Lake Simcoe Region conservation authority

Dam Inspection Report

Pefferlaw Dam

Town of Georgina
Regional Municipality of York

D.M. Wills Project Number 19-5381

D.M. Wills Associates Limited
Partners in Engineering
Peterborough

December 2019

Prepared for:
Lake Simcoe Region
Conservation Authority

Table of Contents

1.0 Introduction 1
2.0 Inspection Methodology 3
3.0 Inspection Results and Recommendations 4
4.0 Closing 8

Figures

Figure 1 – Location Plan 2

Tables

Table 1 – Dam Inspection Recommendations 5

Appendices

Appendix A - Photographic Record
Appendix B - Dam Inspection Form B2
Appendix C - Field Notes and Sketches

1.0 Introduction

D.M. Wills Associates Limited (Wills) was retained by the Lake Simcoe Region Conservation Authority (LSRCA) to undertake an inspection of the Pefferlaw Dam. The purpose of this report is to document the methodology, observations and recommendations of the inspection. The recommendations are based on the field observations as well as a review of the available background material and discussions with LSRCA staff. Wills' inspection crew consisted of David Green, P.Eng. and Zach Staples, P.Eng..

The Pefferlaw Dam is located on the Main Branch of the Pefferlaw Brook approximately 200 m south of Pefferlaw Road in the village of Pefferlaw, Town of Georgina, Regional Municipality of York. The location plan is provided in Figure 1. The dam was constructed in the early 1880's in conjunction with another dam on the East Branch of Pefferlaw Brook. The original purpose of the dams was to provide water storage to power three mills located on the watercourse. Mill races were constructed on both the east and west sides of the Main Branch of the Pefferlaw Brook to channel water to the mills. The mills ceased operations some time ago and the dam's current function is as a flood and ice control structure. The downstream channel and the headpond also provide recreational uses and contribute to the general aesthetic of the area, as the former mill sites downstream of the dam have been redeveloped as a municipal park and a number of residences have been constructed adjacent to the headpond. Several residences have docks constructed on the headpond.

The dam consists of a 31 m long concrete gravity structure with a 20 m long earth embankment on the west side and a 30 m long earth embankment on the east side. The concrete gravity structure includes a 13 m long concrete weir topped with timber flash boards on the left (west) side of the structure, a 4.8 m wide sluiceway with timber stoplogs in the middle of the structure and a 7.2 m long overflow weir on the right (east) side of the structure. There are concrete aprons below the weirs and the centre sluiceway as well as concrete wingwalls on both the left (west) and right (east) sides. Access across the dam is provided by a 1.1 m wide steel truss bridge. The truss bridge is supported on stub concrete abutments located behind the dam wingwalls and by steel posts at the sluiceway piers. The dam is accessed from Pefferlaw Road, which is located approximately 200 m north (downstream) of the structure. Access by motorized vehicles is available via a gravel road on the west side of the Pefferlaw Brook. A gate at Pefferlaw Road restricts unauthorized vehicles from accessing the west side access road. There is a secondary gated access on the east side of the Pefferlaw Brook that could be used as an emergency or maintenance access to the east side of the dam.

