCR 18 and LCR 19**). No significant settlement, cracking, or slope instability was able to be observed.
- The right abutment of the earthfill section (left abutment of the spillway) consists of a steep, vegetated slope (**Photograph LCR 18)**. Wet spots were observed during the inspection. The formation of a head scarp at the slope crest suggests that some minor slope movement and deterioration has likely occurred due to wet slope conditions and

poor runoff control. City personnel previously indicated that wet spots diminished when the reservoir level was decreased 1 m below operating level several years ago. No visible seepage (i.e., trickling water) was noted. The installation of a weir may not suitably intercept this seepage. The source of this seepage has not been confirmed, however, could be occurring through joints in the spillway. The condition of the slope should be continuously monitored and cracks/joints along the spillway should be sealed. Consideration should be given to the removal of vegetation, regrading of the slope, and installation of a reverse filter.

- The LCR dam is considered a large dam and has a significantly high downstream slope. Currently no survey monuments (or pins) exist on the dam crest or the downstream slope. It is recommended to install a few survey pins along two cross sections for deformation monitoring purpose. The monuments should be installed at the dam crest as well as at the top of stabilizer berm.
- Water seepage from the embankment was observed at the toe of the dam (but not monitored remotely) by one 'V' notch weir located in the concrete housing at the toe of the dam as mentioned in **Section 4.6.2** (**Photograph LCR 19**). No major signs of slope distress or instability were found at the downstream slope.

4.6.3.3 Main Spillway

- At the time of the inspection, both bays of the spillway were dry and the lake level was slightly below the spillway invert. Some small debris was observed at the base of the chute. The moss on the walls of the spillway was cleared off to aide with the inspection. The City also attempted to clear off areas of the spillway slab to facilitate the inspection of the concrete slab.
- The upstream end of the spillway was observed to have been undermined, similar to the adjacent upstream concrete wall. The upstream end of the left spillway wall, where it connects to the extended apron area, is being tilted into the reservoir by the upstream wall and a very wide crack has opened. The central pier nose at the upstream end has heavily deteriorated, spalled with a corroded reinforcing bar exposed and also allowed grass to grow within the concrete cracks (**Photograph LCR 6**). It is recommended that this area be repaired to protect the existing rebar from any further corrosion and prevent advancement of the concrete deterioration.
- Diagonal cracking was noted on the downstream bridge pier directly below the bridge beams, similar to the cracking seen at Middle Colliery Dam (**Photograph LCR 24**). This cracking is likely due to bearing stresses from the spillway bridge. It is recommended that this crack be monitored to document any increase in length of size.
- Cracking was noted in multiple locations along the central concrete pier, particularly on the left side where a tree stump is located (the tree was cut down previously by the City) and at the location around the old stoplog slot upstream of the spillway bridge. It is recommended that these cracks be sealed to prevent any seepage through the concrete.

- The condition of the spillway bridge was fair with minor concrete staining and cracking observed. Patches of delamination were observed on the underside of the bridge, similar to the bridge at Middle Colliery Dam. Several spalls were present, exposing corroding reinforcing steel in several locations (**Photograph LCR 23**). This damage should be monitored in future FADIs, and if large portions of concrete begin spalling the bridge's load capacity should be assessed and repairs should be conducted. It was noted that the bolts on the underside of the bridge deck securing the handrail posts to the bridge were corroded. It is recommended that the City monitor the condition of the bolts and consider replacing them if further deterioration is observed.
- Several areas at the base along the left spillway wall downstream of the spillway bridge are showing signs of cavitation and erosion with some local pockets measuring depths of up to 110 mm (**Photograph LCR 9**). There was also suspicion that these pockets are providing a seepage path for water to travel from the spillway through to the right seepage channel noted on the downstream face of the dam (though this cannot be confirmed by the visual inspection as there was not significant water flow in the spillway chute). It is recommended that these pockets be filled with low-pressure grout to prevent seepage through the concrete structure.
- Cold joints were noted in many locations in the original concrete of the walls and piers (**Photograph LCR 24**). The base of all walls have varying levels of erosion and/or poor consolidation during original placement. These areas should be monitored for future progression of damage.
- Another area of erosion was noted at the base of the left spillway wall at the downstream jog in the spillway. City staff confirmed that the flow path of the water in the spillway causes a constriction at this location and it is subjected to higher energy flows compared to the surrounding concrete. It is recommended that a steel plate be installed on the face of the wall to provide increased erosion protection to the concrete in this localized area.
- Additional cracks were observed in the left and right walls at multiple locations. These cracks should be sealed to help prevent any seepage flow through the concrete. The concrete at the base of each wall has experienced minor erosion along the full length of the spillway with small pockets showing more major spalling. These majorly spalled areas should be repaired in conjunction with the repairs being made to the base of the left spillway wall at the suspected seepage path location.
- Several cracks, some of which were capped and sealed in 2022, and erosion at the concrete surface were noted along the spillway slab. The spillway slab overall looked to be in fair condition, and it was noted from the existing reference drawings that a number of cracks had been repaired previously. Some of these repaired areas were located during the inspection and the repairs appeared to still be in satisfactory condition (**Photograph LCR 11**). However, several patches on the walls and chute slab were noted to be spalled and delaminating or missing entirely.

- At the steeply plunging bedrock portion of the main spillway chute, a cavity was observed downstream of the concrete chute due to scouring of the bedrock. The cavity was observed to be filled up to 2 m deep with debris consisting of logs and assorted vegetation (**Photograph LCR 12**). The cavity should be monitored in the long-term to ensure it does not begin to undermine the surrounding slopes.
- Significant erosion is taking place on the left bank of the chute downstream of the spillway slab. This damage should be monitored for ground movement and addressed as required.
- There was a large tree on the left abutment immediately downstream of the pedestrian bridge that requires removal so that its root system does not impact the spillway chute wall (**Photograph LCR 5**). Large trees with branches overhang the top of the spillway chute were observed at the time of this visit and it is recommended to cut the overhanging branches as part of the vegetation control plan.

4.6.3.4 Auxiliary Spillway

- Water in the reservoir was below the crest of the auxiliary spillway at the time of the inspection and some debris had collected either upstream or downstream of the spillway.
- The auxiliary spillway was constructed in 2016 and as expected the exposed concrete was generally in satisfactory condition. As noted in the 2016 FADI, there were some vertical cracks present in the walls with some of these showing minor seepage. Two wet areas were identified during this inspection at the upstream corners of the spillway on the left and right sides, though no flowing water could visually be confirmed (**Photograph LCR 15**). There are no immediate concerns and the City should continue to monitor with routine inspections. The spillway concrete slab at downstream side of the walls was in satisfactory condition with two deteriorated zones noted: one delaminated patch was found by the right wall (**Photograph LCR 25**), and one spall was noted by the left wall on the chute slab (**Photograph LCR 26**).
- Some signs of water leakage were noted between the precast deck girders above the auxiliary spillway.
- The riprap downstream of the auxiliary spillway was in good condition (**Photograph LCR 20**). City personnel indicated that water flow here is minimal and never fully covers the riprap.

4.6.3.5 Reservoir

- The reservoir level was measured at 0.2 m based on the reservoir gauge located by the upstream staircase.
- There are numerous trees and vegetation surrounding the reservoir edge, but in general the reservoir was clear of debris and there were no signs of landslide scars or undercutting along its slopes.

4.6.3.6 Public Safety

- Lower Colliery Dam is located at the north end of Colliery Dam Park. This park has a very high public presence with hundreds of daily users. Recreational activities include swimming, walking/running, dog walking, picnicking, beach users, and fishing. The lake is stocked with fish and recreational fishing is encouraged.
- During the summer of 2016, a security guard was stationed at the new auxiliary spillway to prevent the public from jumping off the concrete walls into the water immediately upstream of the spillway. This was required as the guardrail and signage “DANGER – NO TRESPASSING, Stay Back From Dam, Do Not Climb Fence” was not an effective deterrent for park users.
- There was also extensive graffiti on the walls of the auxiliary spillway demonstrating the high public presence at the site (**Photograph LCR 14**). The City has removed the vegetation on both side of the bridge crossing the auxiliary spillway to facilitate inspections and to discourage trespassers with the improved visibility of the area.
- Fencing was recently erected along the right chute wall of the main spillway.
- The safety boom was observed to be in good condition with no significant issues observed. At the time of the inspection, no debris was present in front of the log boom. The log boom arrangement has been brought back to its original construction, i.e. the left boom anchor was relocated to the left upstream wall of the main spillway such that it provides protection for both the main and auxiliary spillways. However, due to public pressure two gaps were left in it, which allows debris to pass the boom and enter the spillways (**Photograph LCR 2**).
- Dam Safety signage was observed on both abutments.
- Similar to Middle Colliery Dam, it is understood that the public may be resistant to additional public safety control measures such as signage and fencing and therefore this should be considered in the design to minimize the impact to park users while mitigating the identified hazards.

4.6.4 Recommendations

The following surveillance/rehabilitation work is recommended for Lower Colliery Dam as shown in **Table 4-13**. Some of these items are carried over from previous FADIs.

Table 4-13: Lower Colliery Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
LCR 1.01	Address identified public safety issues (i.e., fall hazards along dam and chute walls). Consider developing a public safety management plan for this structure in accordance with the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. Given the site observations, this dam is likely the most critical candidate for this type of assessment. However, many control measures for an effective public safety management plan are already in place, meaning that the task of developing a plan is not likely to be very onerous. Despite the existing control measure, though, public presence and interaction is high, there are several identifiable unmitigated public safety hazards, and there is a high degree of public concern that will complicate any further public safety controls put in place. For these reasons, having a formal public safety assessment completed would allow the City to understand their risk and liability as well as identify the key low impact/publicly palatable control measures to effectively mitigate this risk. Given the amount of public interaction at this site and difficulty in addressing these issues, this may be a very good candidate to pilot the public safety risk assessment process at some point in the future.	2017/2018 FADI
LCR 1.02	Remove large tree along left side of spillway chute.	2016 FADI
LCR 1.03	Install survey monuments (pins) on two cross sections, one on the dam crest and one on the downstream slope, on the stabilizer berm.	2018 FADI
LCR 1.04	Install pins to aid in measuring changing displacement over time. Monitor tilt of upstream concrete facing wall and potential undermining of earth shell underneath.	2020 FADI
LCR 1.05	Clear vegetation and monitor wet area at downstream toe. Continually monitor for changes in the seepage pattern. 2022 Revision: Seepage response (from sealing cracks) along the downstream right abutment slope should be monitored for a maximum of one year. Vegetation should be removed after the monitoring period. The slope should be immediately flattened to a minimum of 2H:1V and overlain by a reverse filter and rockfill.	2020 FADI (Modified 2022)
LCR 1.06	Repair cavitation and erosion in concrete at the base of spillway chute walls. A steel plate should be installed at the left wall where the horizontal jog in the spillway constricts the flow. The remaining areas can be filled with low pressure-grout or concrete.	2020/2021 FADI
LCR 1.07	Seal cracks in the spillway walls using Xypex waterproofing concrete or approved equivalent to prevent seepage through the concrete.	2021 FADI
LCR 1.08	Repair the spillway pier nose concrete to protect the exposed reinforcing from corrosion.	2021 FADI
LCR 1.09	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	2021 FADI
LCR 1.10	Monitor the bridge for progression of delamination, spalling, and reinforcement corrosion. If deterioration is noted to be progressing, a detailed assessment should	2025 FADI

Item	Description	Reference
	be conducted upon the bridge and the bridge should be repaired/replaced to enable continued long-term use.	

4.7 Witchcraft Lake Dam (WCL)

4.7.1 Dam Description

Witchcraft Lake Dam is a timber crib structure built in the 1930s to supply water to Westwood Lake reservoir for the purposes of generating electricity. The power generating facility closed in the 1950s and the reservoir is now part of a popular walking trail. A floating bridge was constructed across the reservoir upstream of the dam as part of the walking trail. However, the bridge was removed in the fall of 2019. The dam can now be accessed from a walking trail further upstream. An overview of the area is shown on **Figure B18** in **Appendix B**.

The reservoir is fed from a diversion channel on McGarrigle Creek which flows from the northwest. The majority of the diversion channel has eroded for a depth of 3 m to 6 m into the slope. As a result of deposition, the reservoir has been filled up with the eroded material for 40 m to 50 m upstream of the dam.

A partial breach of the dam occurred near the right abutment in 1958, causing the top 2 m of the crib to be displaced. The remaining crib is around 1.8 m high from the base at downstream side. The dam is in a state of disrepair and could breach at any time as a result of the rotting and unstable condition of the logs. The logs in the unbreeched section of the dam are in an advanced state of deterioration. Water currently flows around and through the dam and is largely controlled by the channel more so than by the dam. The original reservoir outflow was through an excavated ditch connected to McNeil Creek, which flows into Westwood Lake. Witchcraft Lake Dam data is provided in **Table 4-14**.

In November and December 2025, the City removed logs and silt plugs from the breach channel as formally recommended in the Hatch memo issued in December 2025. This work has resulted in lower reservoir levels that likely haven’t been seen since the breach occurred and sediment started to collect in front of the outlet channel.

The Hatch memo also recommended that the dam be decommissioned and that a decommissioning plan be prepared. The dam should continue to be considered “Significant” consequence due to presence of structures downstream [21].

Table 4-14: Data for Witchcraft Lake Dam

Structure	Details
Type of Dam	Timber Crib Dam
Maximum Height	1.8 m
Crest Length	7.4 m
Storage Volume	31,200 m^3
Spillway	No spillway
Low Level Outlet	No low-level outlet
Dam Failure Consequence Classification	Significant

4.7.2 Instrumentation

There is no instrumentation at Witchcraft Lake Dam. The reservoir level gauge is located on the lake upstream of the dam and was measured to be approximately 8 cm below the zero of the level gauge during the inspection.

4.7.3 Formal Inspection

The Witchcraft Dam was observed to be in a similar deteriorated state to previous years. At the time of inspection, the wood debris around the dam made observations of the timber cribbing difficult. The dam was visually inspected from the left and right abutments and downstream side and was in unsatisfactory condition. The following observations were made during the inspection:

4.7.3.1 Main Dam

- The dam was observed to be in an advanced state of deterioration. The vertical piece of rebar used to hold the timber cribbing together was visible due to the heavy rotting and deterioration of the timber. Logs and wood debris had also collected upstream of the dam, vegetation was present on both abutments, and the area is extremely overgrown (**Photographs WCL 1, WCL 2, WCL 3,** and **WCL 4**). Where visible, the pins between the logs are extremely corroded. Approximately 3.5 logs remain above the downstream water level (approx. 1.07 m or 3’-6”).
- The downstream face of the dam was characterized by slumping and deteriorating horizontally-oriented logs.
- The crib fill material has largely been washed away. No remaining fill material inside the cribs is visible.
- A small trickle of water was passing over the remaining logs during the time of inspection.
- Wet areas were observed at the dam toe and throughout the dam area, and the dam was covered in dozens of logs, rocks, and fallen trees.

- Given the presence of two additional beams upstream of the timber face, both well embedded, parallel to the beam at the top of the face and the presence of nails in one of these, it is possible that the timber cribbing and any related rockfill extends back approximately 3 m from the dam face. This should be considered in any future planning for dam decommissioning or removal.
- Previous FADIs mentioned remnants of a short dyke on the left abutment of the dam with a maximum height of approximately 1.5 m. As the dyke was significantly eroded and difficult to locate, it was not observed during this visit. Additionally, significant undermining and erosion was observed beneath a tree leaning into the channel downstream at the left abutment.
- The inlet channel, a tributary of McGarrigle Creek, was inspected near the dam and signs of significant erosion of channel walls during high flows were noted on the left side of the creek bed.
- As noted in previous inspections, the dam is currently not serving to impound water as the control has shifted to the upstream channel and inlet area. The dam as it stands is largely missing and in an advanced state of decay. Currently the dam is not impounding water or impeding flow out of Witchcraft Lake and is unlikely to significantly impede flow during a large flood event. The hydraulic control is provided by the channel and the lake itself is largely in a natural condition.
- A 40 m to 50 m long reach of sediment deposits have potentially been built up behind the remaining portion of the dam. These currently separate the body of the lake from the dam and limit flows over/through the dam to small amounts. However, in the absence of the dam, these could potentially erode and release, either in a large flood event or due to a structural failure of the dam. *Note: The City removed the trees and sediment in November/December 2025.*

4.7.3.2 Reservoir

- The reservoir level staff gauge was measured at approximately 8 cm below the zero (-8 cm) of the level gauge during the site visit.
- There are numerous trees and heavy vegetation observed surrounding the reservoir edge in addition to some wood debris in the reservoir, but in general there were no signs of landslide scars or undercutting along the reservoir slopes.

4.7.3.3 Public Safety

- Witchcraft Lake Dam is accessible to the public; however, since the installation of a new trail access in the fall of 2019, there is less public presence and not any safety concern for this dam.

4.7.4 Recommendations

The following surveillance/rehabilitation work, as summarized in **Table 4-15**, is recommended for Witchcraft Lake Dam. Some of these items are carried over from previous FADIs.

Table 4-15: Witchcraft Lake Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
WCL 1.01	Witchcraft Lake Dam's definition as a dam is questionable at best. Currently the dam is not impounding water or impeding flow out of Witchcraft Lake as it was designed to do and is unlikely to significantly impede flow during a large flood event. The hydraulic control is provided by the channel and the lake itself is largely in a natural condition. For this reason and the fact that the dam and reservoir have not been required for power generating facility since the 1950s, it is recommended that the City apply to the BC Provincial Dam Safety Officer to rescind the water license, as the dam has essentially been 'decommissioned by nature'. 2022 Revision: Provide documentation to the BC Provincial Dam Safety Officer to get the dam removed from the dam registry. Hatch will provide a memo/documentation that should assist with this process. 2025 Revision: Hatch issued a memo in December 2025 recommending that the dam be decommissioned and that a decommissioning plan be prepared. The dam should continue to be considered "Significant" consequence due to presence of structures downstream.	2017/2018 FADI (Modified 2022, 2025)

4.8 McGregor Creek Dam (MGC) (Linley Valley Dam)

4.8.1 Dam Description

McGregor Creek Dam is an earth dam constructed by Lamont Land Inc. in 2011 to comply with the City of Nanaimo Development Permit requirements for the Linley Valley Subdivision. Ownership was transferred to the City of Nanaimo in January 2020. The water license was transferred by Lamont Land Inc. to the City of Nanaimo in June 2022. The dam is located at the end of a wetland pond. These wetlands and the associated habitat have been in place for many years.

The dam is approximately 3 m high, constructed of silty sand and gravel fill, with a crest width of 4 m and 2H:1V side slopes. The upstream slope is armored with riprap. The dam has a 3 m wide, uncontrolled lowered rockfill spillway that creates an outlet channel. A footbridge spans across of outlet channel for pedestrian traffic. A log boom and 250 mm diameter beaver control drain are used to prevent beavers from creating dams at the spillway location.

An overview of the dam details are shown on **Figure B19** in **Appendix B**.

McGregor Creek Dam data is provided in **Table 4-16**.

Table 4-16: Data for McGregor Creek Dam

Structure	Details
Type of Dam	Impervious Earthfill Dam
Maximum Height	3 m
Crest Length	100 m
Crest Width	4 m
Catchment Area	57 Hectares
Storage Volume	25,950 $m^{3.}$
Spillway	Unregulated rockfill outlet channel. Low flow “Beaver Bypass” 250 mm diameter pipe with shut off valve.
Outlet Channel Flow Capacity	1.64 m^3/sec
Dam Failure Consequence Classification	Significant

4.8.2 Instrumentation

There is no instrumentation at McGregor Creek Dam. A staff gauge is installed at the centre of the log boom (**Photograph MGC 2**), but it is in poor condition and is not currently read by the City. It is recommended that the City install a functional staff gauge and commence taking regular readings.

4.8.3 Formal Inspection

4.8.3.1 Main Dam

McGregor Creek Dam was visually inspected from the crest of the dam and was found to be in satisfactory condition. The water level was below the spillway invert and there was no water flowing through the spillway at the time on inspection. Vegetation growth was observed in the spillway channel at the time of inspection, and it is recommended to regularly clear of vegetation **(Photograph MGC 8)**. There was no significant debris observed in the reservoir at upstream side of the dam.

4.8.3.2 Upstream Face

The upstream slope of the dam was in satisfactory condition at the time of the inspection. The upstream face was overlain by an erosion protection layer of angular cobbles up to approximately 100 mm in diameter. Vegetation growth has occurred within the void space which obscures the protection layer.

There was no sign of slope instability, cracking, sinkholes, or settlement along the upstream slope of the dam during the inspection. Some minor slumping and displacement of riprap pieces were observed.

Significant vegetation was observed up to 2 m high (**Photograph MGC 4**). It is recommended that the vegetation clearing program be performed twice-yearly instead of the current annual program. Vegetation should be removed and any voids from roots filled to the toe of the dam.

4.8.3.3 *Crest and Abutments*

The crest of the dam is a gravelled surface and was in satisfactory condition at the time of inspection (**Photograph MGC 1**). There were no signs of cracks, settlement, or sinkholes on the majority of the dam crest. Minor erosion of the upstream crest line, likely due to precipitation runoff and minor slumping of riprap, was observed. This should be monitored and regraded with gravel and riprap when required (**Photograph MGC 4**).

No seepage was observed at the abutments. All vegetation should be cleared to the toe and abutment.

Some erosion on the crest, upstream and downstream slopes and organic/silty material deposition were noted to the left of the spillway channel (**Photograph MGC 9**). This was likely related to recent vegetation clearing works. Care should be taken during future vegetation clearing to remove only vegetation. Dumping of material on the slopes should be avoided.

