

Introduction

This report is primarily focused on currently known deficiencies and logical next steps. Rather than going through the complexities in full detail of where things began and how it went wrong, the next section Risk Concerns, is most pertinent towards past and current circumstances and the constraints resulting from the current order.

Risk Concerns

Significant progress has been made; all studies required to address seismic concerns have been completed, and some studies required to address flood concerns have begun. Unfortunately overall, rushed decisions based on missing and incorrect information have resulted in the waste of a significant amount of funds. The dams have stood for over 105 years with no factual evidence of ever topping, and the studies completed to date show it to be of good condition.

The extreme sense of urgency to complete remediation immediately as per the terms of the order, is excessive - the potential waste of millions of dollars, needless destruction of the park, and potential damage to the fragile eco system before being able to apply proper due diligence is not justified.

How it Began – Seismic Concerns

In the 2010 seismic assessment completed on the dams, it described significant concerns. The dams were considered unacceptable due to recently changed standards and within the inundation study of 2012 it was discovered and articulated that imminent danger to safety was inevitable if the dams were subjected to even a minor earthquake. Information had circulated throughout the community about how bad they were thought to be:

- Concrete dams crumbling and honey combed
- Rebar – there is no rebar
- Cascading failure of both dams in 3 minutes
- 150 people could perish

A plan was formulated to remove the dams. Powerful words were used to back this up, such as “Extreme Hazard”, “Enormous Liability”, and “Worst Dams in the Province”.

When the community was presented with this, there were varied concerns. Some were concerned about the obviously unacceptable risk that had been portrayed and expressed their support for immediate removal, while others had skepticism as they were concerned that these conclusions had been based primarily upon assumptive data. Based on common sense and logic, they could not comprehend the making of such an important decision which was estimated to cost the tax payers \$30 million in remediation, and cause intrusion to the park that would likely result in its demise.

Previous Council, Staff and DSS expressed strong resistance towards completing further studies before taking remediation action. Facing public outcry from the community due to the lack of factual

supporting information, a Technical Committee was formed and a motion was made to address the insufficient studies.

Seismic Concerns Addressed

In consultation with the Technical Committee and a qualified Engineer, the recommended seismic studies were funded and reached completion. Through these studies it was found that the dams were in much better condition than had been assumed; risk of seismic failure was found to be well within regulatory limits and analysis confirmed that there was an extremely low probability of a dramatic rupture of the dams during an earthquake that would put public safety at risk.

When the concerned parties who had strongly resisted completing proper studies were provided with these results, appropriate logic based decisions prevailed and the plan to decommission was cancelled. A new recommendation for re-classification of the dams was made and adopted by DSS, *even though it was based in part on incomplete studies which didn't adequately address flood concerns, causing a reliance of assumed circumstances in relation to flooding.*

How it Began – Flood Concerns

Although only limited studies have been completed previously towards flood concerns, re-classification recommendations were made upon assumptive flood data. As a result the flood concerns as classified by DSS require significant remediation to address.

Resistance towards completing new studies which adequately address flood concerns was significant during the previous term of Council. In fact, the only flood concerns that were addressed within studies were of such limited scope that the results were inconclusive and ineffective towards making an informed decision. This is a direct result of previous Council and Staff attempting to encapsulate the studies within the remainder of funds available from the previously allocated resources for seismic.

Until new Council was in place, the City was essentially back to the same position it was placed in by Council, Staff, and the DSS – this time facing extreme flooding concerns rather than seismic, and of which the same failed process was being repeated that had already previously caused a premature sense of extreme urgency and a requirement to complete remediation immediately based on incomplete and unconfirmed information.

In November 2014, new Council was in place and began work on the various matters before them, including the significant concerns about the dams and the previous failed processes which had occurred.

In February 2015, Council directed Staff to reinstate the Technical Committee with expressed intent to define scope and proceed with further studies and continue working towards ensuring that the dams were within regulations. This motion was not acted upon by Staff due to technical complications articulated by Staff that the Technical Committee could not be reinstated.

In March 2015, Council directed Staff to work with the CDPPS to define scope and request further studies to be completed in order to work towards ensuring that the dams were within regulations.

This process began, with the previously articulated technical complications left behind. However, later during that month the City of Nanaimo was presented with the order for immediate remediation, and Staff was unable to complete work with the CDPPS in further defining scope and requesting further studies to be completed.