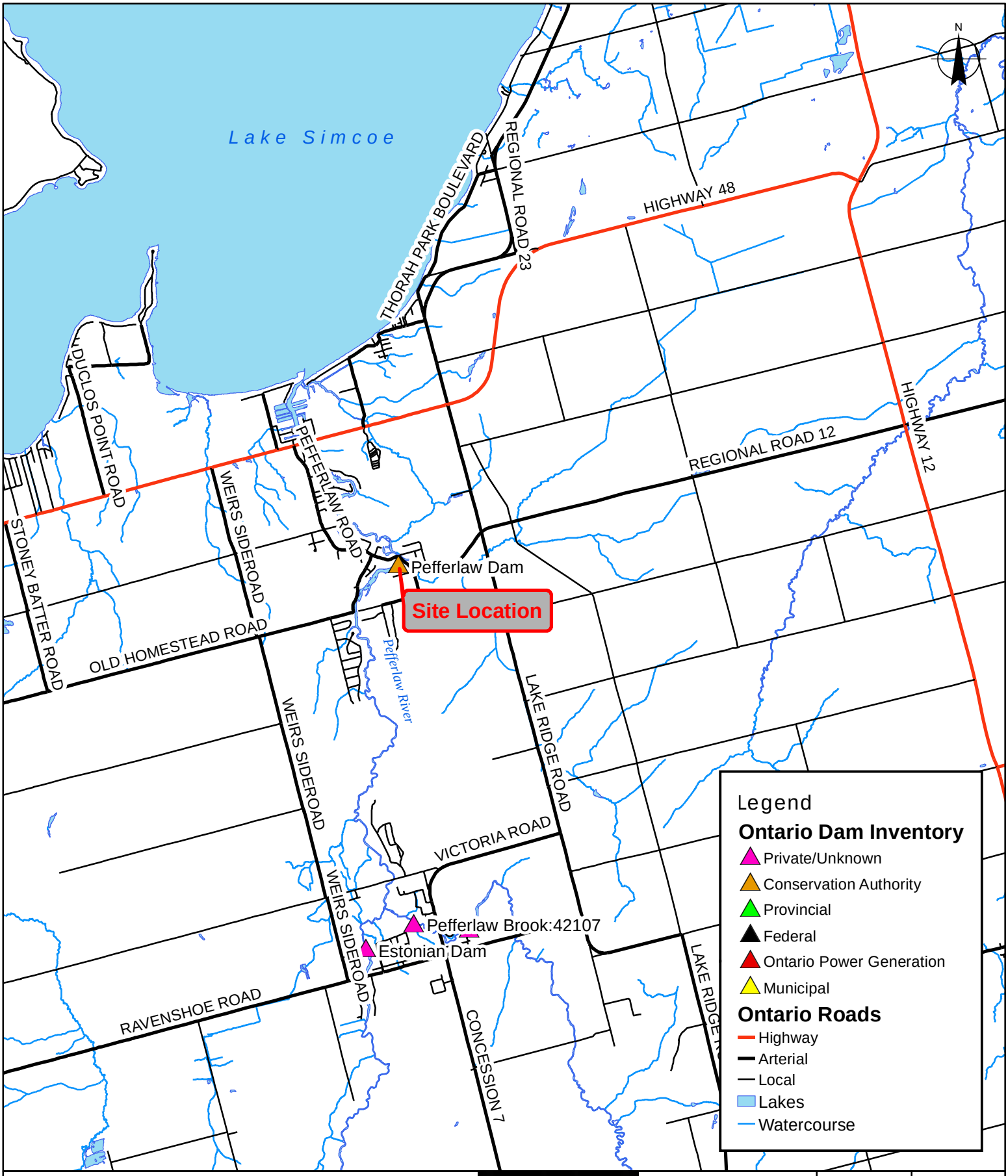

Figure 1: Location Plan

NAD83 UTM Zone 17 North

0 0.5 1 2 3 4 Kilometers

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Drawn by: DG	Scale (Horz.) 1:80,000
Checked by: DG	
Engineer: DG	Map Date: 12/04/19
Project No. 19-5381	Map File No.: 20191204-5381

2.0 Inspection Methodology

Wills undertook the dam inspection with LSRCA staff on November 19, 2019. The dam inspection consisted of a visual inspection of the dam to provide information regarding any condition, operation or safety (dam safety, operator safety, public safety) issues. The dam inspection generally included the following aspects:

- Detailed visual structural inspection of the dam to assess existing conditions, confirm concrete strength and integrity, and to confirm concrete contact with other materials.
- Detailed visual inspection of any earth embankment components to assess existing conditions for seepage, piping, surface erosion, slumping, and cracking.
- Inspect and document the condition of the flow control equipment.
- Review public (safety boom, signage, fencing, railings, etc.) and operator (fall arrest, railings, etc.) safety measures.
- Confirm dam dimensions with the provided sketches / drawings and prepare sketches showing the locations and types of surface defects such that they can be cross-referenced with photographs.
- Georeferenced digital photographs of the major dam components as well as close-ups of identified deficiencies will be captured.
- Aerial imagery and video of the dam and up and downstream areas collected using a Remotely Piloted Aircraft System.
- Underwater video of specific sections of the dam collected using a GoPro camera equipped with an LED lighting system.