4.8.3.4 *Downstream Face and Toe*

The downstream slope of the dam was in satisfactory condition at the time of the inspection and was covered with grass across most of its length. Grasses and trees have begun to encroach on the downstream toe. No wet spots were found on the downstream slope of the dam. No signs of slope distress or instability was found along the downstream slope. Vegetation was well cleared from the downstream toe at the time of the inspection. It is recommended to continue vegetation clearing approximately 2 m from the toe of the dam. It is understood that the public may be resistant to further vegetation clearing but it should be cleared at least to the toe of the dam.

4.8.3.5 *Spillway*

The spillway was inspected from a public walking trail bridge which spans over the spillway channel. The spillway floor and abutments are lined with riprap of approximately 500 mm diameter. Significant vegetation growth was observed within the spillway channel which prevented complete inspection of the spillway. Based on the original design drawings, the spillway floor is anticipated to be lined with a 400 mm thick layer of 10 kg riprap underlain by a non-woven geotextile.

It is recommended to remove and control vegetation within the spillway; however, significant vegetation growth is likely to re-establish annually. The frequency of vegetation control works should be increased such that significant vegetation growth does not establish. City staff noted that as of 2023, the dam is owned by Parks Services. No vegetation clearing services in the spillway or on the dam since has been performed since its acquisition and a regular vegetation management schedule should be established.

The capacity of the spillway and effects of vegetation growth should be assessed by a hydrotechnical engineer. Some level of vegetation growth may be acceptable if it is properly maintained and spillway capacity remains sufficient. Alternatives to riprap or vegetated spillways (e.g., concrete spillways) may be considered if vegetation growth is considered

adverse to spillway operation. City staff noted that they are potentially considering concreting or shotcreting the spillway area to improve its capacity and reduce vegetation growth.

4.8.3.6 Reservoir

The lake level is controlled by an unregulated spillway channel and a 250 mm diameter "Beaver Bypass" pipe. The spillway was viewed from a public walking trail bridge that spans over the spillway channel. The downstream channel was too overgrown to inspect, but riprap protection was visible approximately 5 m downstream of the pedestrian bridge, protecting the channel from flow erosion (**Photograph MGC 6**). The riprap was observed to range in size up to approximately 0.5 m diameter. It is recommended to remove vegetation from the spillway channel.

Beaver activity has historically and recently, as mentioned by the City Staff, been reported in this area but was not observed during the inspection. Minimal debris was observed on the lake during the site visit.

4.8.3.7 Log Boom

There is a log boom installed immediately upstream of the spillway channel consisting of timber logs that are chained together (**Photograph MGC 7**). The boom was in good condition with minimal deterioration and the logs are sitting well above the waterline. Surficial corrosion was observed on the chains and anchors. No debris was observed upstream of the boom at the time inspection.

4.8.3.8 Public Safety

McGregor Creek Dam is accessible to the public via trail through the development and along the dam crest. However, due to the low height of the dam, there were no obvious hazards identified during the site visit. It should be noted that the pedestrian bridge (**Photograph MGC 8**) sits on large (>1 m diameter) rocks that are formed into a wall approximately 2 m high. The spillway channel was covered with heavy vegetation growth at the time of the inspection that made it difficult to inspect the condition of the rock at the base of the bridge abutments. It is recommended to keep this area clear of vegetation for regular visual inspection.

No dam safety signage was observed at McGregor Creek Dam. Dam Safety signage in accordance with the BC Regulation should be installed on both abutments.

4.8.4 Recommendations

The following surveillance/rehabilitation work, as summarized in **Table 4-17**, is recommended for McGregor Creek Dam.

Table 4-17: McGregor Creek Dam – Surveillance/Rehabilitation Recommendations

Item	Description	Reference
MGC 1.01	Remove vegetation on upstream and downstream dam faces, spillway channel, and within 2 m of toe and abutments.	2019 FADI
MGC 1.02	Repair/replace staff gauge and commence taking regular readings during inspections.	2020 FADI
MGC 1.03	Clear vegetation from abutments of pedestrian bridge to aid in visual inspections. 2022 Revision: Perform vegetation clearing twice per year.	2020 FADI (Modified 2022)
MGC 1.04	Perform a hydrotechnical assessment of the spillway to assess the impacts of vegetation growth on spillway capacity. Increase the frequency of spillway vegetation control.	2022 FADI
MGC 1.05	Install dam safety signage on each side of the crest.	2025 FADI
Recommendations to close		
	OMS manual updated in December 2023 to reflect and clarify change in dam ownership.	2019 FADI

5. Summary

There are two types of recommendations summarized below:

1. Outstanding surveillance and rehabilitation recommendations were summarized from previous FADI and new recommendations were made. See **Table 5-1**.
2. Outstanding dam safety recommendations originating from previous DSRs that were in the City's Dam Safety Issues tracking spreadsheet were summarized. See **Table 5-2**.

Note that items in these tables are summarized and additional detail is provided in earlier sections. Additionally, Hatch has attempted to summarize all previous outstanding recommendations; however, it is the City's responsibility to ensure that all previous recommendations have been prioritized and addressed to their satisfaction.

Hatch understands that the City has limited resources. Therefore, it is extremely important to prioritize the various recommendations so the City can create a plan for addressing/resolving these deficiencies. Priority ratings have been added for each item where:

A = high priority (complete within 2 years);

B = medium priority (complete within 5 years); and

C = low priority (complete within 10 years/reassess with changing conditions).

Table 5-1: Summary of Surveillance and Rehabilitation Recommendations

Item	Description	Reference	Priority
GENERAL 1.01	Convert elevations to flow on seepage plots.		A
GENERAL 1.02	The inspection database is a Microsoft Access database which provides an interface for inspectors to input observations. However, there is currently limited capability to export and report data out of the database. Hatch recommends that the database be updated to add functions to report chronological past data such as inspection report observations in tabular form. The most recent Mobile Dam Database checklists have not been completed at the required frequency (weekly) due to either not filling them out or potentially uploading issues. This should be resolved.		A
WWL 1.01	Replace missing hardware at 'V' notch weir.	2020 FADI	B
WWL 1.02	Repair erosional damage at the left bridge abutment at inlet channel. Extend the length of dam sacks downstream and backfill the erosional scarp behind the dam sacks.	2021 FADI	B
WWL 1.03	Vegetation control measures should include clearing any trees and other vegetation a minimum of 3 m beyond the abutment and dam toe.	2023 FADI	B
WWL 1.04	Repair the riprap along the outlet channel step to protect the dam sacks from further undermining.	2023 FADI	A
WWL 1.05	Install dam safety signage on each side of the crest	2025 FADI	B
HAW 1.01	Address identified public safety issues (i.e., missing handrail and fall hazards around dam). The City should also consider moving towards a more Formal Public Safety around Dams program based on the recommendations in the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. This would involve performing a public safety risk assessment and developing a formal public safety management plan for each site that is open to the public. This would help the city to understand public safety risks in a systematic priority-based process that will allow an overall reduction of liability and is defensible to the public. Observations at the site indicate that the public presence is relatively light and overall hazards are relatively low; therefore, this process does not have to be an immediate priority and should be considered as part of future initiatives.	2017/2018 FADI	B

Item	Description	Reference	Priority
HAW 1.02	Scour protection should be placed at the exit side of the spillway chute. It is recommended that a 300 mm diameter rock (riprap) blanket that is 3 m wide by 8 m long by 0.6 m high be placed downstream of the spillway chute, underlain by a minimum 400 gr/m^2 non-woven geotextile. 2022 Revision: Place 300 mm median diameter riprap blanket with underlying filter which extends 0.5 m beyond the spillway wingwalls and is minimum 10 m long.	2015 FADI/ 2018 FADI (Modified 2022)	A
HAW 1.03	Perform detailed concrete condition assessment of dam and spillway structures and subsequent repairs. 2021 Revision: This condition assessment should also provide recommendations on what repairs would need to be made to maintain long term operability of the dam given the reduced maximum operating level compared to original design.	2015 FADI	A
HAW 1.04	Repair the stacked rock wall and remove moss.	2018 FADI	B
HAW 1.05	Seal cracks along the bottom portions of spillway wall and slab to prevent seepage.	2019/2021 FADI (Updated 2023)	B
HAW 1.06	Clear vegetation and debris from channel downstream of rock wall.	2020 FADI	A
HAW 1.07	Install dam safety signage on each side of the crest.	2025 FADI	B
UCR 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan.	2017/2018 FADI	B
UCR 1.02	Perform detailed concrete condition assessment of dam and spillway structures and provide subsequent repair details.	2015 FADI	A
UCR 1.03	Install pins on either side of major buttress wall crack to monitor crack width. Clear the vegetation at the base of the vertical crack along the buttress wall.	2017/2021 FADI	A
UCR 1.04	Reinstate eroded material under the downstream end of the culverts and protect eroding slope at culvert outlet with geotextile and riprap after vegetation removal and regrading.	2020/2021 FADI	B
UCR 1.05	Regrade slopes around the spillway wingwalls and provide coir-mesh and hydroseed to establish protective vegetation. Construct drainage swales along the crest of the wingwalls to collect and discharge runoff. Fill the void beneath the spillway headwall on the right abutment.	2022 FADI	A
UCR 1.06	It is recommended that the ground surface behind the right dam wall be leveled to avoid water accumulation at the	2023 FADI	A

Item	Description	Reference	Priority
	location of the observed depression to facilitate surface runoff away from the wall.		
UCR 1.07	Backfill the area of camera pole foundation to prevent further undermining and slope erosion.	2023 FADI	A
UCR 1.08	Install dam safety signage on each side of the crest.	2025 FADI	B
MCR 1.01	Address identified public safety issues (i.e., fall hazards along chute walls, consider adding some signage). Consider developing a public safety management plan for this structure in accordance with the 2011 Canadian Dam Association Guidelines for Public Safety Around Dams. Given the site observations, this dam and Lower Colliery Dam are likely the most critical candidates for this type of assessment. Public presence and interaction is high, there are several identifiable unmitigated public safety hazards, and there is a high degree of public concern that will complicate any further public safety controls put in place. For these reasons, having a formal public safety assessment completed would allow the City to understand their risk as well as identify the key low impact/publicly palatable control measures to effectively mitigate this risk.	2017/2018 FADI	B
MCR 1.02	Repair/replace the spillway bridge to enable continued long-term use. Any capital work should be deferred (if possible) until the spillway upgrade study is complete and a concept is selected.	2021 FADI (Updated in 2023 and 2025)	C
MCR 1.03	Repair the automatic data acquisition system and monitor weir measurements in response to reservoir elevation and precipitation events. Consider grouting of the bedrock if weir flows do not correlate with reservoir elevations.	2018 FADI (Modified 2022)	A
MCR 1.04	All undermining and cavitation at interface of concrete bedrock/soil should be repaired by grout/concrete fill. Cracks or deterioration in concrete should also be repaired.	2020 FADI	A
MCR 1.05	Seal the smaller concrete cracks in the spillway walls using Xypex concrete waterproofing or other equivalent materials depending on the severity of damage.	2021 FADI	B
MCR 1.06	Install pins at major cracks on the upstream dam face to monitor movement of the cracks over time. Continue to monitor the upstream face of concrete as part of annual inspections and consider repaired if deterioration advances significantly.	2021 FADI	A
MCR 1.07	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	2021 FADI	C

Item	Description	Reference	Priority
MCR 1.08	Install Dam Safety signage on left abutment in a visible location when approaching the dam.	2025 FADI	B
LCR 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan. Given the amount of public interaction at this site and difficulty in addressing these issues, this may be a good candidate to pilot the public safety risk assessment process.	2017/2018 FADI	B
LCR 1.02	Remove large tree along left side of spillway chute.	2016 FADI	A
LCR 1.03	Install survey monuments (pins) on two cross sections, one on the dam crest and one on the downstream slope, on the stabilizer berm.	2018 FADI	A
LCR 1.04	Install survey pins to monitor deflection of right abutment upstream wall.	2020 FADI	A
LCR 1.05	Clear vegetation and inspect depression/wet area at downstream toe. Continually monitor for changes. 2022 Revision: Seepage response (from sealing cracks) along the downstream right abutment slope should be monitored for a maximum of one year. Vegetation should be removed after the monitoring period. The slope should be immediately flattened to a minimum of 2H:1V and overlain by a reverse filter and rockfill.	2020 FADI (Modified 2022)	A
LCR 1.06	Repair cavitation and erosion in concrete at the base of spillway chute walls.	2020/2021 FADI	B
LCR 1.07	Seal cracks in the spillway walls using Xypex waterproofing concrete or approved equivalent to prevent seepage through the concrete.	2021 FADI	B
LCR 1.08	Repair the spillway pier nose concrete to protect the exposed reinforcing from corrosion.	2021 FADI	A
LCR 1.09	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	2021 FADI	C
LCR 1.10	Monitor the bridge for progression of delamination, spalling, and reinforcement corrosion. If deterioration is noted to be progressing, a detailed assessment should be conducted upon the bridge and the bridge should be repaired/replaced to enable continued long-term use.	2025 FADI	C

Item	Description	Reference	Priority
WCL 1.01	Witchcraft Lake Dam's definition as a dam is questionable at best. Currently the dam is not impounding water or impeding flow out of Witchcraft Lake as it was designed to do and is unlikely to significantly impede flow during a large flood event. The hydraulic control is provided by the channel and the lake itself is largely in a natural condition. For this reason and the fact that the dam and reservoir have not been required for power generating facility since the 1950s, it is recommended that the City apply to the BC Provincial Dam Safety Officer to rescind the water license, as the dam has essentially been 'decommissioned by nature'. 2022 Revision: Provide documentation to the BC Provincial Dam Safety Officer to get the dam removed from the dam registry. Hatch will provide a memo/documentation that should assist with this process. 2025 Revision: Hatch issued a memo in December 2025 recommending that the dam be decommissioned and that a decommissioning plan be prepared. The dam should continue to be considered "Significant" consequence due to presence of structures downstream.	2017/2018 FADI (Modified 2022)	A
MGC 1.01	Remove vegetation on upstream and downstream dam faces, spillway channel, and within 2 m of toe and abutments.	2019 FADI	A
MGC 1.02	Repair/replace staff gauge and commence taking regular readings during inspections.	2020 FADI	A
MGC 1.03	Clear vegetation from abutments of pedestrian bridge to aid in visual inspections. 2022 Revision: Perform vegetation clearing twice per year.	2020 FADI (Modified 2022)	A
MGC 1.04	Perform a hydrotechnical assessment of the spillway to assess the impacts of vegetation growth on spillway capacity. Increase the frequency of spillway vegetation control.	2022 FADI	A
MGC 1.05	Install dam safety signage on each side of the crest.	2025 FADI	B

Table 5-2: Outstanding Dam Safety Issues

Item	Description	Reference	Priority
WWL 2.01	Review hydraulics and hydrology to determine if outlet channel width needs to be increased to accommodate debris in channel to satisfy fish habitat requirements. 2025 Update: Fish Habitat requirements typically don't constitute a dam safety issue. Consider removing as dam safety issue.	2013 DSR	A
WWL 2.02	Update inundation mapping.	2013 DSR	A
R01 2.01	Test post-tensioned anchors. *Note: On hold.	2013 DSR	On Hold
R01 2.02	Perform stability analysis/seismic review (including special inspection of the upstream face by emptying the reservoir). This should include stability against PMF flooding from Upper Colliery reservoir into Old Reservoir No. 1. *Note: Permanently dewatered. Recommendation put on hold.	2013 DSR	On Hold
R01 2.03	Perform hydrology/hydraulic study (inundation study) including consequence category. *Note: Permanently dewatered. Recommendation put on hold.	2013 DSR	On Hold
R01 2.04	Produce a plan to determine the long-term future of the dam.	BC DS Regulator Recommendation (2020)	A
HAW 2.01	Hydrology/hydraulic study to determine to determine capacity of spillway.	2013 DSR	B
HAW 2.02	Update inundation mapping and review dam classification.	2013 DSR/ 2017 FADI	A
UCR 2.01	Check for potential of a cascade failure of the downstream structures caused by a failure of Upper Colliery Dam.	2019 FADI	A
MCR 2.01	Review and compare crest elevation for as-built drawings vs. survey information of the dam crest. 2022 Revision: Include a new survey in the scope of work for the next DSR which is planned for 2024.	2009 FADI	B
MCR 2.02	Check for potential of a cascade failure of the downstream structures caused by a failure of Middle Colliery Dam. 2025 Update: This was completed as part of the Middle Colliery Dam IDF Study. Close item.	2021 FADI	A
MCR 2.03	Implement capital plan to increase the capacity of the spillway to allow for passage of an IDF event.	2022 FADI	A

Item	Description	Reference	Priority
LCR 2.01	Perform dam stability analysis of earth fill dam. The upper portion of downstream slope is particularly steep. 2022 Revision: Include this in the scope of work for the next DSR which is planned for 2024. 2025 Update: This work was completed in 2014 and can be closed.	2003 DSR	A
LCR 2.02	Perform stability analysis of spillway walls including seismic loading. 2022 Revision: Include this in the scope of work for the next DSR which is planned for 2024.	2003 DSR	A

6. Cost Estimate

The cost estimate is an ASCE Class 5 (-50% to +100%) cost estimate that provides for engineering services and for maintenance/rehabilitation works where the scope of work is defined sufficiently to provide an estimate. Where an engineering study is required, the subsequent rehabilitation has not been estimated as this will be dependent on the findings the engineering report and detailed design.

Table 6-1: Cost Estimate – Outstanding Surveillance and Rehabilitation Issues

Item	Description	Estimated Cost	Notes
GENERAL 1.01	Convert elevations to flow on seepage plots.	N/A	By City staff
GENERAL 1.02	The most recent Mobile Dam Database checklists have not been completed at the required frequency (weekly to monthly) due to either not filling them out or potentially uploading issues. This should be resolved.	N/A	By City staff
WWL 1.01	Replace missing hardware at ‘V’ notch weir.	$ 200	Labour by City staff
WWL 1.02	Repair erosion at the inlet channel left bridge abutment.	$ 5,000	Labour by City staff
WWL 1.03	Vegetation control measures should include clearing any trees and other vegetation a minimum of 3 m beyond the abutment and dam toe.	$ 7,000	Labour by City staff
WWL 1.04	Repair the riprap along the outlet channel step to protect the dam sacks from further undermining.	$ 5,000	Labour by City staff
WWL 1.05	Install dam safety signage on each side of the crest.	$ 500	Labour by City staff
HAW 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan.	$ 15,000	Site visit combined with other dams PSMPs.