It was at that time that progress was interrupted and focus was shifted over to address the conditions of the order and determine how to proceed.

Where Are We At Now?

Currently the City of Nanaimo is in a position where an order is in place that effectively prevents Council and Staff from completing further progress towards the due diligence Council has determined necessary from its review of previously failed processes and incomplete information.

Council is faced with an order to decide upon options that Council does not consider to be in the community's best interest, and are options which may well be in excess of what is required since Council does not have the sufficient information it needs to make a properly informed decision.

As a result, the City of Nanaimo has filed a stay and appeal in order to try and have a reasonable amount of time to complete due diligence and explore other options. It is with this meeting with officials ahead of the formal stay and appeal process, that Council hopes to convey a better understanding of the circumstances to the officials so that a potential compromise can be reached and Council can finish the necessary due diligence towards design flood performance studies and select a remediation option which both meets regulatory requirements and satisfies the community's best interests.

Design Flood Performance Studies

Seismic vs. Flood Studies

Flood performance studies differ from seismic and are crucial towards assessing risk and completing due diligence as they require studies based upon a different set of data points. Flooding events also occur in a very different manner to a seismic event - they are much slower and allow time for forecasting, early warning and evacuation.

In the limited flood studies that were completed, the hydrographs were able to reveal that the design flood conditions would result in a flood that is only hours in duration due to the watershed being small - the time to peak and subside is short. *It is likely that during design flood conditions, large spread flooding would occur and is not limited to this area of Nanaimo. Residents will likely be inundated (and have already left their homes) even before the dams reach overtopping levels.*

Deficiencies in Current Studies

When focus was switched from seismic to flood risk, previously allocated funds were not sufficient to complete studies identified by Golder towards flooding and environmental risks and as a result remain uncompleted (on record from Golder - not enough money and time to explore). Flood performance was originally going to be part of the work from Golder but was somewhere dropped along the way.

Golder has stated in reports that they are providing expert opinions or other subjective estimates and assumptions based on various critical points because the data is not available due to the scope of studies requested and the available funding.

Definition of Further Studies

Since studies identified by Golder and the Technical Committee were never completed in switching from seismic to flood concerns, the actual performance of the dams under a major flood event is still undefined. The currently assessed flood safety risk is modeled upon the availability of limited data. This has caused an inherent requirement to consider and report upon assumptive conditions that have not been confirmed, and as a result have likely affected Golder's assessments in a conservative way, resulting in a higher risk classification recommendation.

There are two equally qualifying methods/phases to determine the flood performance of the dam. Which one to pursue first is simply a cost determination; completing both methods is only necessary if the first method pursued is found not to meet the requirements of the design flood. *In other words, if either method is found to meet design flood requirements it establishes that remediation is unnecessary.*

The two qualifying methods/phases are:

1. Prove/disprove the core by itself
2. Prove/disprove the downstream fill by itself

The work involved in proving/disproving each method differs, and is derived from applicable areas within the [Areas of Study](#) section. *If studies in these areas identify that a problem exists within both methods/phases as described above, appropriate remediation options must be defined as described in the [Remediation Option Prerequisites](#) section.*

Areas of Study

Four areas of study found to be deficient remain incomplete. The following questions in these areas of study are necessary in determining whether the core wall will survive in design flood conditions.

Site Investigation

A proper site investigation will contribute significantly towards the determining factors in overall risk and potential remediation options. Simple cost effective strip excavations answer the following:

- i. Physical properties of the concrete core wall and valve block
- ii. Actual as built conditions
- iii. Dimensions and geometry of the core as it rests between the cleft
- iv. Bedrock confirmation
- v. Does core thicken towards base

Structural Performance

Determining whether the wall will survive a design flood event is crucial towards defining appropriate remediation solutions if deficiencies are found. The following unanswered questions are critical in