During the dam inspection, the head pond was drawn down to its winter water level with one (1) stoplog installed in the sluiceway. There was significant flow through the sluiceway during the inspection, limiting the inspection of the sluiceway and sluiceway apron. Snow was present on the earth embankment and concrete structures during the inspection. Wills' staff cleared snow from the concrete structures to the best of their ability prior to commencing the inspection.

3.0 Inspection Results and Recommendations

The dam inspection results are documented in the photographic record in Appendix A and the Dam Inspection Form B2 in Appendix B. Field sketches and notes are provided in Appendix C. Digital copies of all photographs and videos from the inspection will be provided to the LSRCA either by USB or other form of digital file transfer.

The inspection recommendations along with prioritization and cost estimates for each recommendation are provided in Table 1. The degree of accuracy for the cost estimates is approximately +/-25% and are based the best information available at the time of report production. The priorities are classified as "Immediate", "High", "Medium" and "Low" and are defined as follows:

- Immediate – Remedial action that needs to be carried out as soon as possible because the deficiency is an immediate high risk dam safety hazard with a high likelihood of occurrence of loss of life and /or serious environment and/or serious economic consequences.
- High – Remedial action is required within the next 2 years to meet current regulations and/or dam safety requirements and is a high risk dam safety hazard.
- Medium – These items may include additional work that could improve the performance or issues that may become serious dam deficiencies. These items typically should be addressed within 5 years.
- Low – These are opportunities to improve safety or only in the long term may become a serious dam safety deficiency. The recommendation can be carried out at LSRCA's convenience or the recommended remedial action is expected to be required only at least 6 years from now.

The recommendations are prioritized based on the following:

- Risk of occurrence.
- Significance of potential negative impacts.
- Resources (cost, time, effort) required to implement.

Table 1 – Dam Inspection Recommendations

Recommendation	Description of Deficiency	Priority	Estimated Cost	Additional Comments
1. Remove the trees from the earth embankment and from adjacent to concrete or masonry structures and remediate the voids left by the root systems.	There are a significant number of large trees located on the earth embankment sections.	Medium	$15,000	The cost estimate assumes that a contractor would be hired to remove the trees, remediate the root systems and restore the earth embankment. Cost savings may be realized if the LSRCA is able to complete this work using internal resources.
2. Undertake a concrete condition assessment for the dam, including concrete coring and detailed surface mapping, and based on the results of the concrete condition assessment prepare a detailed rehabilitation design for the concrete components of the structure.	The condition of the concrete is poor in a number of locations.	High	$40,000*	The cost estimate provided is the cost of the concrete condition assessment and detailed rehabilitation design. The cost of completing the concrete rehabilitation could be in the range of $100,000 to $150,000, to be confirmed as part of the detailed rehabilitation design project. This work should be completed by a professional consulting engineer.
3. Undertake a structural evaluation of the truss bridge within one (1) year and develop a detailed repair or replacement design for the truss bridge and dam deck. Depending on the results of the structural evaluation, temporary repairs, the removal of the stoplogs stored on the deck or temporary suspension of dam operations may be required.	The steel truss is in poor condition with failure of the coating and cracking and bowing of the structural steel members.	Immediate	$5,000*	The cost estimate provided is the cost for the structural evaluation only. The cost for the detailed design for the repair or replacement will depend on the results of the structural evaluation and on the structure type but would likely be in the range of $30,000 to $60,000. This work should be completed by a professional consulting engineer. As an alternate to undertaking Recommendation 3, the LSRCA could stop operating the dam, remove the stoplogs stored on the dam and eliminate public access across the dam. However, this is only seen as a short term solution and a permanent solution, such as repair, replacement or dam decommissioning will ultimately be required in order to ensure public and operator safety.
4. Repair the chain link fence along the west property line.	The chain link fence is broken.	Low	$5,000	The cost estimate assumes that the LSRCSA would retain a contractor to complete this work. Cost savings may be realized if the LSRCA is able to complete this work using internal resources.