Item	Description	Estimated Cost	Notes
HAW 1.02	Place scour protection at the exit side of the spillway chute. 2022 Revision: Place 300 mm median diameter riprap blanket which extends 0.5 m beyond the spillway wingwalls and is minimum 10 m long.	$ 10,000	
HAW 1.03	Perform detailed concrete condition assessment of dam and spillway structures and subsequent repairs. 2021 Revision: This condition assessment should also provide recommendations on what repairs would need to be made to maintain long term operability of the dam given the reduced maximum operating level compared to original design.	$ 40,000	From City estimate with added cost for repair details.
HAW 1.04	Repair the stacked rock wall and remove moss.	N/A	By City staff
HAW 1.05	Seal other cracks along the bottom portions of spillway wall and slab to prevent seepage.	$ 200	Labour by City staff
HAW 1.06	Clear vegetation and debris from channel downstream of rock wall.	N/A	By City staff
HAW 1.07	Install dam safety signage on each side of the crest.	$ 500	Labour by City staff
UCR 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan.	$ 15,000	Site visit combined with other dams PSMPs.
UCR 1.02	Perform detailed concrete condition assessment of dam and spillway structures and provide subsequent repair details.	$ 30,000	From City estimate
UCR 1.03	Install pins on either side of major buttress wall crack to monitor crack width. Clear the vegetation at the base of the vertical crack along the buttress wall.	N/A	By City staff
UCR 1.04	Reinstate eroded material under the downstream end of the culverts and protect eroding slope at culvert outlet with geotextile and riprap after vegetation removal and regrading.	$ 10,000	
UCR 1.05	Regrade slopes around the spillway wingwalls and provide coir-mesh and hydroseed to establish protective vegetation. Construct drainage swales along the crest of the wingwalls to collect and discharge runoff. Fill the void beneath the spillway headwall on the right abutment.	$ 25,000	
UCR 1.06	It is recommended that the ground surface behind the right dam wall be leveled to avoid water accumulation at the location of the observed depression to facilitate surface runoff away from the wall.	N/A	By City staff

Item	Description	Estimated Cost	Notes
UCR 1.07	Backfill the area of camera pole foundation to prevent further undermining and slope erosion.	N/A	By City staff
UCR 1.08	Install dam safety signage on each side of the crest	$ 500	Labour by City staff
MCR 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan.	$ 20,000	Site visit combined with other dams PSMPs.
MCR 1.02	Repair/replace the spillway bridge to enable continued long-term use.	$234,500	Repair cost was estimated by Herold Engineering [20].
MCR 1.03	Repair the automatic data acquisition system and monitor weir measurements in response to reservoir elevation and precipitation events. Consider grouting of the bedrock if weir flows do not correlate with reservoir elevations.	$ 2,000	Allowance
MCR 1.04	All undermining and cavitation at interface of concrete bedrock/soil should be repaired by grout/concrete fill. Cracks or deterioration in concrete should also be repaired.	$ 2,000	Labour by City staff
MCR 1.05	Seal the smaller concrete cracks in the spillway walls using Xypex concrete waterproofing or other equivalent materials depending on the severity of damage.	$ 1,000	Labour by City staff
MCR 1.06	Install pins at major cracks on the upstream dam face to monitor movement of the cracks over time. Continue to monitor the upstream face of concrete as part of annual inspections and consider repaired if deterioration advances significantly.	$ 500	Labour by City staff
MCR 1.07	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	$ 40,000	Allowance for major repairs to upstream face and minor repairs to the chute walls and bridge pier.
MCR 1.08	Install Dam Safety signage on left abutment in a visible location when approaching the dam.	$ 500	Labour by City staff
LCR 1.01	Address identified public safety hazards. Consider moving towards a more Formal Public Safety around Dams program and creating a formal Public Safety Management Plan. Given the amount of public interaction at this site and difficulty in addressing these issues, this may be a good candidate to pilot the public safety risk assessment process.	$ 25,000	Site visit combined with other dams PSMPs.
LCR 1.02	Remove large tree along left side of spillway chute.	$ 5,000	

Item	Description	Estimated Cost	Notes
LCR 1.03	Install survey monuments (pins) on two cross sections, one on the dam crest and one on the downstream slope, on the stabilizer berm.	$ 1,000	
LCR 1.04	Install survey pins to monitor deflection of right abutment upstream wall.	N/A	By City staff
LCR 1.05	Clear vegetation and inspect depression/wet area at downstream toe. Continually monitor for changes. 2022 Revision: Joints and cracks in the original spillway should be sealed and the seepage response along the downstream right abutment slope should be monitored for a maximum of one year. Vegetation should be removed after the monitoring period. The slope should be immediately flattened to a minimum of 2H:1V and overlain by a reverse filter and rockfill.	$ 30,000	Allowance for design and construction.
LCR 1.06	Repair cavitation and erosion in concrete at the base of spillway chute walls.	$ 3,000	Labour by City staff
LCR 1.07	Seal cracks in the spillway walls using Xypex waterproofing concrete or approved equivalent to prevent seepage through the concrete.	$ 1,000	Labour by City staff
LCR 1.08	Repair the spillway pier nose concrete to protect the exposed reinforcing from corrosion.	$ 5,000	
LCR 1.09	Repair the spalled concrete areas along the spillway walls and pier that have been identified in the condition assessment. Chip away loose and delaminated surfaces prior to repairing with a patching mortar.	$ 100,000	Allowance for major repairs to upstream wall that's titling and undermined and local repairs to spillway chute walls, piers and slab.
LCR 1.10	Monitor the bridge for progression of delamination, spalling, and reinforcement corrosion. If deterioration is noted to be progressing, (1) a detailed assessment should be conducted upon the bridge and (2) the bridge should be repaired/replaced to enable continued long-term use.	(1) $15,000 (2) $40,000	Repair cost is an allowance as it will be dependent on findings of condition assessment.
WCL 1.01	Given the advanced state of deterioration of the dam structure, consideration should be given to partially or fully decommissioning the structure and/or replacing it with a simple rockfill overflow structure to preserve the upstream lake level and reduce/eliminate the potential risk of failure. Given its current state, it could potentially be abandoned and struck from the registry since it is no longer acting as a water retaining structure.	$30,000 $200,000	Allowance for decommissioning plan development and dam removal. Note that costs are very rough.

Item	Description	Estimated Cost	Notes
	2022 Revision: Provide documentation to the BC Provincial Dam Safety Officer to get the dam removed from the dam registry. Hatch will provide a memo/documentation that should assist with this process. 2025 Revision: Hatch issued a memo in December 2025 recommending that the dam be decommissioned and that a decommissioning plan be prepared. The dam should continue to be considered “Significant” consequence due to presence of structures downstream.		
MGC 1.01	Remove vegetation on upstream and downstream dam faces, spillway channel, and within 2 m of toe and abutments.	N/A	By City staff
MGC 1.02	Repair/replace staff gauge and commence taking regular readings during inspections.	$ 500	By City staff
MGC 1.03	Clear vegetation from abutments of pedestrian bridge to aid in visual inspections. 2022 Revision: Perform vegetation clearing twice per year.	N/A	By City staff
MGC 1.04	Perform a hydrotechnical assessment of the spillway to assess the impacts of vegetation growth on spillway capacity. Increase the frequency of spillway vegetation control.	$ 25,000	Engineering fees
MGC 1.05	Install dam safety signage on each side of the crest	$ 500	Labour by City staff

Table 6-2: Cost Estimate – Outstanding Dam Safety Issues

Item	Description	Estimated Cost	Comments
WWL 2.01	Review hydraulics and hydrology to determine if outlet channel wide needs to be increased.	$ 20,000	Does not include survey
R01 2.01	Test post-tensioned anchors.	$ 20,000	Allowance
R01 2.02	Perform stability analysis/seismic review (including special inspection of the upstream face by emptying the reservoir). This should include stability against PMF flooding from Upper Colliery reservoir into Old Reservoir No. 1.	$ 30,000	Can be removed if Old Reservoir No. 1 is permanently dewatered and no longer classified as a dam. Dam plan required (see item N01 2.04).
R01 2.03	Check for potential of a cascade failure of the downstream structures caused by the failure of Old Reservoir No. 1.	$ 5,000	Simple volume/capacity assessment of sunny day failure.
R01 2.04	Produce a plan to determine the long-term future of the dam.	$ 20,000	
R01 2.05	Reduce consequence classification to Low or remove from fleet of dams if there is no plan to re-fill the reservoir.	N/A	By City staff with BC Dam Regulator.
HAW 2.01	Hydraulic study to determine to determine capacity of spillway.	$ 10,000	Using existing drawings, not including additional survey acquisition if needed.
HAW 2.02	Review dam classification by assessing the potential for downstream damages.	$ 25,000	Very simplified assessment, full assessment $40K plus LiDAR acquisition.
UCR 2.01	Check for potential of a cascade failure of the downstream structures caused by a failure of Upper Colliery Dam.	$ 5,000	Simple volume/capacity assessment of sunny day failure.
MCR 2.01	Review and compare crest elevation for as-built drawings vs. survey information of the dam crest.	N/A	*By City staff
MCR 2.02	Check for potential of a cascade failure of the downstream structures caused by a failure of Middle Colliery Dam.	N/A	Study currently underway
MCR 2.03	Implement capital plan to increase the capacity of the spillway to allow for passage of an IDF event.		Cost can be estimated once MCR 2.02 is completed.
LCR 2.01	Perform dam stability and seepage analysis of earth fill dam.	$ 30,000	
LCR 2.02	Perform stability analysis of spillway walls including seismic loading.	$ 25,000	

Appendix A
Summary of Information Reviewed

Item	Document Name	Date
1	Dam Mobile Database (pdf files from most recent routine inspections)	September 2023
2	Reservoir No. 1 OMS Manual	May 2024
3	Westwood Lake Dam OMS Manual	May 2024
4	Upper Chase River Dam OMS Manual	December 2021
5	Middle Chase River Dam OMS Manual	October 2023
6	Lower Chase River Dam OMS Manual	October 2023
7	Harewood Lake Dam OMS Manual	January 2024
8	Witchcraft Lake Dam OMS Manual	April 2024
9	McGregor Creek Dam OMS Manual	December 2023
10	2024 Formal Annual Dam Inspections	March 2025
11	2023 Formal Annual Dam Inspections	November 2024
12	2022 Formal Annual Dam Inspections	April 2023
13	2021 Formal Annual Dam Inspections	June 2022
14	2020 Formal Annual Dam Inspections	February 2021
15	City of Nanaimo – Dam Safety Management Program	March 2024
16	2024 City of Nanaimo – Recreational Dams Emergency Plan	January 2024
17	Westwood Dam – Dam Safety Review	2025
18	Lower Colliery Dam – Dam Safety Review	2025
19	Dam Safety Reviews for Jump Creek Dam & Saddle Dam, South Fork Dam, Reservoir No. 1 Dam, Westwood Lake & Saddle Dam	2014
20	Dam Safety Reviews for the Middle & Lower Chase River Dams	2014
21	Water Licence Amendment 114478	June 2022
22	Herold Engineering – Middle Chase Dam Bridge – Bridge Condition Assessment – Load Capacity Evaluation	July 2022
23	Memo – Recommendation for Witchcraft Lake Dam	December 2025
24	Middle Colliery Dam – Dam Safety Review	December 2025
25	Middle Colliery Dam – Geotechnical Investigation Factual Report	December 2025
26	Middle Chase Dam – Inflow Design Flood Study	2025

Appendix B
Figures

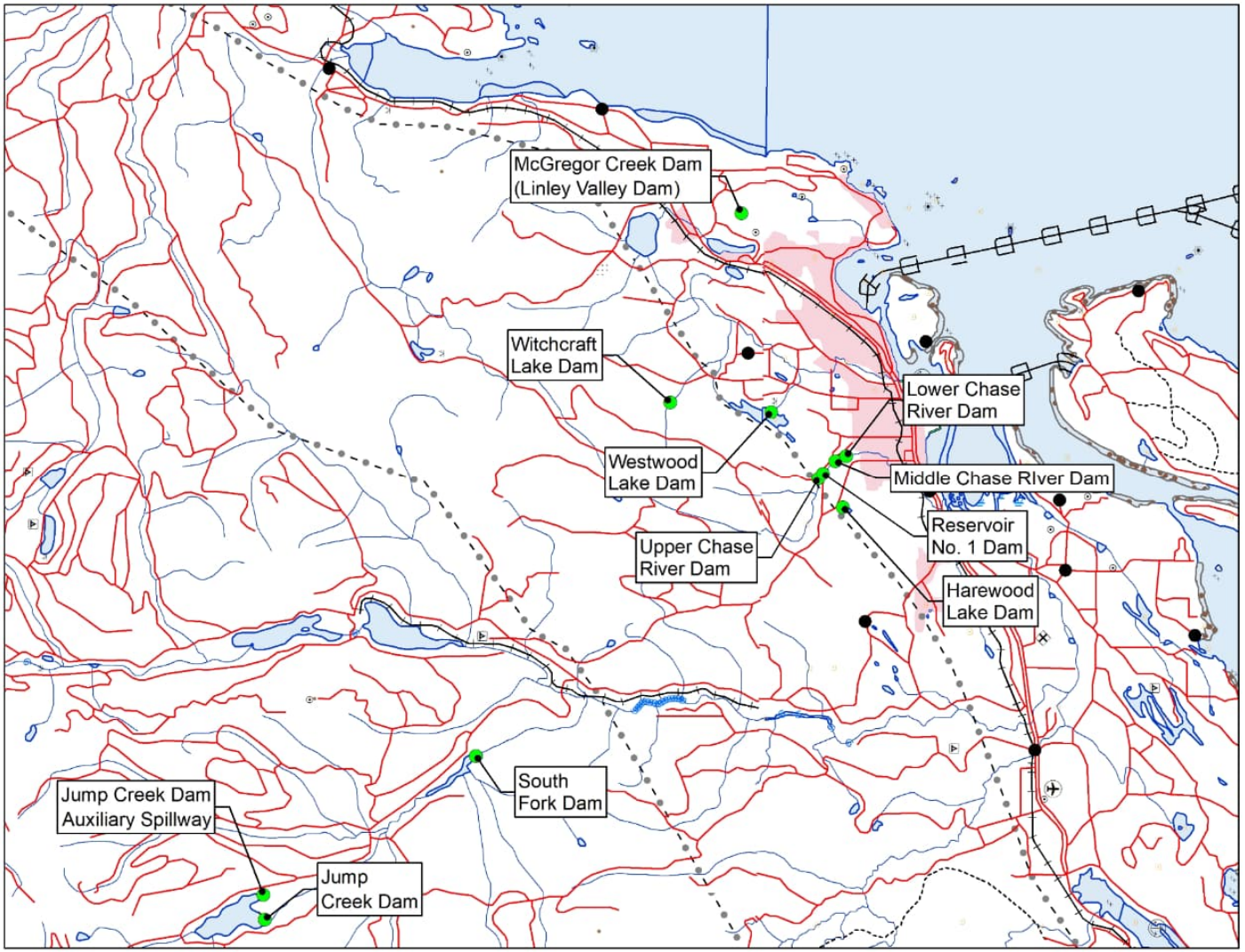


Figure B1: Dam Locations

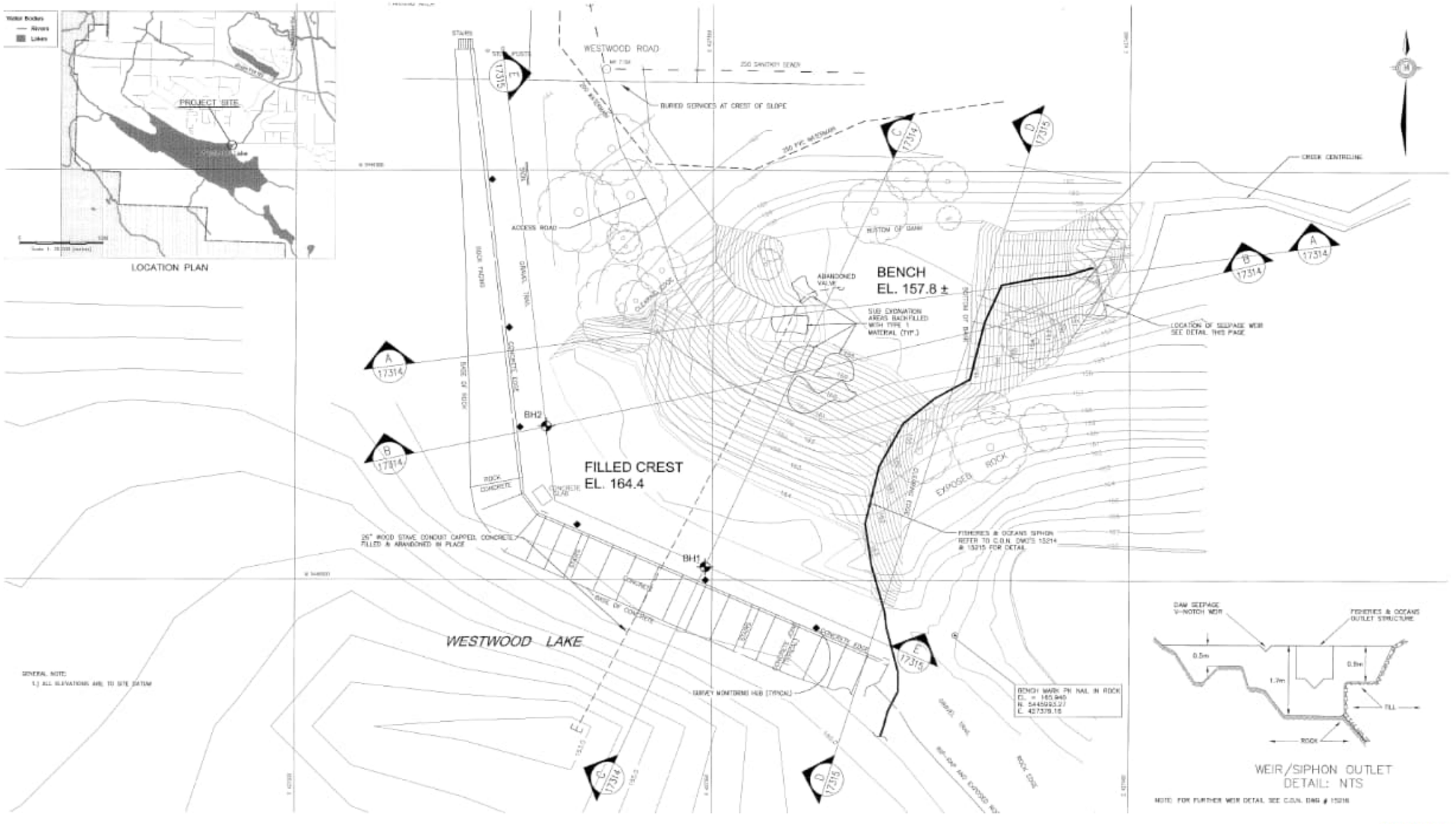
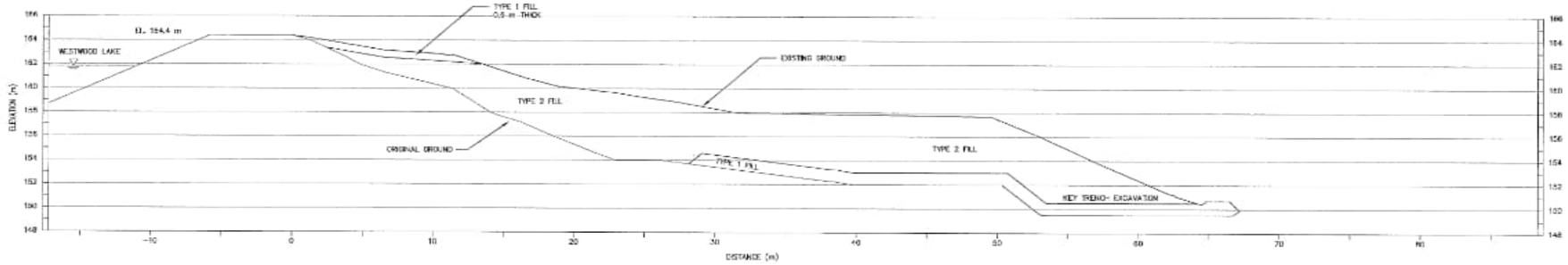


Figure B2: General Layout and Cross Sections of Westwood Dam
(Provided by The City)



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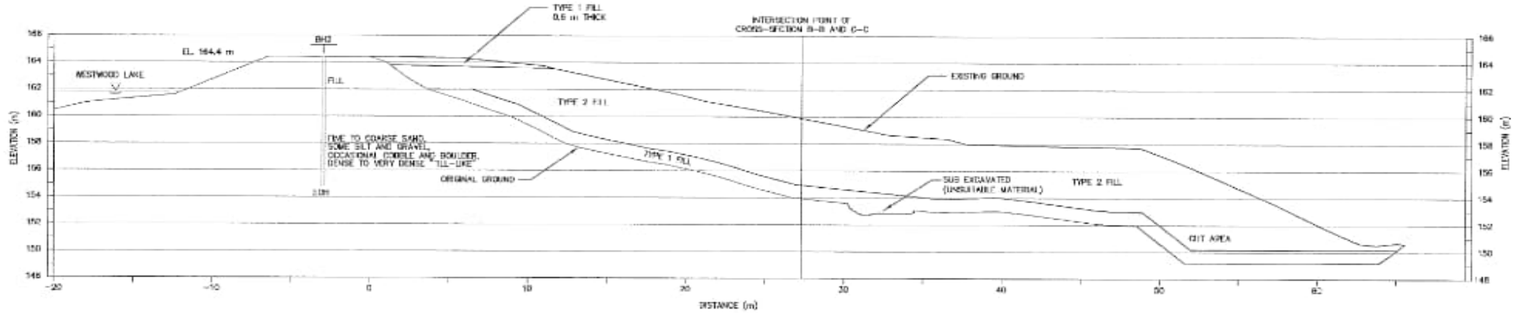
1:200 17313