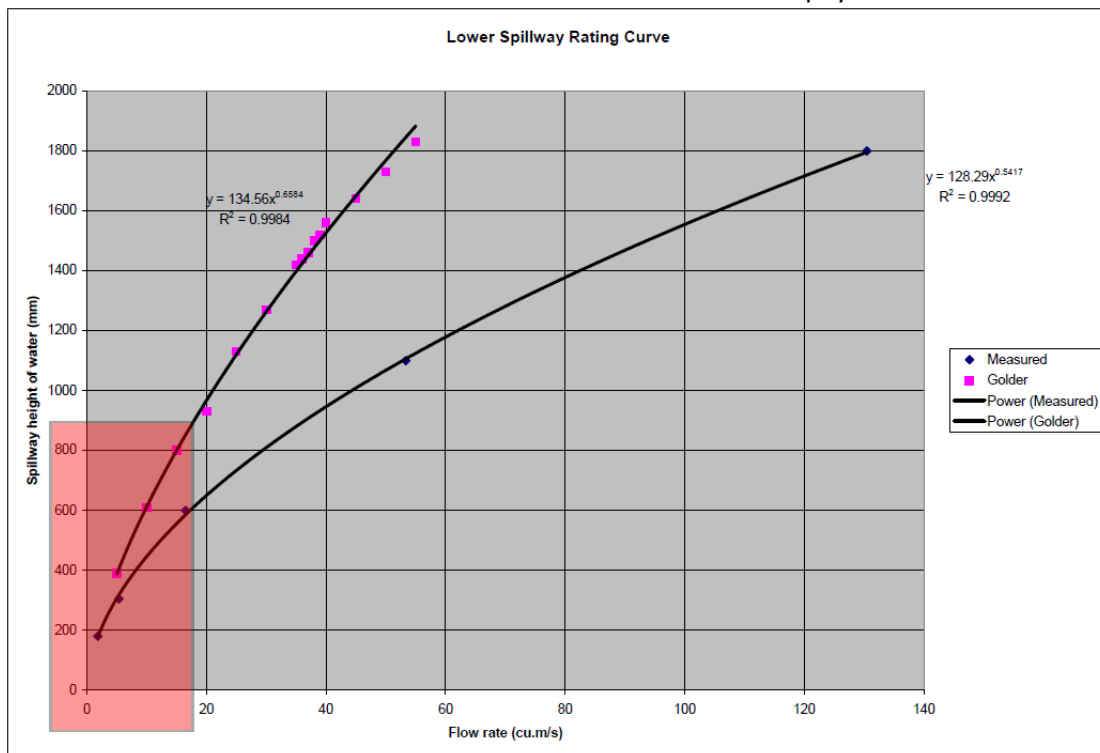
determining structural performance under design flood conditions:

- i. Will concrete core fracture
- ii. Will concrete core erode
- iii. Can the wall withstand an overtopping event unsupported (i.e. no rock fill downstream)

Flow Rate Performance

Due to required assumptions on coefficients in theoretical calculations, proper validation of flow rate performance can only be obtained by physical measurements. Initial findings based on differences found between theoretical calculations and actual physical measurements taken show a significant variance:

- i. As a preliminary test, the lower dam flow rate performance was physically measured during multiple rain events. It was found that the results were significantly different between the theoretical and physical methods. *At 600mm of water the theoretical flow was rated at 10cu.m/s, whereas the actual flow was 17cu.m/s*
- ii. Flow certainty could exist if a velocity reading at a point higher than 600mm was taken to further confirm the actual flow rate curve. However as it stands, the curves do follow the same trend with the updated values.
- iii. Results of the flow curve described above based on theoretical vs. physical measurements:



Environmental/Cultural Concerns

The area has been identified as a wildlife sanctuary containing a variety of protected and endangered species. Without further environmental studies, intrusive remediation options could cause irreparable damage to the fragile ecosystem.

Current studies are deficient in addressing these environmental concerns. Golder has stated the following in their reports:

- i. An environmental assessment has not been conducted
- ii. Potential exceedance of sensitive site standards for sediment were identified but it has not been confirmed whether such standards would apply at this site
- iii. Effects on such factors as downstream water quality due to the release of contaminated soils in the downstream environment has not been studied

The park is also valuable part of the Nanaimo Heritage Register due to its rare tangible link with Nanaimo's industrial heritage and has significant cultural value. The park is readily accessible to the public as a recreational and interpretive venue.

Remediation Option Prerequisites

If the areas of study indicate that an incremental catastrophic failure could occur, further questions must be answered regarding flow and structural performance previous to determining and recommending potential remediation options:

- i. How much support is required (ie rock fill berm)
- ii. Can the downstream fill survive the design flood
- iii. Is there enough supporting fill
- iv. How much water will flow over the crest
- v. Lateral dissipation of the water once spillway has reached capacity
- vi. Actual capacity of spillway
- vii. What is the rate of erosion of the down stream – how much fill is lost

Conclusion

The City of Nanaimo requires further time to conduct additional studies and collect key information in order to determine appropriate remediation measures and conclusively verify the current risk classifications or validate the need to have a qualified Engineer reassess the risk classification based upon new information found in the completed studies.