Recommendation	Description of Deficiency	Priority	Estimated Cost	Additional Comments
5. Replace the flashboards and flashboard posts, as planned. Note: Future replacement of the stoplogs may be required.	The flashboards and flashboard posts are in poor condition and the LSRCA is already planning to replace them. The stoplogs may require replacement in 2 to 5 years.	High	$8,000	The cost estimate assumes that the LSRCA will outsource the fabrication of the flashboard posts and will fabricate the flashboards using internal resources.
6. Repair the erosion on the upstream left (west) and right (east) sides of the earth embankment.	There is erosion at the normal operating water level.	Medium	$25,000	The cost estimate assumes that the LSRCA will retain a contractor to complete grading and rip-rap placement along the shoreline.
7. Repair the erosion behind the downstream left (west) and right (east) armour stone retaining walls.	There is erosion behind the armour stone retaining walls.	High	$25,000	The scope of the erosion repair is difficult to determine due to the presence of snow on the ground during the dam inspection. The cost estimate assumes that the LSRCA will retain a contractor to complete the work.
8. Complete a Public Safety Risk Assessment and based on the results of the assessment prepare a Public Safety Plan and implement the recommended additional public safety measures. Additional public safety measures that could be identified during the Public Safety Risk Assessment and may need to be considered as part of the Public Safety Plan include: signage on the pedestrian approaches to the dam and at the entrance to the park, a public safety boom in the head pond and additional railings/fencing around the stoplog storage area on the deck.	There is no existing Public Safety Risk Assessment or Public Safety Plan for the site and there is significant public interaction with the dam. The existing public safety measures may not be sufficient to reduce the risk to public safety.	Medium	$15,000*	The cost estimate provided is for the completion of the Public Safety Risk Assessment and Public Safety Plan. This work is typically completed by a professional consulting engineer; however, it could be completed by LSRCA staff if they have appropriate training and experience in Public Safety Risk Assessments for dams. Depending on the results of the study, the cost of additional public safety measures could range from $2,500 for additional signage to $75,000 for a public safety boom. As an alternate to undertaking Recommendation 8, the LSRCA could go ahead and implement additional public safety measures; however, there would be limited justification for which measures to put in which locations and limited information as to whether or not they would have the intended effect of reducing the risk to public safety.

Recommendation	Description of Deficiency	Priority	Estimated Cost	Additional Comments
9. Confirm, through the structural evaluation of the truss bridge, that the truss/railing has sufficient capacity to act as a fall arrest anchor point for use by operators during stoplog operations. If the anchor point does not have sufficient capacity, implement additional operator fall protection measures.	There is engineered fall arrest anchor point for the stoplog sluiceway and the fall from the top of the deck to the concrete surface below is greater than 3.0 m.	Immediate	$5,000	This cost estimate assumes that the evaluation of the anchor point will be incorporated into the structural evaluation of the steel truss bridge. The cost would be more if this work is completed on its own. This work should be completed by a professional consulting engineer. As an alternate to undertaking Recommendation 9, the LSRCA could stop operating the dam. However, this is seen as only a temporary solution. Ultimately an engineered anchor point or fall arrest system will be required if the dam is to continue operation.
10. Complete a new Dam Safety Review that incorporates a new hydrology and dam breach study, concrete gravity dam stability assessment and earth embankment stability assessment. The dam safety review should be completed in accordance with the Lakes and Rivers Improvement Act Technical Bulletins and Best Management Practices (MNR, 2011).	The latest Dam Safety Review was completed over 10 years ago using outdated MNR dam safety guidelines and does not include a detailed dam breach analysis. Additionally, the previous Dam Safety Review indicated that the dam was not stable under some loading conditions.	High	$90,000*	This work should be completed by a professional consulting engineer. As an alternate to undertaking Recommendation 10, the LSRCA could complete a Hazard Potential Classification (HPC) and Inflow Design Flood (IDF) Review instead of a full Dam Safety Review. The results of the HPC and IDF Review would assist the LSRCA in determining if a full Dam Safety Review is required. For example, if the dam is confirmed to be Low hazard then updating the stability assessment may not be required. The cost for an HPC and IDF Review would be in the range of $50,000.