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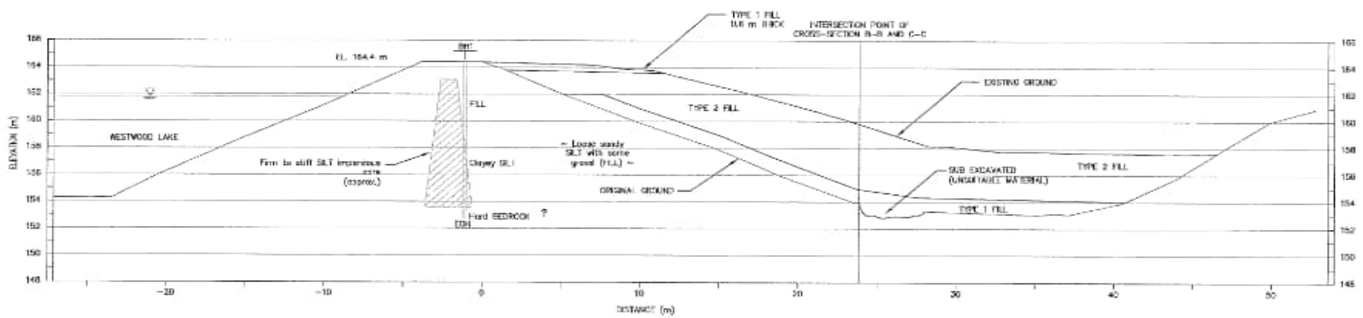
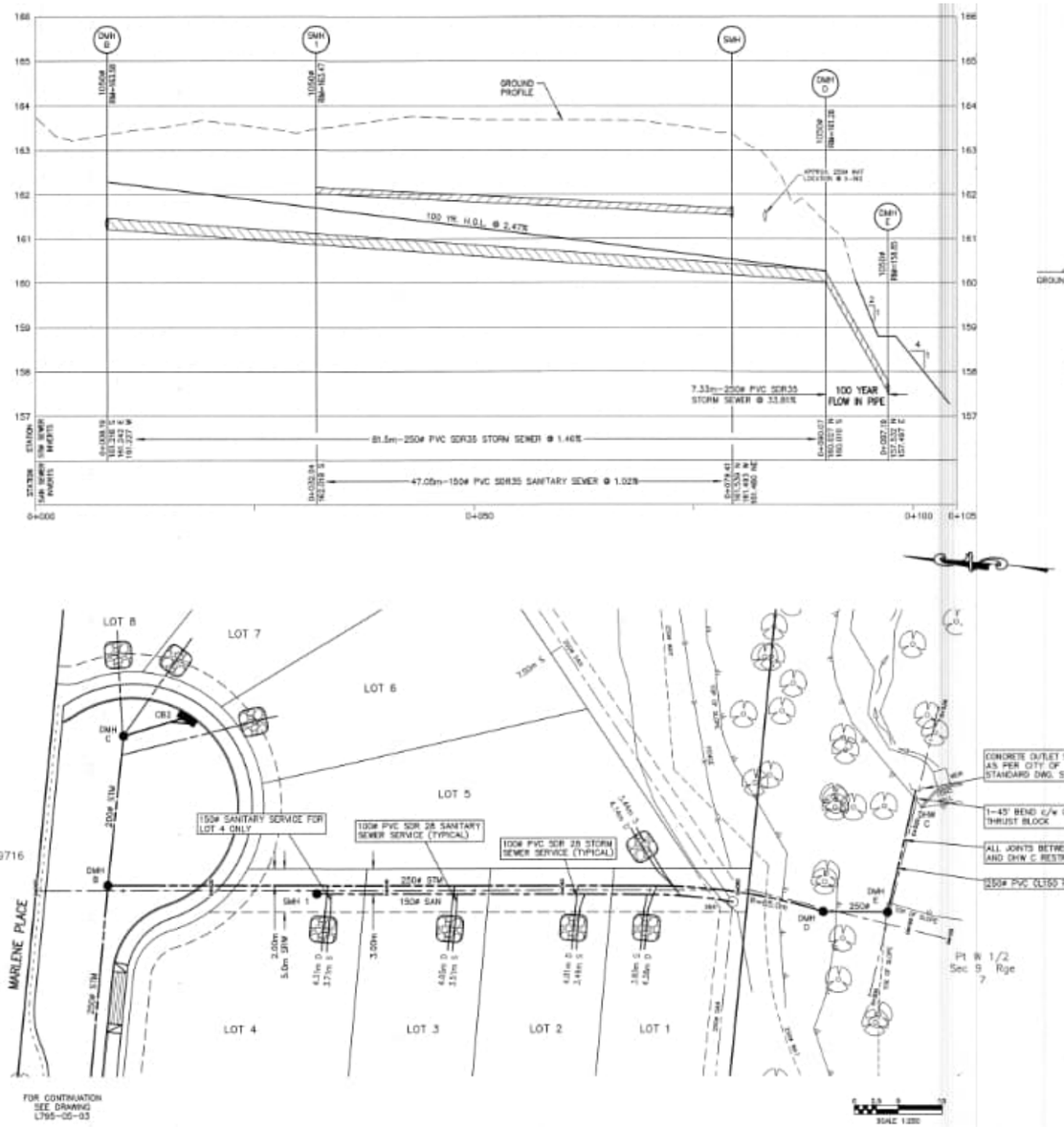


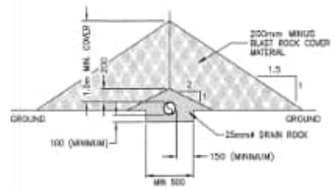
SECTION C
1:200 17313

Figure B3: Cross Sections of Westwood Dam (Provided by The City)



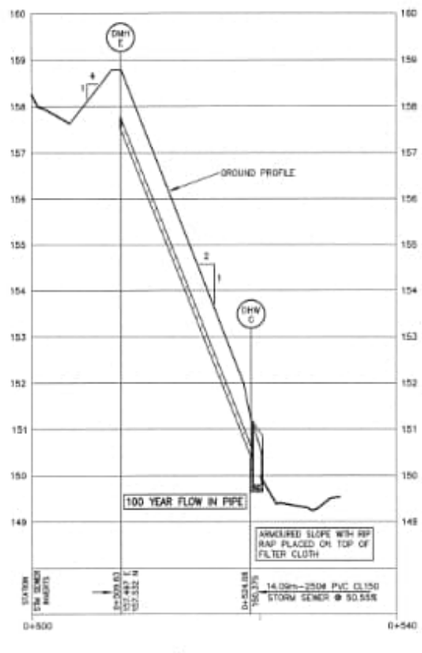
LOT No.	SAN INV. @ ℄	WYE CHAINAGE FROM D/S MH
1	161.754	9.8
2	161.834	16.9
3	161.975	31.4
4	162.070	45.8
5	161.714	6.0
6	161.530	-
7	160.982	-
8	160.978	-

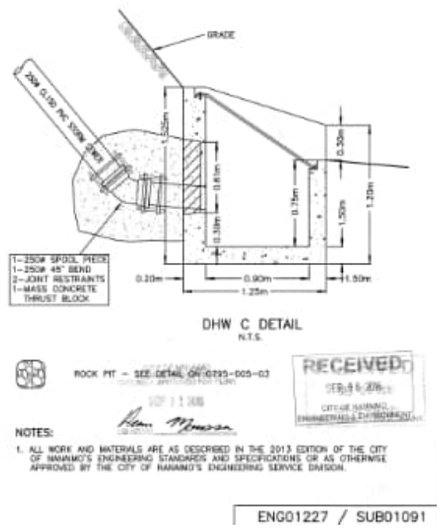
LOT No.	STM INV. @ ℄	WYE CHAINAGE FROM D/S MH
1	160.586	19.2
2	160.662	35.1
3	160.957	42.1
4	161.098	56.1
5	160.490	17.3



NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
2. BEDDING AND COVER MATERIAL PLACED UNDER DIRECTION OF THE GEOTECHNICAL CONSULTANT.

DMH E TO DHW C PIPE COVER SECTION
N.T.S.





DHW C DETAIL
N.T.S.

ROCK PIT – SEE DETAIL ON 0795-005-03

RECEIVED
CITY OF NANAIMO
ENGINEERING & ENVIRONMENT

NOTES:
1. ALL WORK AND MATERIALS ARE AS DESCRIBED IN THE 2013 EDITION OF THE CITY OF NANAIMO'S ENGINEERING STANDARDS AND SPECIFICATIONS OR AS OTHERWISE APPROVED BY THE CITY OF NANAIMO'S ENGINEERING SERVICE DIVISION.

ENG01227 / SUB01091

Figure B4: Cross Sections of Storm and Sanitary Sewers at Westwood Lake Dams (Provided by The City)

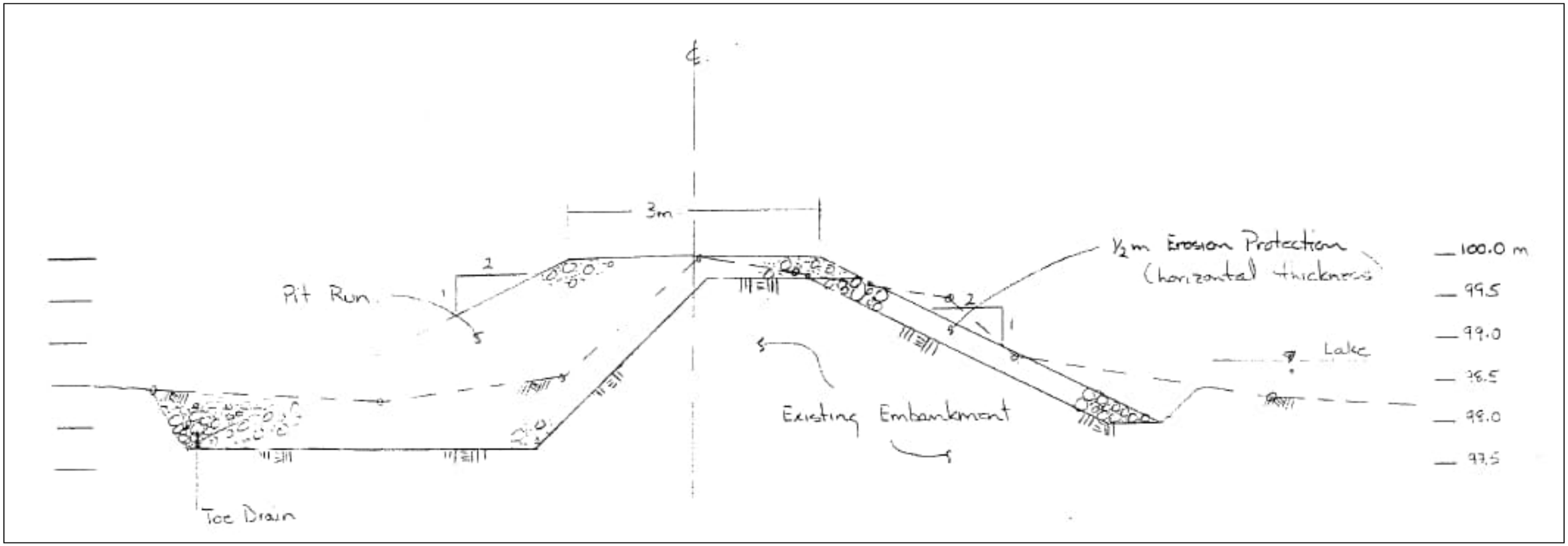


Figure B5: Cross Sections of Saddle Dam at Westwood Lake
(From OMS Manual)

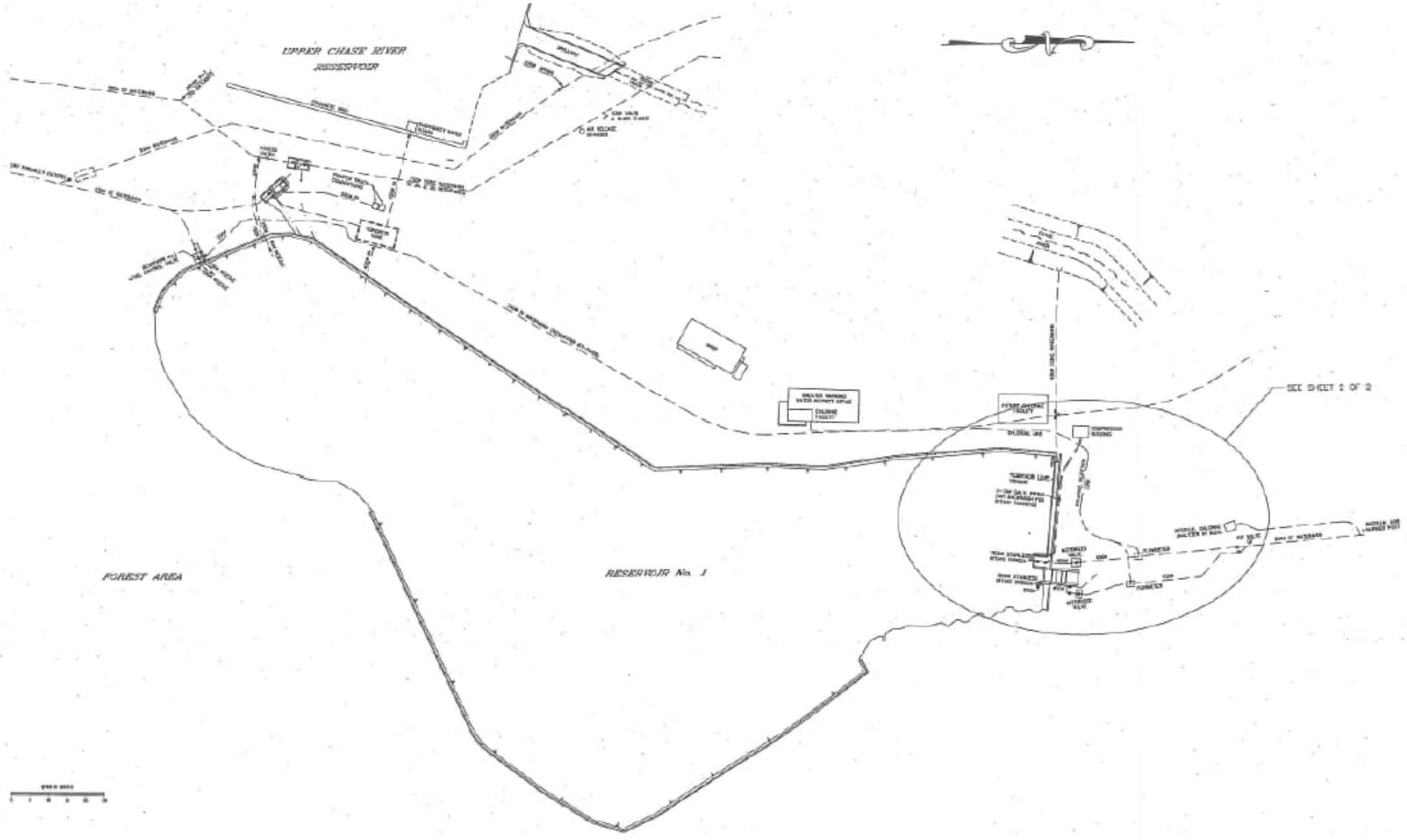


Figure B6: Cross Sections of Old Reservoir Dam No. 1
(Figure taken from 2016 FADI)

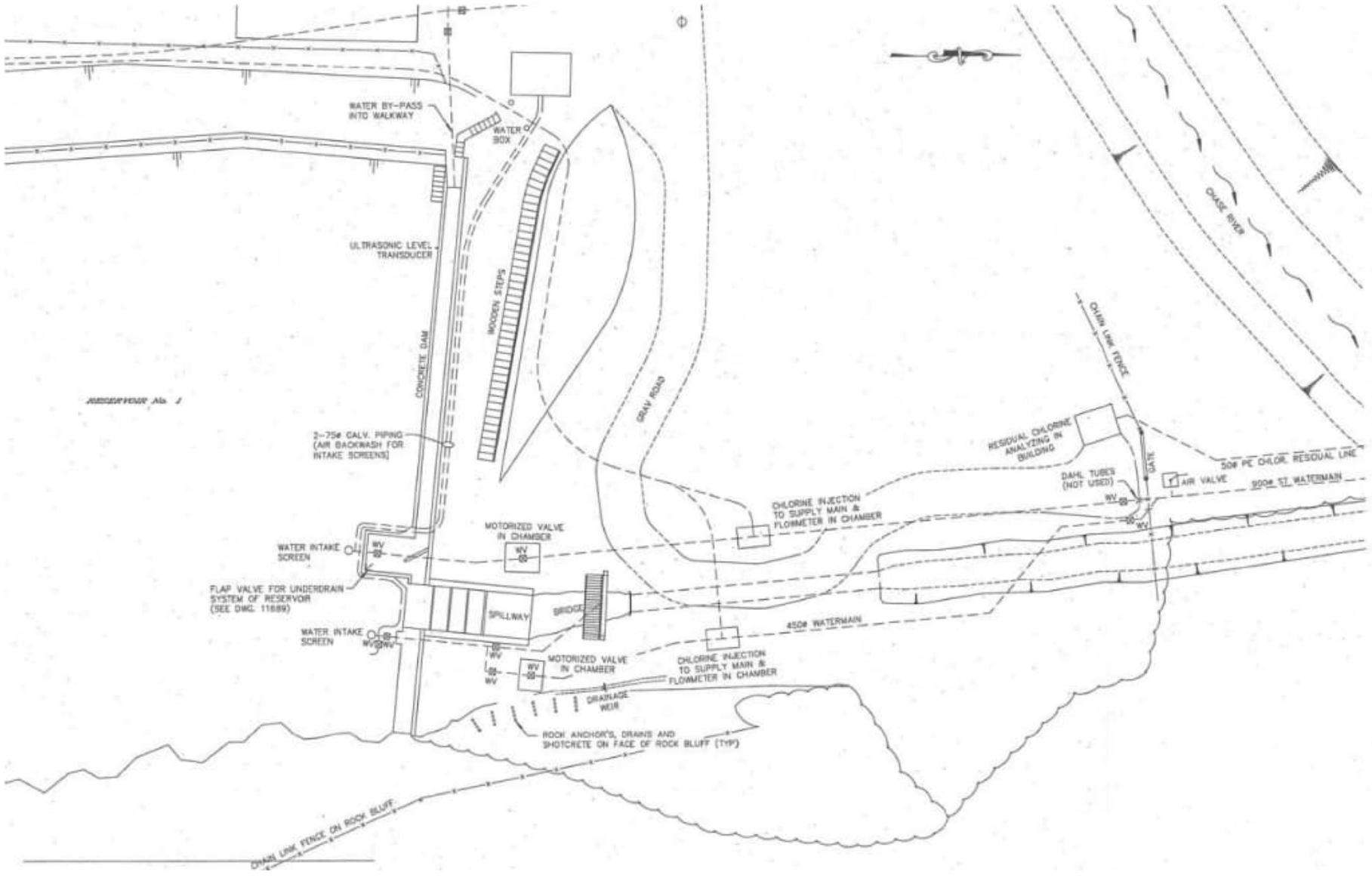


Figure B7: General Layout of Old Reservoir Dam No. 1
(Figure taken from 2014 DSR)

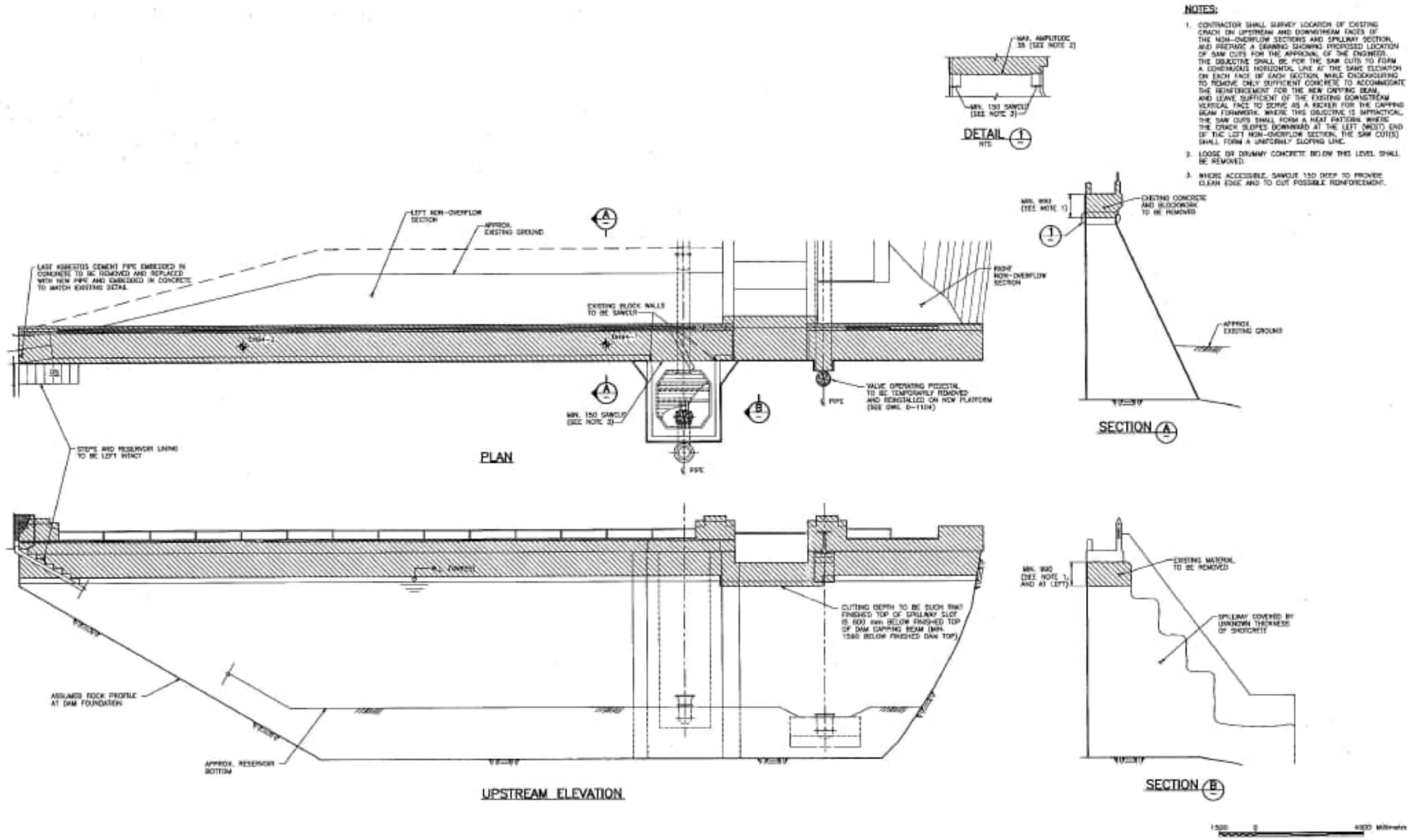


Figure B8: Cross Sections of Old Reservoir Dam No. 1
(Figure taken from 2014 DSR)