Council remains committed to ensuring that the dams become fully compliant with regulations. It is important that the City of Nanaimo is able to complete due diligence in order to proceed with appropriate remediation steps.

Council is requesting that previous to the completion of the stay and appeal process, that the order be rescinded or altered to allow further time to complete due diligence after which the City of Nanaimo would be seeking approval from the Comptroller to proceed forward with a recommended remediation

solution that would be based on the results. If this is permitted, then Council will proceed with the following:

Council will direct Staff to retain a qualified Engineer to consult with a Council appointed Technical Committee in order to define a suitable scope of studies and funding requirements.

Council will direct Staff to act upon the recommendations by allocating the required funds and directing a qualified Engineer to complete the studies and provide remediation solution recommendations.

Upon approval from the Comptroller, Council will direct Staff to act upon the selected remediation solution and complete all required remediation work found to be necessary.

Appendix

Engineer Statements of Study Limitations

Provided below are Golder statements within the June 2014 Risk Assessment, August 2014 Remediation Report, and November 2014 Consequence Classification referencing challenges and limitations to the studies due to scope, time restraints, budget, and assumptions.

Risk Assessment - July 2014:

- "These predictions took into account the potential effectiveness of evacuation warnings and considered "incremental" consequences (i.e., consequences that are in addition to those that would occur if the dams were not there). For several scenarios, flooding or incremental consequences have been interpolated/extrapolated from the results of other scenarios, due to the high cost and time required for hydraulic modeling."

Remediation Report - August 2014:

- "A key project challenge was the tight timeframe, as there was a strong preference to carry out the options assessment and selection as well as detailed design and construction of the dam remediation in 2014."
- "Due to access, budget and time restraints, a test pit investigation program was considered optimal for collecting information on the properties of the dam fills on the downstream face, near the existing spillway and on the dam crest."
- "A third planned core hole (CH14-01) was not completed due to time constraints."
- "Due to time constraints, the development of the remediation options was carried out concurrently with the site investigation (Golder 2014a), the risk assessment (including the dam safety analyses, (Golder 2014b, c and d) and the dam re-classification. This parallel sequence of events required some assumptions during the options development, including the use of the design criteria for the previous dam classification (since the dam was not re-

classified until later in the options development), as well as certain assumptions of how the risk assessment may be applied (since, for DSS, this was the first application of the risk assessment process for dam safety analysis in BC).”

- “Due to time constraints, this list of initial options was developed in conjunction with a preliminary flow and scour analysis.”
- “Due to poor supportability of the loose cinders and slag fill surface which might settle or move with time, construction difficulties of forming and placement of concrete on a steep surface, cost and time limitations, CRCS was not carried forward as an overtopping protection system.”
- “In order to provide a consistent basis for comparison, the screened option assessment was based on a hydraulic capacity of 175m³/s. At the time this work was undertaken, the dams were both assigned a consequence classification of Extreme, and therefore a conservative flow requirement, slightly greater than the regulatory requirement (PMF), was selected. As noted in Section 4.0, the hazard classification for the Lower Dam was later reduced to Very High.”

Consequence Classification - November 2014

- “Although not studied and analysed in detail, a breach of the Lower Dam is expected to result in a release of most, if not all, of the contaminants into the downstream portions of the Chase River and on to the inundated low-lying areas to the Chase River. The consequences of this release of contaminated soils have been considered in the consequence classification for the Lower Dam, as described in the next section”
- “Based on the review of the dam failure scenarios, it is likely that destruction of aquatic and terrestrial resources will occur and probable that the resulting flooding downstream from the dams would permanently alter or destroy habitat. The review of available online databases and literature sources suggest that the Study Area contains high value habitat and populations of many native species. It is Golder’s opinion that the environmental consequences of dam failure would likely be classed as “high” under Schedule 1 of the BC Dam Safety Regulations. This classification is described as “the significant loss or deterioration of the following:
 - Important fisheries habitat or important wildlife habitat;
 - Rare or endangered species; or
 - Unique landscapes or sites of cultural significance.Restoration or compensation in kind is highly possible.”

Golder has made the above statement with the limitation that an environmental assessment was not conducted.”