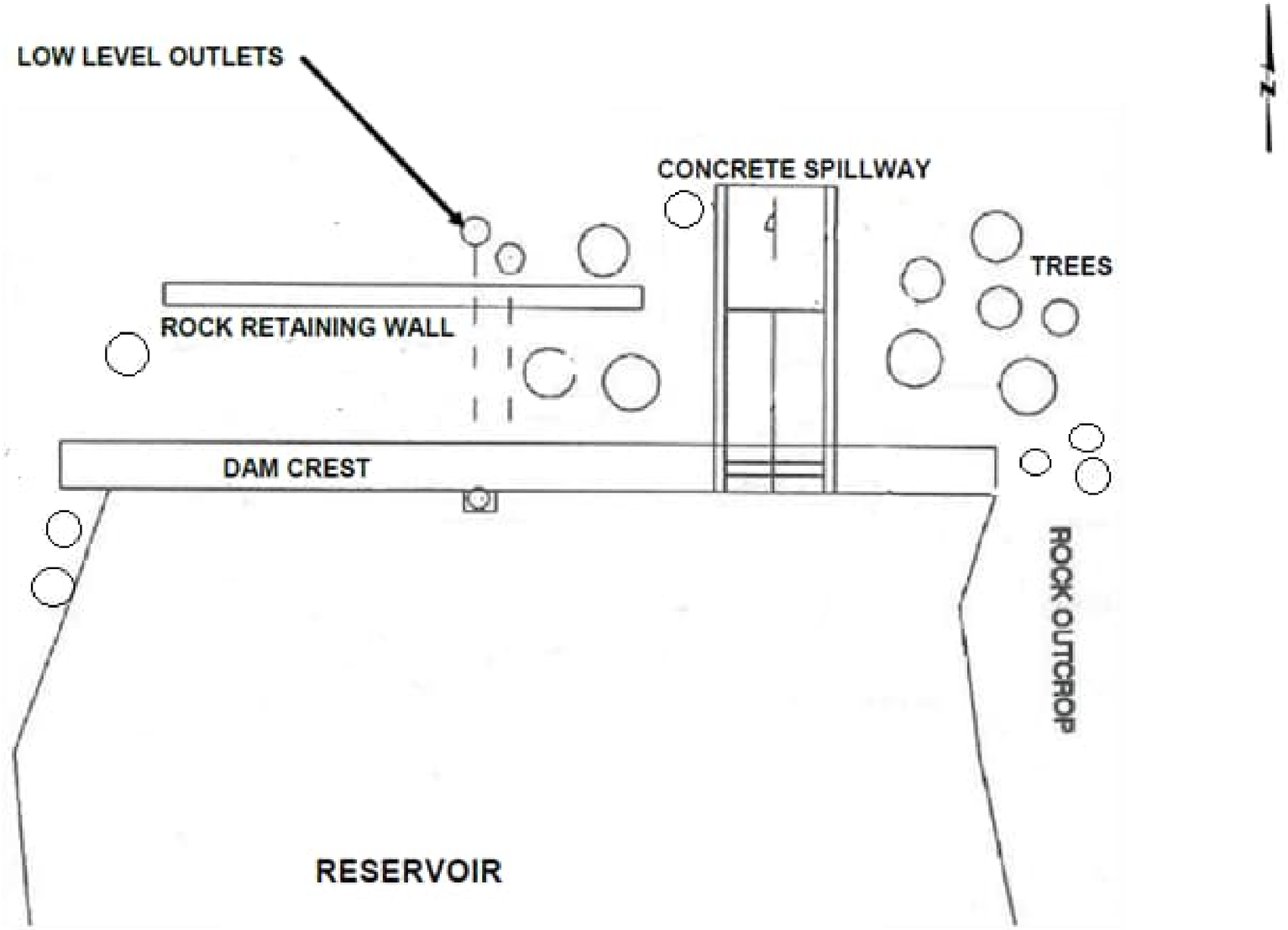


Figure B9: General Arrangement of The Harewood Dam
(Adapted from 2016 FADI Figure)

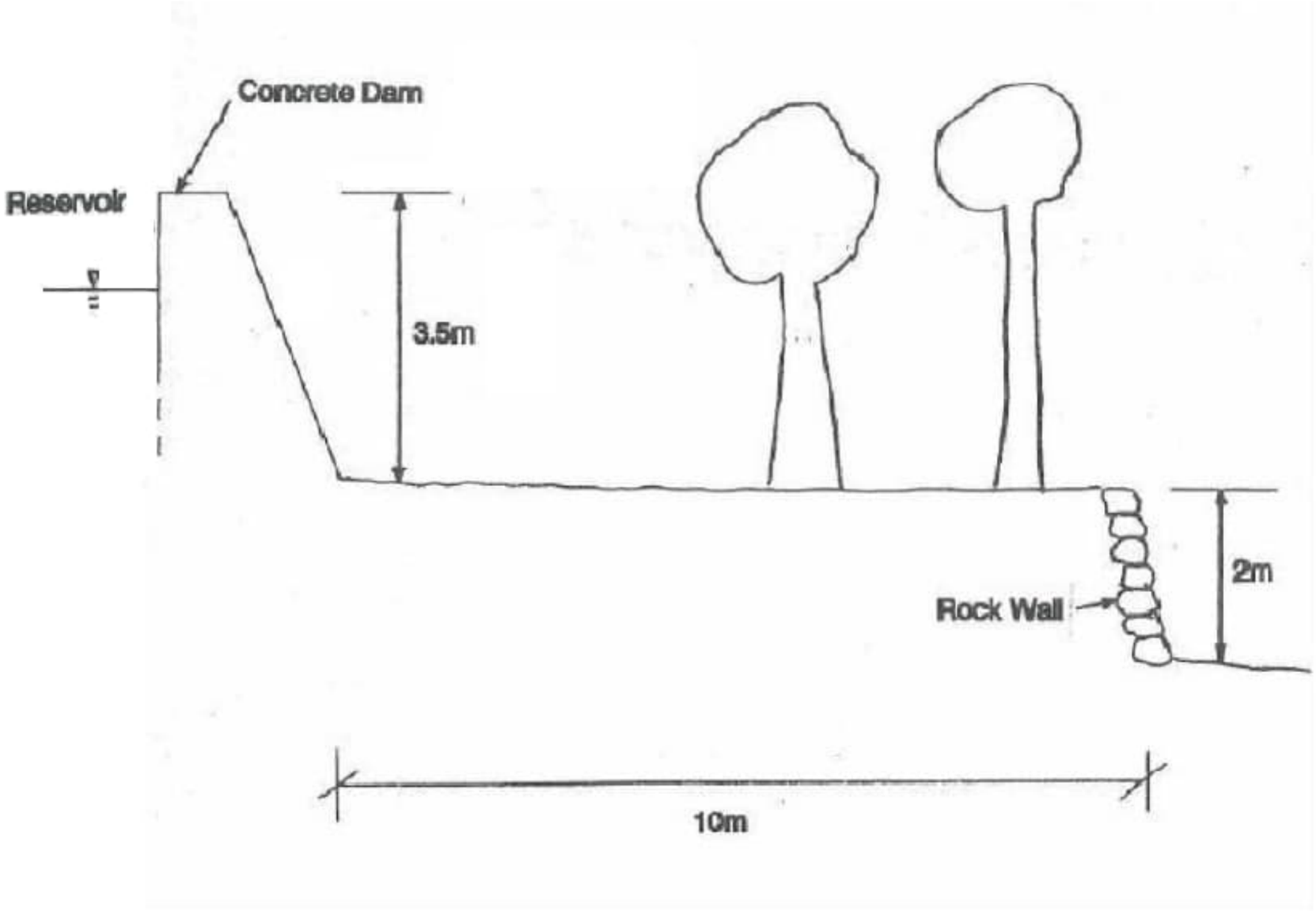


Figure B10: General Cross Section of the Harewood Dam
(Figure Taken From 2016 FADI))

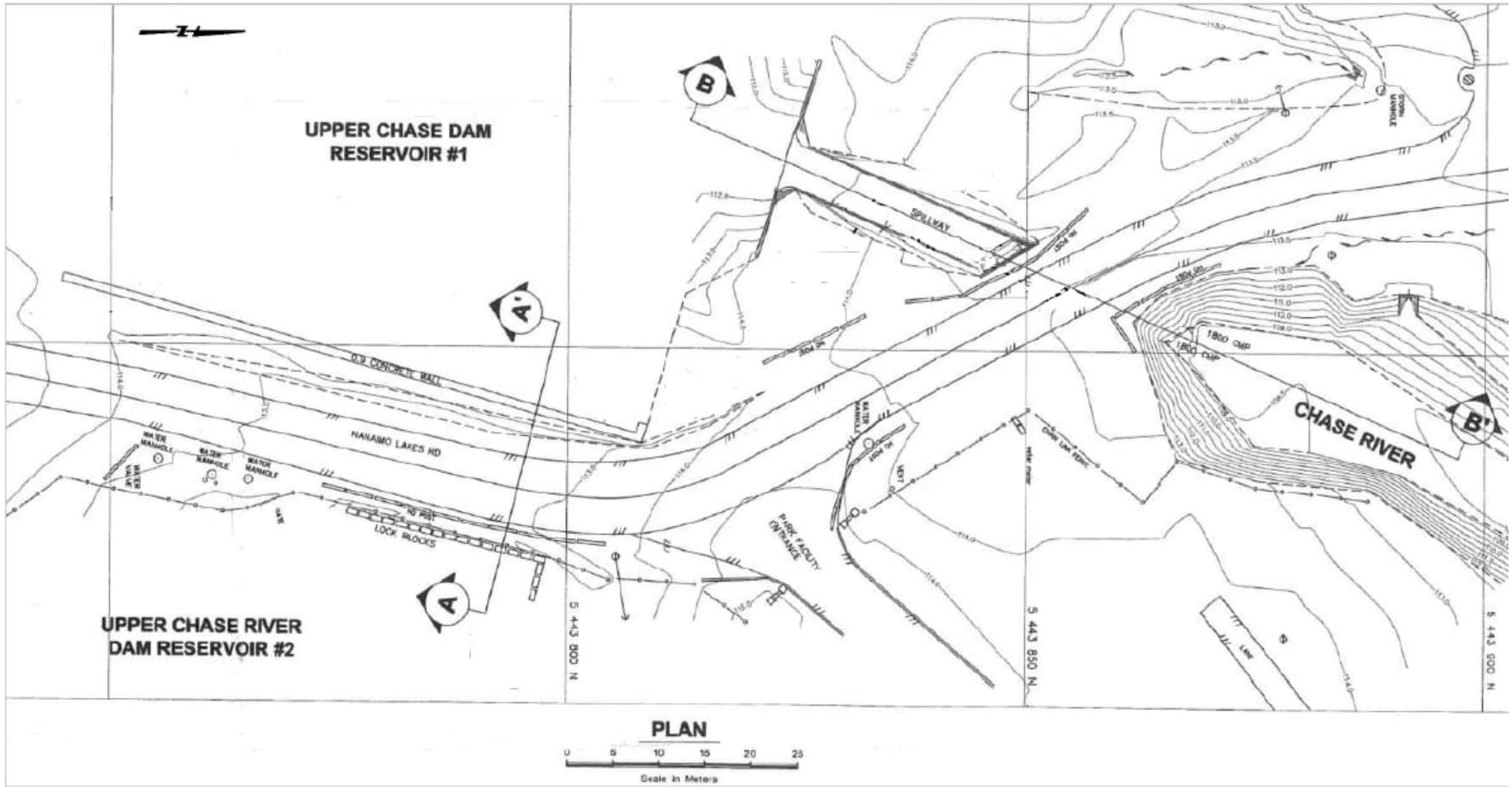


Figure B11: General Layout of Upper Chase River Dam
(Figure taken from 2016 FADI)

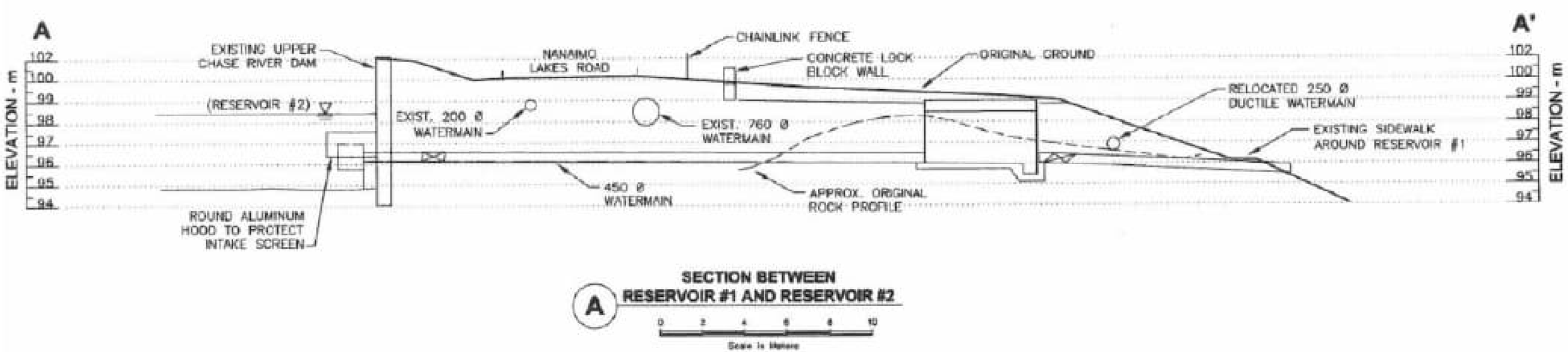


Figure B12: General Cross Section of Upper Chase River Dam
(Figure taken from 2016 FADI)

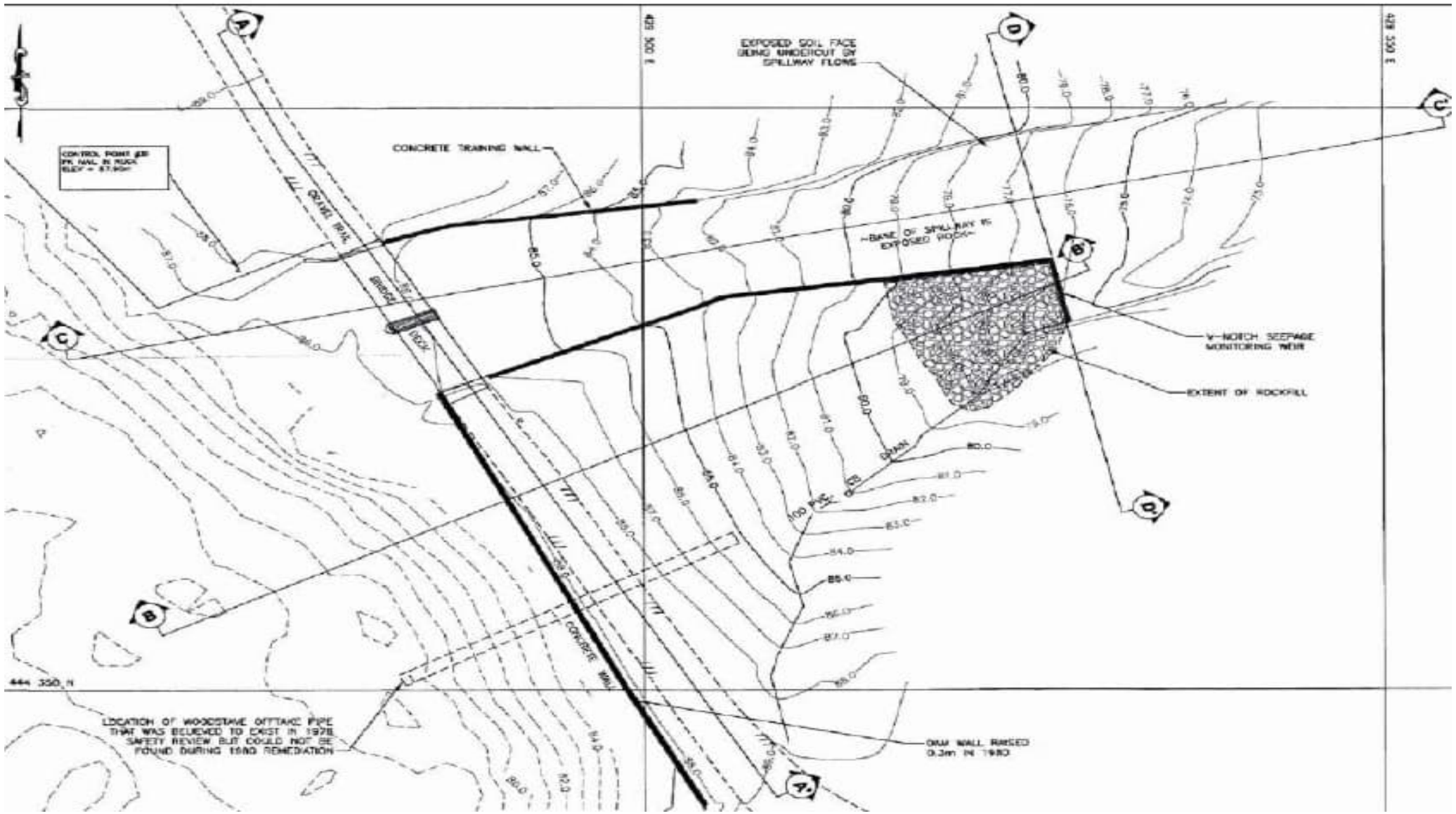


Figure B13: General Layout of Middle Chase River Dam
(Figure taken from 2016 FADI)

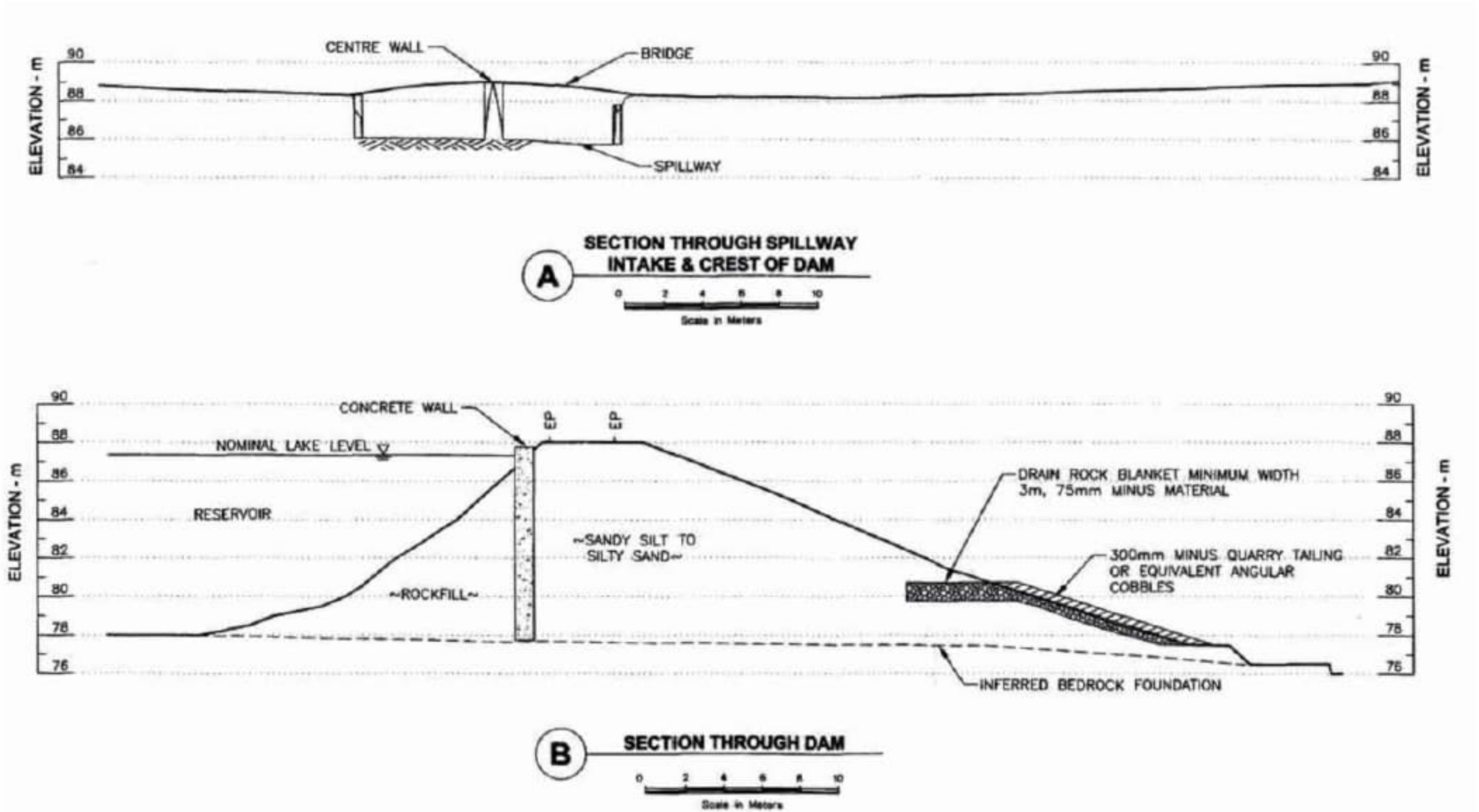


Figure B14: Cross Sections of Middle Chase River Dam
(Figure taken from 2016 FADI)

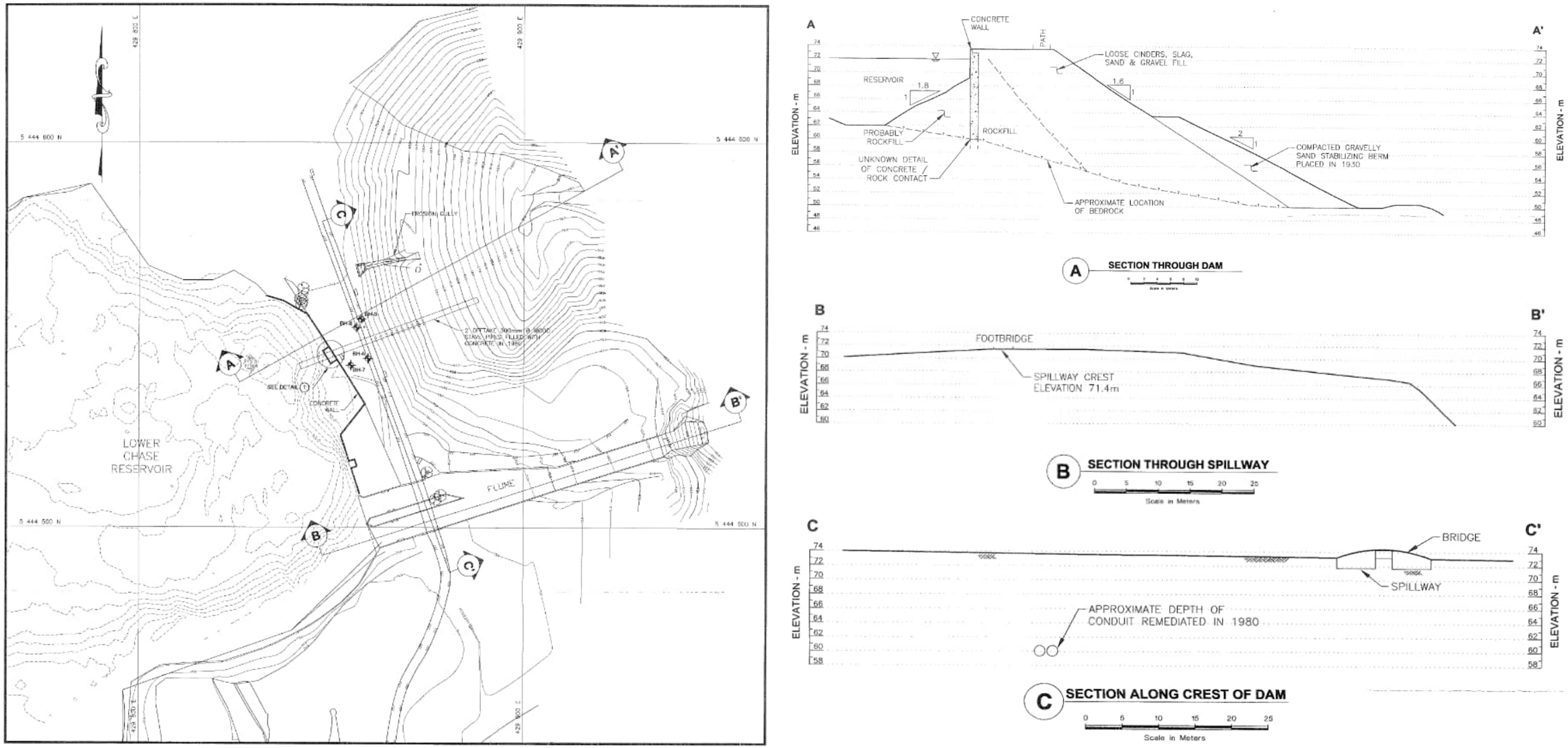


Figure B15: Plan and Cross Sections of Lower Chase River Dam
(Figure taken from Drawing No. 15430)

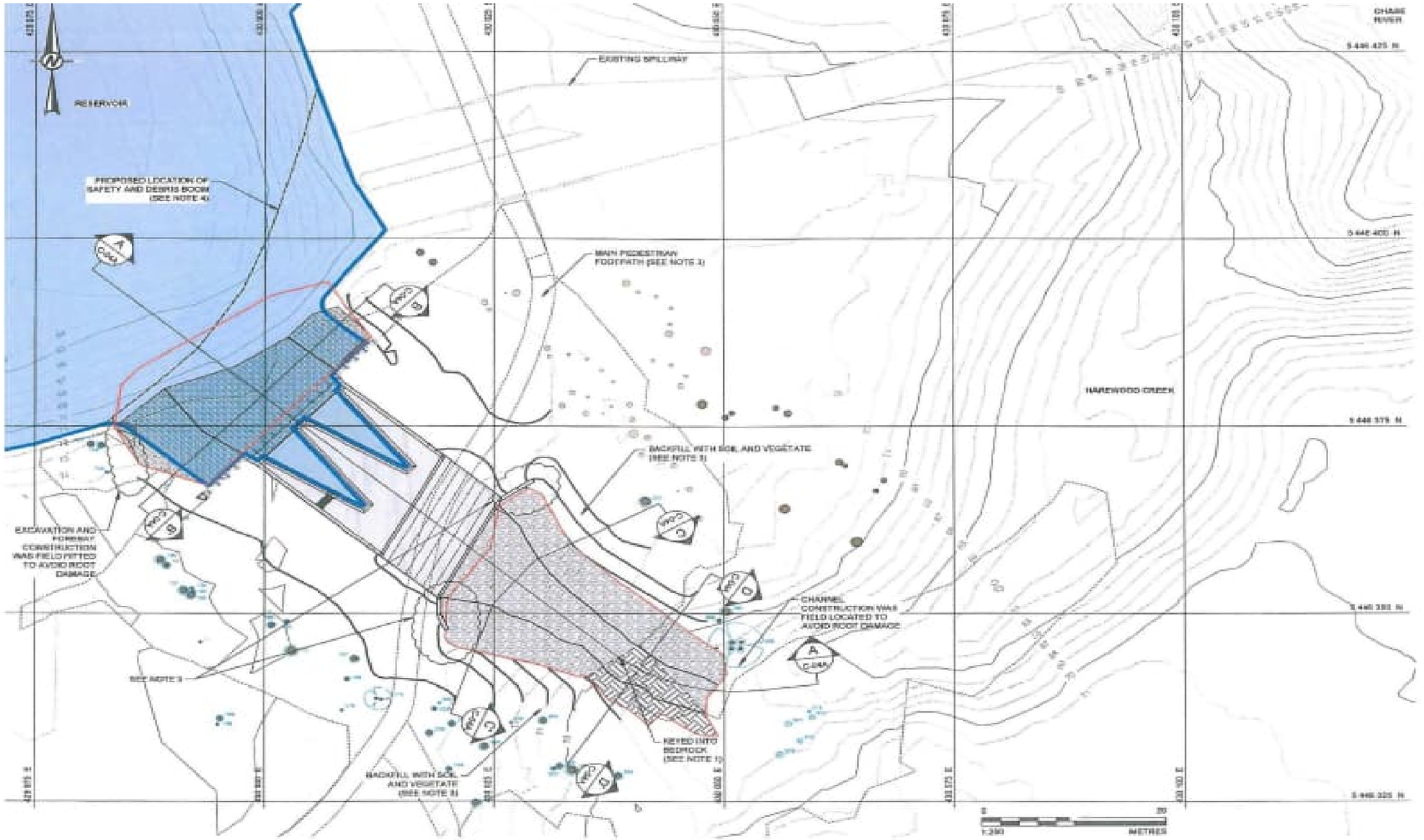


Figure B16: General Plan of Lower Chase River Dam Auxiliary Spillway
(Figure taken from 2016 FADI)

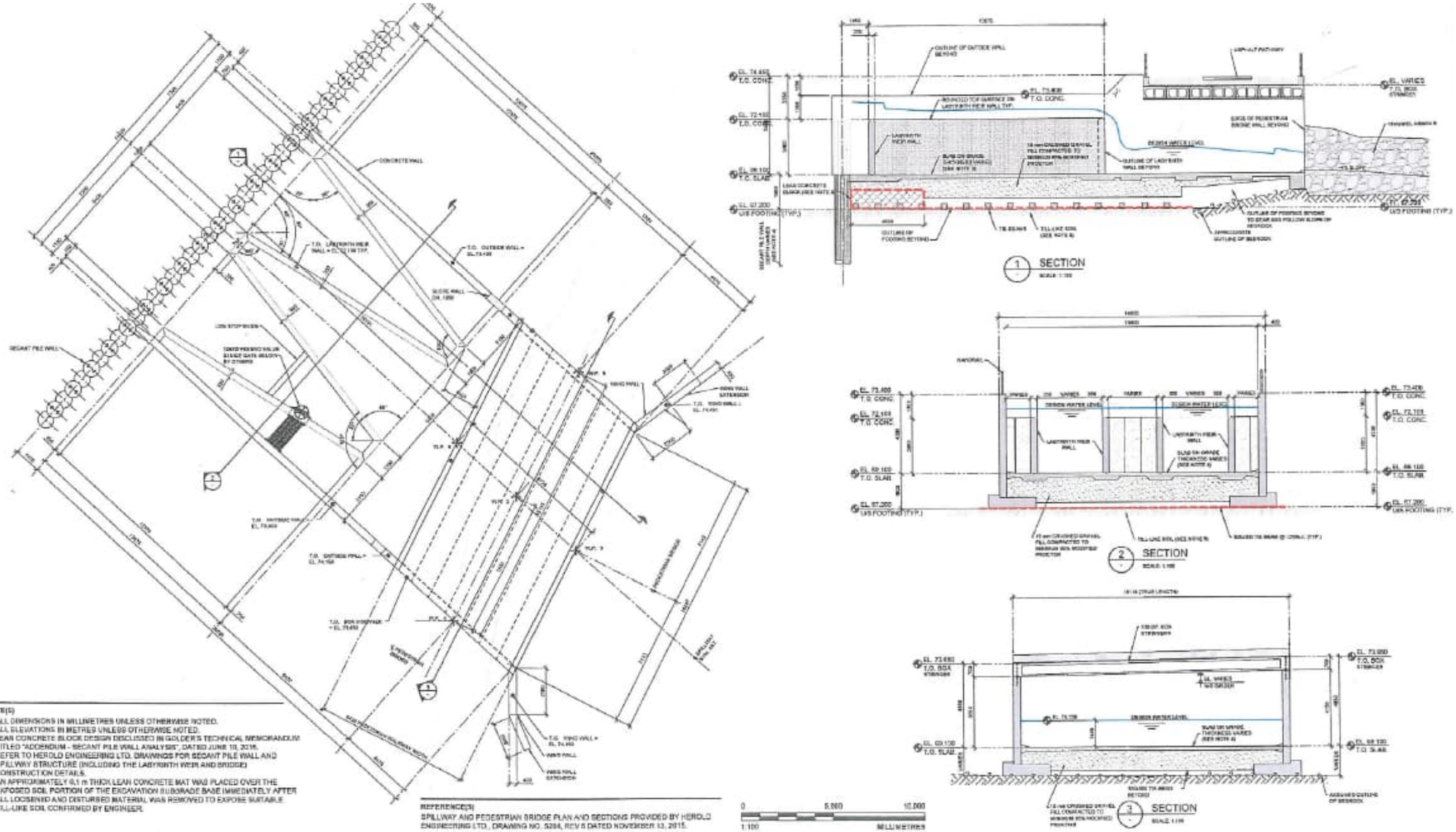


Figure B17: General Cross Sections of Lower Chase River Dam Auxiliary Spillway (Figure taken from 2016 FADI)

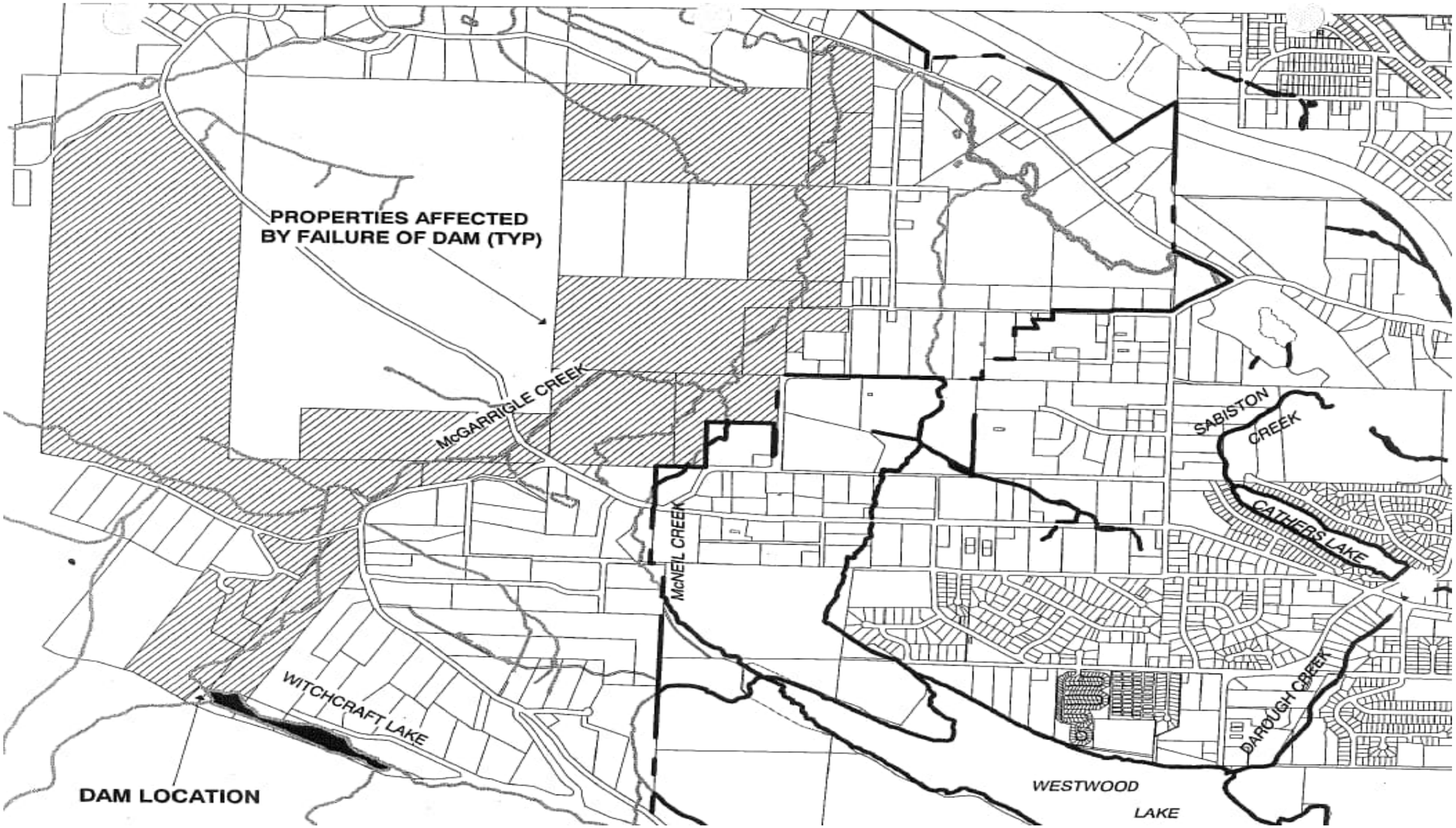
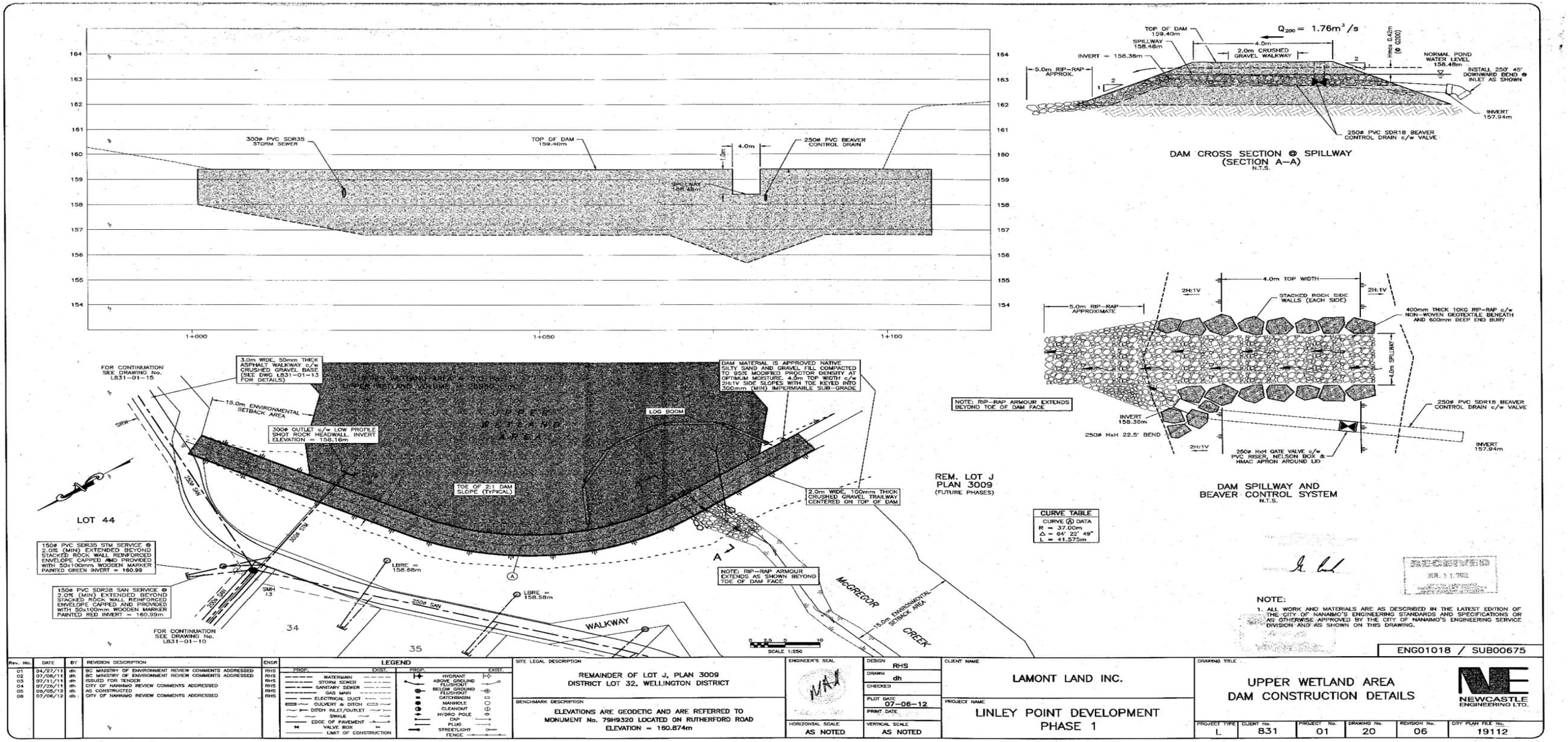


Figure B18: Location of Witchcraft Lake Dam



Rev. No.	DATE	BY	REVISION DESCRIPTION	ENGR
01	04/27/11	dh	BC MINISTRY OF ENVIRONMENT REVIEW COMMENTS ADDRESSED	RHS
02	07/08/11	dh	BC MINISTRY OF ENVIRONMENT REVIEW COMMENTS ADDRESSED	RHS
03	07/11/11	dh	ISSUED FOR TENDER	RHS
04	07/25/11	dh	CITY OF NANAIMO REVIEW COMMENTS ADDRESSED	RHS
05	06/05/12	dh	AS CONSTRUCTED	RHS
06	07/06/12	dh	CITY OF NANAIMO REVIEW COMMENTS ADDRESSED	RHS

Figure B19: McGregor Creek Dam – Details

Appendix C
Inspection Photographs

WWL 1: Reservoir, Crest of Main Dam and Upstream Stone Face of Main Dam

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 2: Trees at Crest of Main Dam and Downstream Slope

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 3: Upstream Concrete Face of Main Dam with Horizontal Cracking

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 4: Upstream Concrete Face of Main Dam with Joint Deterioration and Cracking

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 5: Upstream Stone Face of Main Dam

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 6: Dam Crest of Main Dam (Looking towards the Right Abutment)

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 7: Downstream Face of Main Dam where Part of the Buried Department of Fisheries pipe is Exposed

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 8: Downstream Face of Main Dam

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 9: Downstream Seepage Monitoring Weir

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 10: Monitoring weir, looking downstream

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 11: Saddle Dam Crest

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 12: Downstream Face of Saddle Dam

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 13: Upstream Face of Saddle Dam

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 14: Debris Accumulated at Upstream Toe of Saddle Dam and Light Furrowing on the Upstream Slope

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 15: Westwood Lake Outlet Concrete Sill (Outlet Channel)

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 16: Erosion Damage on Downstream Right Abutment of Bridge (Inlet Channel)

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

WWL 17: Undermining of the Dam Sacks and Dispersed Riprap at the Downstream Step in the Inlet Channel

Location: Westwood Lake Dam (WWL)

Date: September 17, 2025

R01 1: Dewatered Reservoir Looking Upstream from the Dam

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

R01 2: Dewatered Reservoir Looking Upstream from the Dam

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

R01 3: Downstream Face and Spillway of the Dam

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

R01 4: Mechanical Equipment at Upstream Side of the Dam

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

R01 5: Right Abutment Wall Downstream of the Dam (Bedrock, Partially Covered in Shotcrete)

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

R01 6: Dam Crest and Left Abutment Slope and Wooden Access Stair and Handrail Downstream of Dam

Location: Old Reservoir No. 1 Dam (N01)

Date: September 16, 2025

HAW 1: Dam Crest from the Left Abutment

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 2: Dam Crest from the Right Abutment

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 3: Upstream Face of the Dam and Spillway from Right Abutment

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 4: Concrete Deterioration of the Top of the Spillway Bridge

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 5: Spillway Chute looking Upstream

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 6: Spillway Slab at Downstream End

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 7: Downstream Side of the Dam

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 8: Concrete Deterioration at Downstream Face of the Dam

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 9: 'V' Notch Weir (Looking Downstream)

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 10: Left Spillway Bay Looking Upstream

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 11: Channel Downstream of Spillway with Minimal Riprap Protection

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 12: Gap in Joint at Top of Spillway Left Chute Wall

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 13: Right Side of Downstream Bench and Stacked Rock Wall

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 14: Stacked Rock Wall

Location: Harewood Dam (HAW)

Date: September 16, 2025

HAW 15: Small Seepage Area Downstream of the Rock Wall

Location: Harewood Dam (HAW)

Date: September 16, 2025

UCR 1: Buttressed Retaining Wall at Upstream Face of the Dam

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 2: Crest from Right Abutment of Concrete Face of Dam

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 3: Concrete Deterioration at Right Side of Buttress Wall of the Dam

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 4: Spillway Structure and FlowDar System (looking Downstream)

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 5: Embankment Dam and Vegetated Shoreline, Looking from Buttress Dam Towards Spillway

Location: Upper Chase River (UCR)

Date: September 17, 2025

UCR 6: Vegetation Growth Immediately Upstream of the Spillway Channel

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 7: Left Spillway Chute Wall with Crack at Water Gauge

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 8: Right Spillway Chute Wall with Crack at Drainage Pipe

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 9: Embankment Dam and Vegetated Shoreline

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 10: Spillway Wingwalls

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 11: Spillway Wingwalls from Left Abutment

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 12: Surface Runoff Erosion Along Wingwall Slopes

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 13: Surface Runoff Erosion Along Wingwall Slopes

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 14: Fencing Along Buttress Dam

Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 15: Camera Pole Foundation at Left Abutment

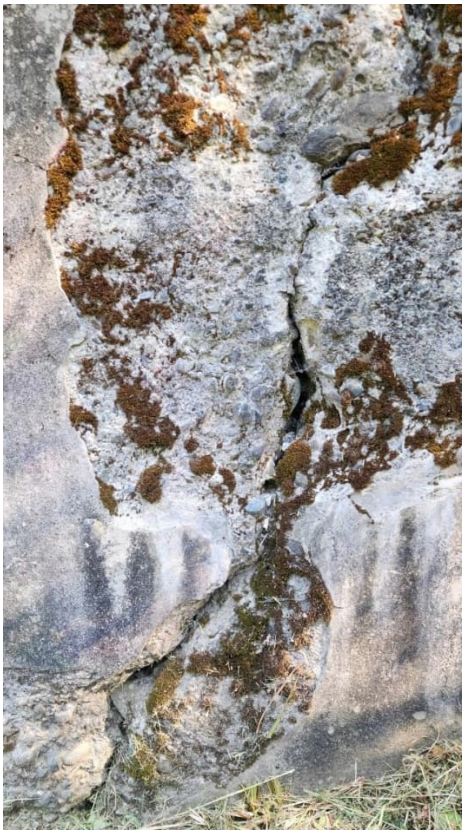
Location: Upper Chase River (UCR)

Date: September 16, 2025

UCR 16: Damage to Left Culvert at Downstream End

Location: Upper Chase River (UCR)

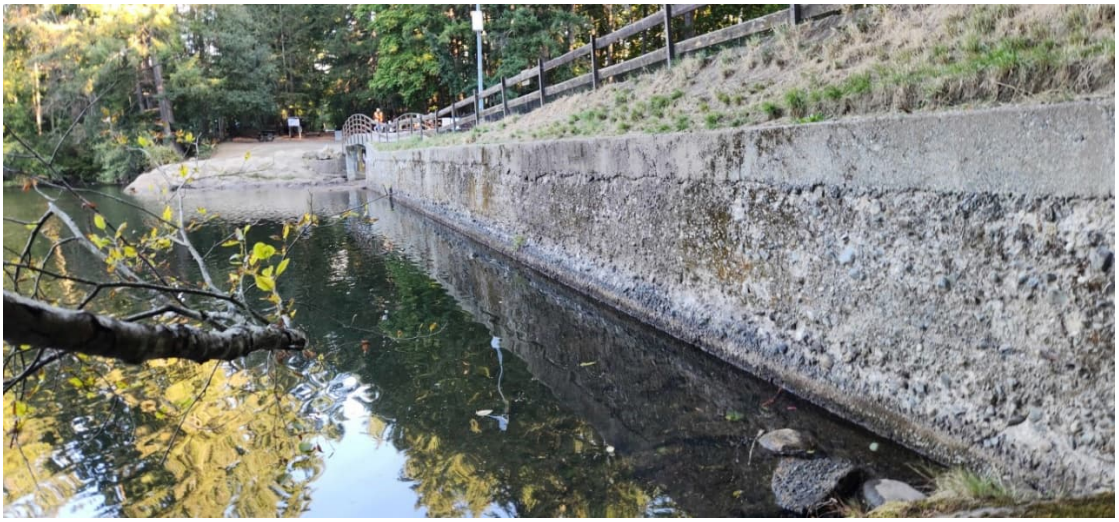
Date: September 16, 2025



UCR 17: Large Crack on Upstream Wall Face

Location: Upper Chase River (UCR)

Date: September 16, 2025



MCR 1: Upstream Wall of the Dam (from Right Abutment)

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 2: Upstream Wall of the Dam and Spillway

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 3: Right Spillway Pier

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 4: Concrete Deterioration with Exposed Reinforcing Bars Underside of the Spillway Bridge Deck (Left Bay)

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 5: Concrete Erosion at Contact with Rock at Left Abutment of the Spillway Bridge Deck (Left Bay)

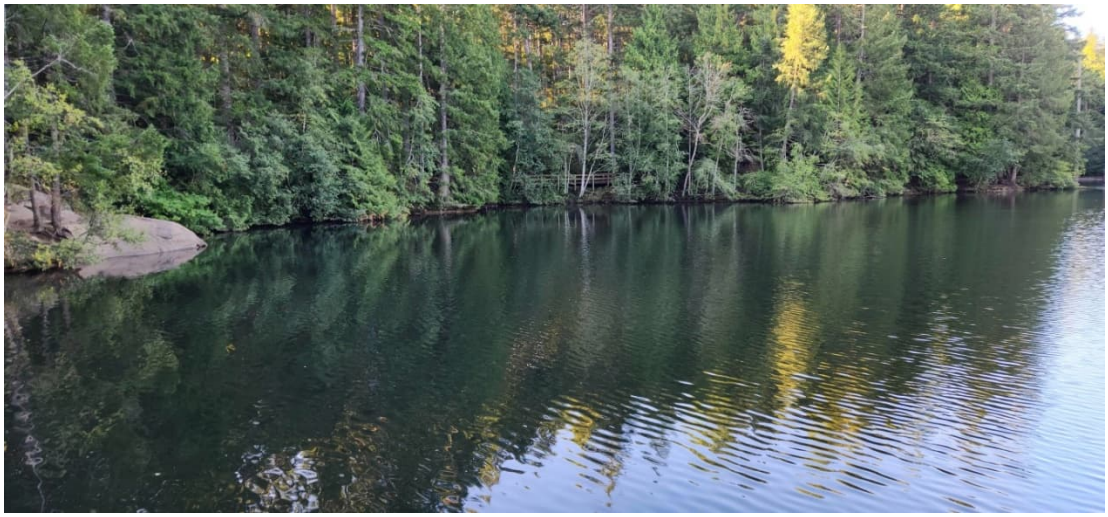
Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 6: Spillway Chute Slab (Looking Downstream)

Location: Middle Chase River (MCR)

Date: September 17, 2025



MCR 7: Dam Reservoir.

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 8: Spillway Chute Structure

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 9: Bedrock at the Left Abutment.

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 10: Crest of the Dam (Looking at the Right Abutment)

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 11: Concrete/Bedrock at the Right Abutment

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 12: Downstream Face of Dam

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 13: 'V' Notch Weir Housing at Downstream Toe

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 14: 'V' Notch Weir Concrete Housing (Weir Not Visible)

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 15: Newly Placed Riprap at the Left Embankment Beyond the Wing Wall

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 16: New Fence/Handrail and Presence of Cobble Cover at Left Side of Spillway

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 17: Upstream of Dam Looking Left Abutment

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 18: Concrete Crack at Top Corner of Centre Spillway Pier

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 19: Undermining of Central Spillway Pier

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 20: Undermining of Right Abutment Wall

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 21: Undermining of Left Abutment Wall

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 22: Downstream Seepage

Location: Middle Chase River (MCR)

Date: September 17, 2025

MCR 23: Dam Signage

Location: Middle Chase River (MCR)

Date: September 17, 2025

LCR 1: Upstream Face of the Dam with Reservoir (from Left Abutment)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 2: Safety Boom Upstream Side of Auxiliary Spillway

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 3: Spillway Structure (Downstream Side of Bridge)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 4: Spillway Chute Structure (Looking Upstream)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 5: Large Tree Downstream of the Spillway Bridge on the Left Abutment

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 6: Spillway Centre Pier Nose with Exposed Reinforcing Bar

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 7: Upstream Retaining Wall for Reservoir Access with Spalling Visible

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 8: Cracks at Upstream Lower Wall Corner

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 9: Erosion at the Base of the Spillway Chute Left Concrete Wall

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 10: Repair at the Base of Spillway Chute Left Wall

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 11: Spillway Chute Structure (looking Downstream)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 12: Scoured Rock Channel filled with Debris Downstream of Main Spillway Chute Slab

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 13: Auxiliary Spillway Structure Looking Upstream with Safety Boom Beyond

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 14: Downstream Face of Auxiliary Spillway Structure

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 15: Downstream Face of Auxiliary Spillway (Wet Area at Corner)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 16: Upstream Side of Auxiliary Spillway Structure and Log Boom Beyond

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 17: Large Trees at Right Abutment (Downstream)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 18: Large Trees at Left Abutment (Downstream)

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 19: Wet Area at Downstream Toe of Dam and 'V' Notch Weir Housing

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 20: Well-Interlocked Riprap Downstream of Auxiliary Spillway Looking Downstream

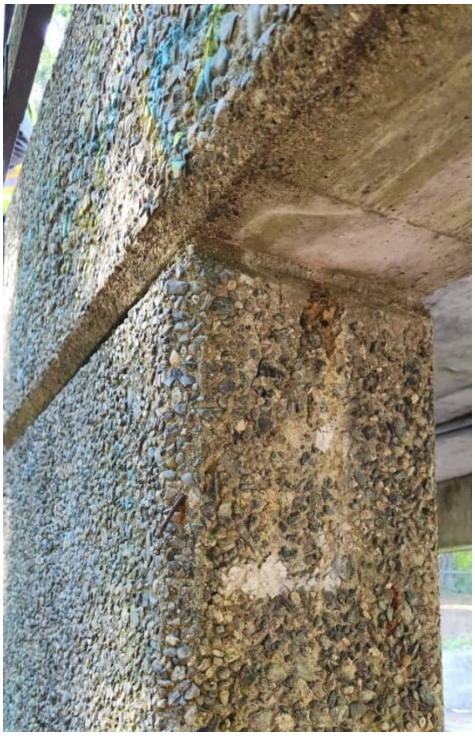
Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 21: Erosion at Upstream Rock Retaining Rock

Location: Lower Chase River (LCR)

Date: September 17, 2025



LCR 22: Diagonal Cracking on Downstream Bridge Pier

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 23: Delamination on Underside of Spillway Bridge

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 24: Cold Joints in Left Abutment

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 25: Delamination by Right Wall of Auxiliary Spillway

Location: Lower Chase River (LCR)

Date: September 17, 2025

LCR 26: Spall at Left Wall of Auxiliary Spillway

Location: Lower Chase River (LCR)

Date: September 17, 2025

WCL 1: Left Abutment of Dam Showing High Degree of Deterioration

Location: Witchcraft Lake Dam (WCL)

Date: September 17, 2025

WCL 2: Left Abutment Looking Downstream

Location: Witchcraft Lake Dam (WCL)

Date: September 17, 2025

WCL 3: Dam Showing High Degree of Deterioration

Location: Witchcraft Lake Dam (WCL)

Date: September 17, 2025

WCL 4: Right Abutment of Dam

Location: Witchcraft Lake Dam (WCL)

Date: September 17, 2025

MGC 1: Dam Crest (from Right Abutment of Spillway Bridge)

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 2: Staff Gauge and Boom Upstream of the Dam

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 3: Upstream Slope at Right Side of Spillway

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 4: Upstream Face (Looking towards the Right Abutment)

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 5: Vegetation on the Downstream Face at Right Abutment

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 6: Downstream of Spillway

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 7: Log Boom at Upstream Side of Spillway Channel

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

MGC 8: Pedestrian Bridge

Location: McGregor Creek Dam (MGC)

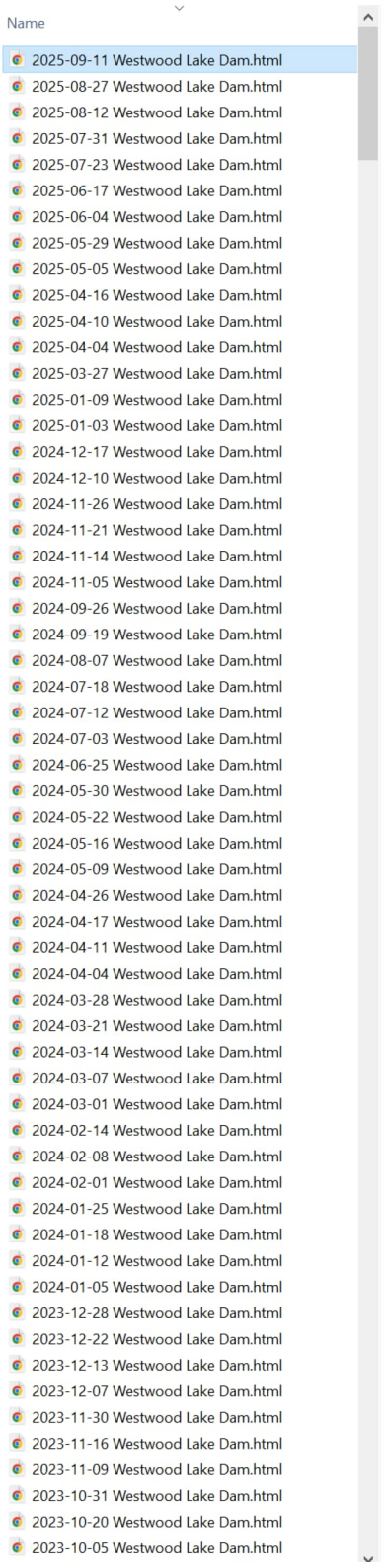
Date: September 17, 2025

MGC 9: Organic/Silty Material to the Left of the Spillway Channel

Location: McGregor Creek Dam (MGC)

Date: September 17, 2025

Appendix D
City of Nanaimo – Mobile Dam Inspection Database September 2025



Westwood Lake Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: -50cm
Weir Level: 0.08cm
Siphon Gauge: 14.5cm
Auxilliary Spillway Weir Level: 0.08cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Reservoir	Tree Toppling	Minor	
Dam Crest	Cracking	N/A	
Dam Crest	Settlement	Minor	
Upstream Slope	Cracking	Minor	
Upstream Slope	Settlement	N/A	
Upstream Slope	Spalling	Minor	
Upstream Slope	Loose Rocks in Concrete	Minor	
Downstream Slope	Cracking	N/A	
Downstream Slope	Settlement	Minor	
Downstream Slope	Vegetation Growth	Minor	
Storm Sewer System	Riprap	N/A	
Storm Sewer System	Energy Dissipator	N/A	
Saddle Dam Crest	Cracking	N/A	
Saddle Dam Crest	Settlement	Minor	
Saddle Dam Upstream Slope	Erosion	Minor	
Saddle Dam Upstream Slope	Settlement	Minor	
Saddle Dam Downstream Slope	Erosion	N/A	
Saddle Dam Downstream Slope	Settlement	N/A	
Saddle Dam Downstream Slope	Vegetation Growth	Moderate	Seasonal weedeating required.
Saddle Dam Downstream Slope	Seepage	Minor	
Concrete Sill	Cracking	Minor	
Concrete Sill	Debris	Minor	
Concrete Sill	Erosion	Minor	
Concrete Sill	Spalling	N/A	
Log Boom	South Anchor	N/A	
Log Boom	North Anchor	N/A	
Log Boom	Chain and Cable	N/A	
Log Boom	Logs	N/A	
Ground Survey	Completed	No	

Additional Info

Feature	Condition	Rating	Comment
Storm Sewer System	Riprap	Minor	
Storm Sewer System	Energy Dissipator	Minor	

Westwood Lake Dam

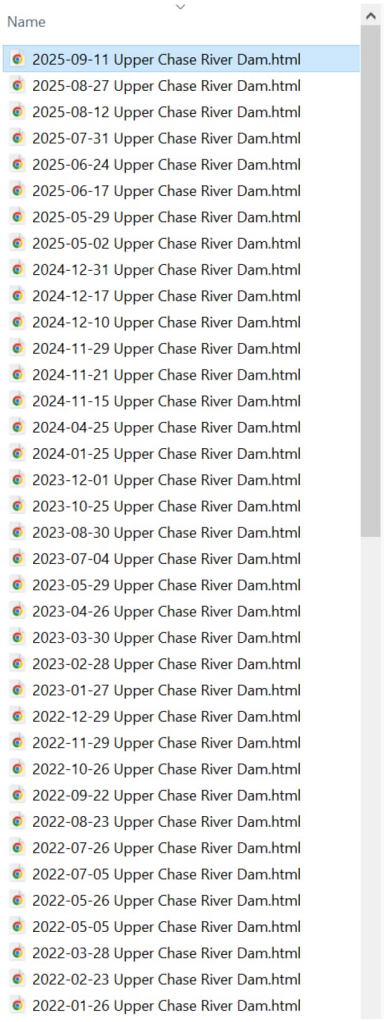
Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: -50cm
Weir Level: 0.08cm
Siphon Gauge: 14.5cm
Auxilliary Spillway Weir Level: 0.08cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Reservoir	Tree Toppling	Minor	
Dam Crest	Cracking	N/A	
Dam Crest	Settlement	Minor	
Upstream Slope	Cracking	Minor	
Upstream Slope	Settlement	N/A	
Upstream Slope	Spalling	Minor	
Upstream Slope	Loose Rocks in Concrete	Minor	
Downstream Slope	Cracking	N/A	
Downstream Slope	Settlement	Minor	
Downstream Slope	Vegetation Growth	Minor	
Storm Sewer System	Riprap	N/A	
Storm Sewer System	Energy Dissipator	N/A	
Saddle Dam Crest	Cracking	N/A	
Saddle Dam Crest	Settlement	Minor	
Saddle Dam Upstream Slope	Erosion	Minor	
Saddle Dam Upstream Slope	Settlement	Minor	
Saddle Dam Downstream Slope	Erosion	N/A	
Saddle Dam Downstream Slope	Settlement	N/A	
Saddle Dam Downstream Slope	Vegetation Growth	Moderate	Seasonal weedeating required.
Saddle Dam Downstream Slope	Seepage	Minor	
Concrete Sill	Cracking	Minor	
Concrete Sill	Debris	Minor	
Concrete Sill	Erosion	Minor	
Concrete Sill	Spalling	N/A	
Log Boom	South Anchor	N/A	

Log Boom	North Anchor	N/A
Log Boom	Chain and Cable	N/A
Log Boom	Logs	N/A
Ground Survey	Completed	No

Additional Info

Feature	Condition	Rating	Comment
Storm Sewer System	Riprap	Minor	
Storm Sewer System	Energy Dissipator	Minor	



Upper Chase River Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Spillway Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Moderate	Vegetation is heavily overgrown at the start of the spillway (removal scheduled for Sept.12/25) Seasonal weedeating needed along the top of the spillway on both sides.
Reservoir	Tree Toppling	Minor	
Reservoir	Valve Operated	No	
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	N/A	
Concrete Buttress Wall	Cracking	Moderate	
Concrete Buttress Wall	Settlement	N/A	
Concrete Buttress Wall	Spalling	**Major**	
Spillway	Cracking	Minor	
Spillway	Debris	**Major**	Grass has grown extensively at the mouth of the spillway restricting flow (removal scheduled for Sept.12/25).
Spillway	Movement	N/A	
Spillway	Spalling	Minor	
Downstream Slope	Cracking	Minor	
Downstream Slope	Settlement	Minor	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Ground Survey	Completed	No	

Upper Chase River Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Spillway Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Moderate	Vegetation is heavily overgrown at the start of the spillway (removal scheduled for Sept.12/25) Seasonal weedeating needed along the top of the spillway on both sides.
Reservoir	Tree Toppling	Minor	
Reservoir	Valve Operated	No	
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	N/A	
Concrete Buttress Wall	Cracking	Moderate	
Concrete Buttress Wall	Settlement	N/A	
Concrete Buttress Wall	Spalling	**Major**	
Spillway	Cracking	Minor	
Spillway	Debris	**Major**	Grass has grown extensively at the mouth of the spillway restricting flow (removal scheduled for Sept.12/25).
Spillway	Movement	N/A	
Spillway	Spalling	Minor	
Downstream Slope	Cracking	Minor	
Downstream Slope	Settlement	Minor	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Ground Survey	Completed	No	

Middle Chase River Dam

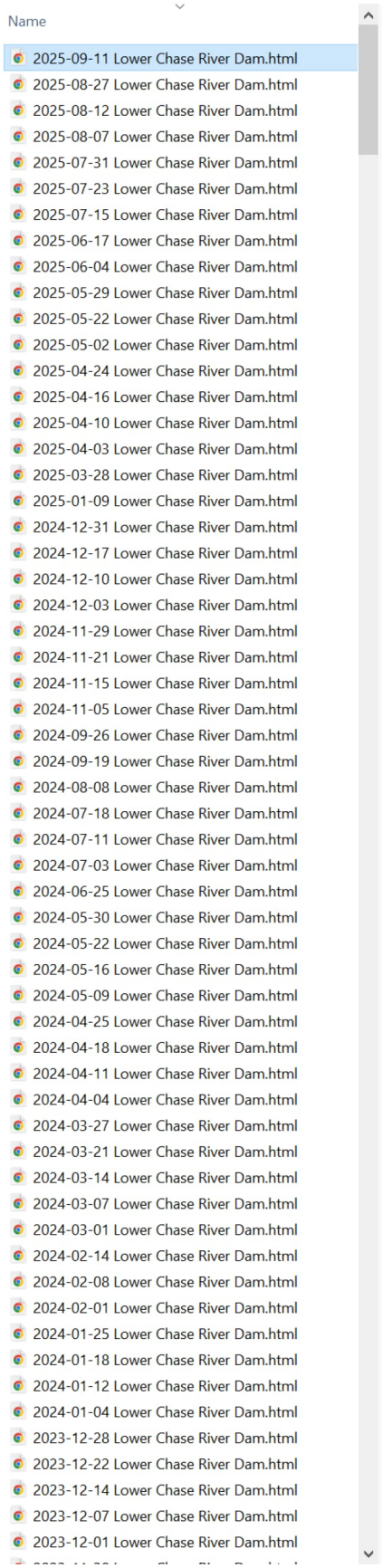
Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Weir Level: 0cm
Spillway Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	N/A	
Reservoir	Debris	Moderate	
Reservoir	Settlement	N/A	
Dam Crest	Cracking	N/A	
Dam Crest	Settlement	N/A	
Upstream Slope	Cracking	N/A	
Upstream Slope	Settlement	N/A	
Upstream Slope	Spalling	N/A	
Spillway	Cracking	N/A	
Spillway	Erosion	N/A	
Spillway	Movement	N/A	
Spillway	Spalling	N/A	
Spillway	Vegetation Growth	N/A	Small debris remains in the spillway. Debris larger than 30cm was removed by Dam Inspector.
Spillway	Tree Foliage Overhanging	Minor	
Downstream Slope	Movement	N/A	
Downstream Slope	Spalling	N/A	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Foot Bridge	Handrails	N/A	
Foot Bridge	Deck (Underneath)	Unsatisfactory	Concrete falling off. Rebar exposed and corroding.
Foot Bridge	Abutment	N/A	
Foot Bridge	Central Peir	N/A	
Ground Survey	Completed	Yes	Ground survey(Drilling test holes) from April 22-25/2025. Seismic ground survey conducted April 29 & 30th/2025. HATCH ground survey report complete and has been distributed to all who require it.

Middle Chase River Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Weir Level: 0cm
Spillway Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	N/A	
Reservoir	Debris	Moderate	
Reservoir	Settlement	N/A	
Dam Crest	Cracking	N/A	
Dam Crest	Settlement	N/A	
Upstream Slope	Cracking	N/A	
Upstream Slope	Settlement	N/A	
Upstream Slope	Spalling	N/A	
Spillway	Cracking	N/A	
Spillway	Erosion	N/A	
Spillway	Movement	N/A	
Spillway	Spalling	N/A	
Spillway	Vegetation Growth	N/A	Small debris remains in the spillway. Debris larger than 30cm was removed by Dam Inspector.
Spillway	Tree Foliage Overhanging	Minor	
Downstream Slope	Movement	N/A	
Downstream Slope	Spalling	N/A	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Foot Bridge	Handrails	N/A	
Foot Bridge	Deck (Underneath)	Unsatisfactory	Concrete falling off. Rebar exposed and corroding.
Foot Bridge	Abutment	N/A	
Foot Bridge	Central Peir	N/A	
Ground Survey	Completed	Yes	Ground survey(Drilling test holes) from April 22-25/2025. Seismic ground survey conducted April 29 & 30th/2025. HATCH ground survey report complete and has been distributed to all who require it.



Lower Chase River Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: 9cm
Weir Level: 2.3cm
Spillway Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	Moderate	
Dam Crest	Accelerometer Data Downloaded	No	
Upstream Slope	Cracking	Minor	
Upstream Slope	Settlement	Minor	
Upstream Slope	Spalling	Minor	
Spillway	Cracking	Minor	
Spillway	Erosion	Minor	
Spillway	Movement	Minor	
Spillway	Spalling	Minor	
Spillway	Vegetation Growth	Moderate	Lots of debris(logs and branches) in spillway.
Spillway	Tree Foliage Overhanging	Moderate	
Downstream Slope	Cracking	N/A	
Downstream Slope	Settlement	Moderate	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required. Some tree removal required (both standing and fallen).
Tuff Boom	East Anchor	N/A	
Tuff Boom	West Anchor	N/A	
Tuff Boom	Chain and Cable	N/A	
Tuff Boom	Logs	N/A	
Auxiliary Spillway	Debris Removed	No	
Auxiliary Spillway	Labyrinth Weir Condition (Leaks/Cracks)	Satisfactory	Very minor seepage along the left abutment where the two concrete walls meet.
Auxiliary Spillway	Log Stop (Removed/Installed)	No	
Auxiliary Spillway	Valve Sluice Gate Operated	Yes	
Auxiliary Spillway	Rip Rap	Satisfactory	
Auxiliary Spillway	Vegetation	Moderate	Seasonal weedeating required around the Aux Spillway fence.
Harewood Creek	Condition (Erosion)	N/A	
Pedestrian Bridge	Handrails	Satisfactory	
Pedestrian Bridge	Deck (Underneath)	Satisfactory	
Pedestrian Bridge	Abutments	Satisfactory	
Pedestrian Bridge	Central Pier	Satisfactory	
Auxiliary Spillway Bridge	Handrails	N/A	
Auxiliary Spillway Bridge	Deck (Above and Under)	N/A	
Auxiliary Spillway Bridge	Abutments	N/A	
Ground Survey	Completed	No	

Additional Info

Feature	Condition	Rating	Comment
Auxiliary Spillway	Log Stop (Installed)	Minor	
Auxiliary Spillway Bridge	Handrails	Minor	
Auxiliary Spillway Bridge	Deck (Above and Under)	Moderate	Heavy grafitti. Contractor's quote for graffiti removal has been submitted to Parks Dept.
Tuff Boom	East Anchor	Minor	
Tuff Boom	West Anchor	Minor	
Tuff Boom	Chain and Cable	Minor	
Tuff Boom	Logs	Minor	
Security fencing	Vandalism	Minor	A couple holes in the fencing

Lower Chase River Dam

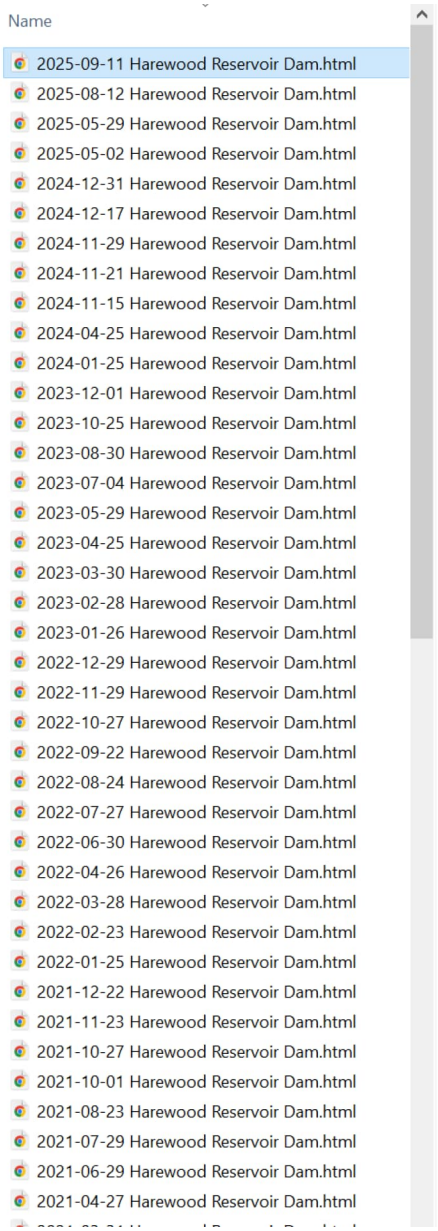
Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: 9cm
Weir Level: 2.3cm
Spillway Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	Moderate	
Dam Crest	Accelerometer Data Downloaded	No	
Upstream Slope	Cracking	Minor	
Upstream Slope	Settlement	Minor	
Upstream Slope	Spalling	Minor	
Spillway	Cracking	Minor	
Spillway	Erosion	Minor	
Spillway	Movement	Minor	
Spillway	Spalling	Minor	
Spillway	Vegetation Growth	Moderate	Lots of debris(logs and branches) in spillway.
Spillway	Tree Foliage Overhanging	Moderate	
Downstream Slope	Cracking	N/A	
Downstream Slope	Settlement	Moderate	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required. Some tree removal required (both standing and fallen).
Tuff Boom	East Anchor	N/A	
Tuff Boom	West Anchor	N/A	
Tuff Boom	Chain and Cable	N/A	
Tuff Boom	Logs	N/A	
Auxiliary Spillway	Debris Removed	No	
Auxiliary Spillway	Labyrinth Weir Condition (Leaks/Cracks)	Satisfactory	Very minor seepage along the left abutment where the two concrete walls meet.
Auxiliary Spillway	Log Stop (Removed/Installed)	No	
Auxiliary Spillway	Valve Sluice Gate Operated	Yes	
Auxiliary Spillway	Rip Rap	Satisfactory	

Auxiliary Spillway	Vegetation	Moderate	Seasonal weedeating required around the Aux Spillway fence.
Harewood Creek	Condition (Erosion)	N/A	
Pedestrian Bridge	Handrails	Satisfactory	
Pedestrian Bridge	Deck (Underneath)	Satisfactory	
Pedestrian Bridge	Abutments	Satisfactory	
Pedestrian Bridge	Central Pier	Satisfactory	
Auxiliary Spillway Bridge	Handrails	N/A	
Auxiliary Spillway Bridge	Deck (Above and Under)	N/A	
Auxiliary Spillway Bridge	Abutments	N/A	
Ground Survey	Completed	No	

Additional Info

Feature	Condition	Rating	Comment
Auxiliary Spillway	Log Stop (Installed)	Minor	
Auxiliary Spillway Bridge	Handrails	Minor	
Auxiliary Spillway Bridge	Deck (Above and Under)	Moderate	Heavy grafitti. Contractor's quote for graffiti removal has been submitted to Parks Dept.
Tuff Boom	East Anchor	Minor	
Tuff Boom	West Anchor	Minor	
Tuff Boom	Chain and Cable	Minor	
Tuff Boom	Logs	Minor	
Security fencing	Vandalism	Minor	A couple holes in the fencing



Harewood Reservoir Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: -15cm
Weir Level: 0.04cm
Auxilliary Spillway Weir Level: 0.04cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Reservoir	Erosion	N/A	
Reservoir	Tree Toppling	N/A	
Dam Crest	Cracking	Minor	
Dam Crest	Movement	N/A	
Dam Crest	Settlement	N/A	
Dam Crest	Spalling	Minor	
Upstream Face	Cracking	Minor	
Upstream Face	Movement	N/A	
Upstream Face	Settlement	N/A	
Upstream Face	Spalling	N/A	
Downstream Face	Cracking	Minor	
Downstream Face	Movement	N/A	
Downstream Face	Settlement	N/A	
Downstream Face	Spalling	N/A	
Spillway	Debris	Minor	
Spillway	Cracking	N/A	
Spillway	Erosion	N/A	
Spillway	Movement	N/A	
Spillway	Spalling	N/A	
Downstream Embankment	Cracking	N/A	
Downstream Embankment	Seepage	N/A	
Downstream Embankment	Settlement	N/A	
Downstream Embankment	Vegetation Growth	Minor	Seasonal weedeating completed Sept.9/25.
Downstream Embankment	Rock Wall Stability	Satisfactory	
Downstream Embankment	Low-Level Outlet	Satisfactory	
Ground	Survey	No	

Harewood Reservoir Dam

Date: 2025-09-11
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun
Reservoir Level: -15cm
Weir Level: 0.04cm
Auxilliary Spillway Weir Level: 0.04cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	
Reservoir	Debris	Minor	
Reservoir	Erosion	N/A	
Reservoir	Tree Toppling	N/A	
Dam Crest	Cracking	Minor	
Dam Crest	Movement	N/A	
Dam Crest	Settlement	N/A	
Dam Crest	Spalling	Minor	
Upstream Face	Cracking	Minor	
Upstream Face	Movement	N/A	
Upstream Face	Settlement	N/A	
Upstream Face	Spalling	N/A	
Downstream Face	Cracking	Minor	
Downstream Face	Movement	N/A	
Downstream Face	Settlement	N/A	
Downstream Face	Spalling	N/A	
Spillway	Debris	Minor	
Spillway	Cracking	N/A	
Spillway	Erosion	N/A	
Spillway	Movement	N/A	
Spillway	Spalling	N/A	
Downstream Embankment	Cracking	N/A	
Downstream Embankment	Seepage	N/A	
Downstream Embankment	Settlement	N/A	
Downstream Embankment	Vegetation Growth	Minor	Seasonal weedeating completed Sept.9/25.
Downstream Embankment	Rock Wall Stability	Satisfactory	
Downstream Embankment	Low-Level Outlet	Satisfactory	
Ground	Survey	No	

No 1 Reservoir Dam

Date: 2023-03-21
Inspected By: Troy Monsell
Ground Condition: Dry
Weather: Overcast
Weir Level: 0cm
Spillway Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	Reservoir is drained -6.8m
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	N/A	
Upstream Slope	Cracking	Minor	
Upstream Slope	Spalling	Minor	
Downstream Slope	Cracking	Minor	
Downstream Slope	Seepage	Minor	
Downstream Slope	Settlement	N/A	
Downstream Slope	Spalling	Minor	
Downstream Slope	Rock Slope	Satisfactory	
Spillway	Cracking	Minor	
Spillway	Erosion	Minor	
Spillway	Movement	N/A	
Spillway	Spalling	Minor	
Ground Survey	Completed	No	
Valve Operation	Condition	No	

Additional Info

Feature	Condition	Rating	Comment
Dam Crest	Spalling	Moderate	Moderate spalling on walkway on dam crest
Valve Operation	Completed	N/A	drain valve is 25% open and sump is clear.

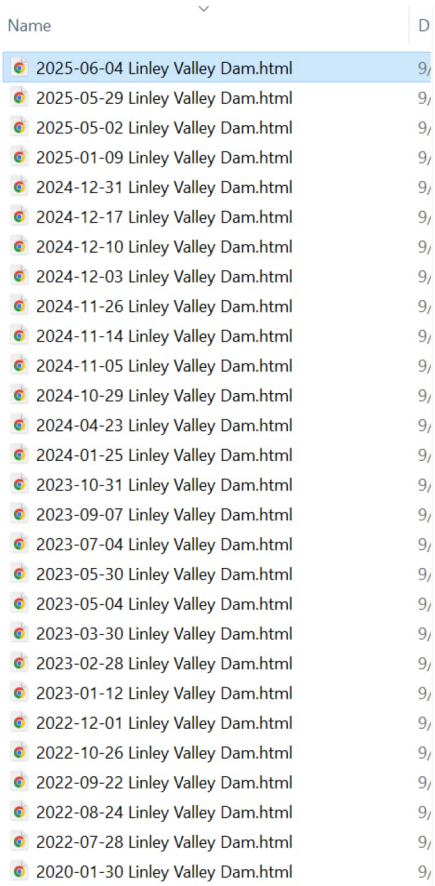
No 1 Reservoir Dam

Date: 2023-03-21
Inspected By: Troy Monsell
Ground Condition: Dry
Weather: Overcast
Weir Level: 0cm
Spillway Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Bank Stability	Satisfactory	Reservoir is drained -6.8m
Dam Crest	Cracking	Minor	
Dam Crest	Settlement	N/A	
Upstream Slope	Cracking	Minor	
Upstream Slope	Spalling	Minor	
Downstream Slope	Cracking	Minor	
Downstream Slope	Seepage	Minor	
Downstream Slope	Settlement	N/A	
Downstream Slope	Spalling	Minor	
Downstream Slope	Rock Slope	Satisfactory	
Spillway	Cracking	Minor	
Spillway	Erosion	Minor	
Spillway	Movement	N/A	
Spillway	Spalling	Minor	
Ground Survey	Completed	No	
Valve Operation	Condition	No	

Additional Info

Feature	Condition	Rating	Comment
Dam Crest	Spalling	Moderate	Moderate spalling on walkway on dam crest
Valve Operation	Completed	N/A	drain valve is 25% open and sump is clear.



Linley Valley Dam

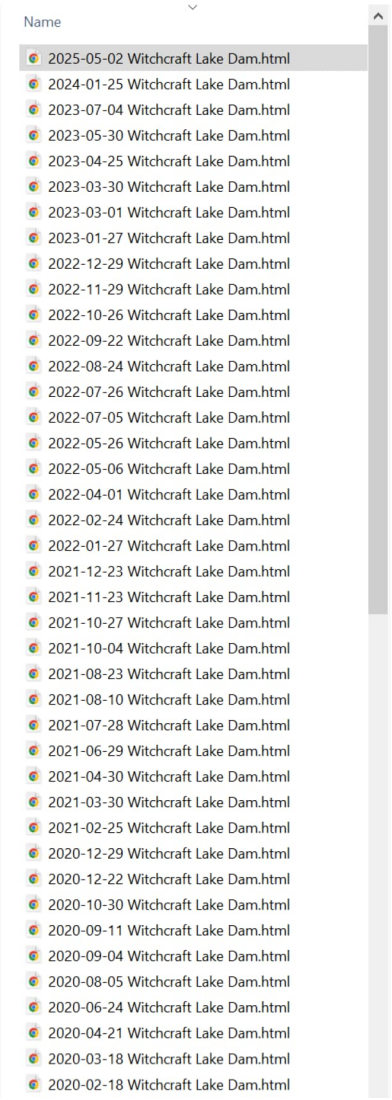
Date: 2025-06-04
Inspected By: B.Martin/C.Meier
Ground Condition: Dry
Weather: Overcast
Reservoir Level: -5cm
Weir Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Debris	N/A	
Reservoir	Tree Toppling	N/A	
Dam Crest	Settlement	N/A	
Dam Crest	Erosion	N/A	
Upstream Slope	Settlement	N/A	
Upstream Slope	Erosion	N/A	
Upstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Downstream Slope	Settlement	N/A	
Downstream Slope	Erosion	N/A	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required. Lots of Alders are growing along the dam face, seasonal tree removal required.
Downstream Slope	Seepage	N/A	
Spillway	Debris	**Major**	Beaver has been busy trying to dam off the spillway. Update: Beaver has established a solid dam that looks like people can walk on. Parks & Rec. needs to get a mini ex in to completely clear the dam!!
Spillway	Vegetation Growth	**Major**	Heavy grass growing in spillway.
Log Boom	South Anchor	N/A	
Log Boom	North Anchor	N/A	
Log Boom	Chain and Cable	N/A	
Log Boom	Logs	N/A	
Beaver Control System	Pipe	N/A	
Beaver Control System	Control Valve	N/A	
Downstream Culvert	Debris	N/A	
Downstream Culvert	Vegetation Growth	**Major**	Heavy amount of grass growing at outlet.
Ground Survey	Completed	No	

Linley Valley Dam

Date: 2025-06-04
Inspected By: B.Martin/C.Meier
Ground Condition: Dry
Weather: Overcast
Reservoir Level: -5cm
Weir Level: 0cm
Auxilliary Spillway Weir Level: 0cm

Feature	Condition	Rating	Comment
Reservoir	Debris	N/A	
Reservoir	Tree Toppling	N/A	
Dam Crest	Settlement	N/A	
Dam Crest	Erosion	N/A	
Upstream Slope	Settlement	N/A	
Upstream Slope	Erosion	N/A	
Upstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required.
Downstream Slope	Settlement	N/A	
Downstream Slope	Erosion	N/A	
Downstream Slope	Vegetation Growth	**Major**	Seasonal weedeating required. Lots of Alders are growing along the dam face, seasonal tree removal required.
Downstream Slope	Seepage	N/A	
Spillway	Debris	**Major**	Beaver has been busy trying to dam off the spillway. Update: Beaver has established a solid dam that looks like people can walk on. Parks & Rec. needs to get a mini ex in to completely clear the dam!!
Spillway	Vegetation Growth	**Major**	Heavy grass growing in spillway.
Log Boom	South Anchor	N/A	
Log Boom	North Anchor	N/A	
Log Boom	Chain and Cable	N/A	
Log Boom	Logs	N/A	
Beaver Control System	Pipe	N/A	
Beaver Control System	Control Valve	N/A	
Downstream Culvert	Debris	N/A	
Downstream Culvert	Vegetation Growth	**Major**	Heavy amount of grass growing at outlet.
Ground Survey	Completed	No	



Witchcraft Lake Dam

Date: 2025-05-02
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun

Feature	Condition	Rating	Comment
Reservoir	Flow from Diversion Creek	Minor	
Downstream Slope	Movement	Minor	
Downstream Slope	Settlement	Minor	
Downstream Slope	Seepage	Minor	
Dam Breach Area	Log Cribbing	Unsatisfactory	
Dam Breach Area	Waterflow Increase	Minor	
Diversion Channel	Condition	Satisfactory	
Diversion Channel	Erosion	Moderate	
Ground Survey	Completed	No	

Witchcraft Lake Dam

Date: 2025-05-02
Inspected By: C.Meier
Ground Condition: Dry
Weather: Sun

Feature	Condition	Rating	Comment
Reservoir	Flow from Diversion Creek	Minor	
Downstream Slope	Movement	Minor	
Downstream Slope	Settlement	Minor	
Downstream Slope	Seepage	Minor	
Dam Breach Area	Log Cribbing	Unsatisfactory	
Dam Breach Area	Waterflow Increase	Minor	
Diversion Channel	Condition	Satisfactory	
Diversion Channel	Erosion	Moderate	
Ground Survey	Completed	No	