* Estimated cost is based on recent quotations and may have a higher level of accuracy.

4.0 Closing

Thank you for the opportunity to provide engineering services to the LSRCA for the inspection of the Pefferlaw Dam. Wills would be pleased to further discuss the recommendations provided in **Table 1** and assist the LSRCA with developing a plan to address the noted deficiencies.

Respectfully Submitted,

David Green, P.Eng.
Assistant Manager,
Water Resources Engineering

Appendix A

Photographic Record

Photo 0921 - Nov. 19, 2019
Pefferlaw Dam
Pefferlaw Dam, Downstream Elevation

Photo 0925 - Nov. 19, 2019
Pefferlaw Dam
Channel and Bridge Downstream of Dam

Photo 0927 - Nov. 19, 2019
Pefferlaw Dam
Downstream Area

Photo 0934 - Nov. 19, 2019
Pefferlaw Dam
General Plan View of Dam

Photo 0935 - Nov. 19, 2019
Pefferlaw Dam
Upstream Area / Head Pond

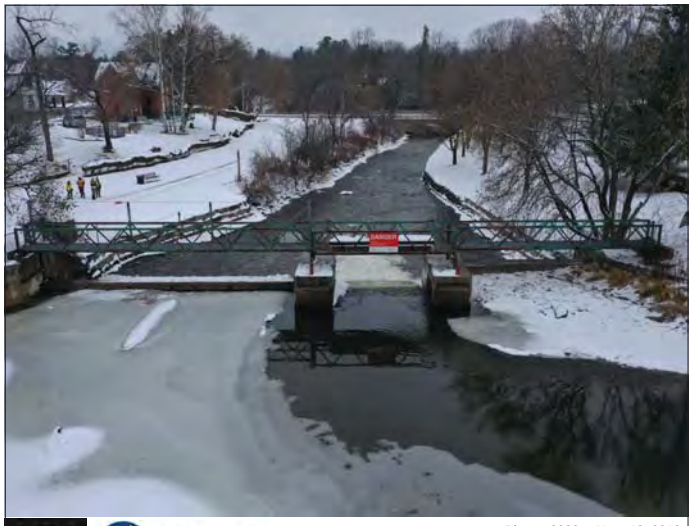


Photo 0939 - Nov. 19, 2019
Pefferlaw Dam
Pefferlaw Dam, Upstream Elevation

Photo 0922 - Nov. 19, 2019
Pefferlaw Dam
Public Safety Sign, Downstream Side of Dam

Photo 0923 - Nov. 19, 2019
Pefferlaw Dam
Public Safety Sign, Downstream Side of Dam

Photo 0940 - Nov. 19, 2019
Pefferlaw Dam
Public Safety Sign, Upstream Side of Dam

Photo 0942 - Nov. 19, 2019
Pefferlaw Dam
Pier 1 (West Pier) Upstream and Right Face

Photo 0943 - Nov. 19, 2019
Pefferlaw Dam
Pier 2 (East Pier) Upstream and Left Face

Photo 0947 - Nov. 19, 2019
Pefferlaw Dam
Retaining Wall Along Head Pond Shoreline

Photo 0948 - Nov. 19, 2019
Pefferlaw Dam
Head Pond

Photo 0961 - Nov. 19, 2019
Pefferlaw Dam
Sluiceway and Operating Deck from Above

Photo 0964 - Nov. 19, 2019
Pefferlaw Dam
Remnants of Fish Ladder

Photo 0965 - Nov. 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 0966 - Nov. 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 0967 - Nov. 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 0968 - Nov. 19, 2019
Pefferlaw Dam
Left (West) Apron and Weir

Photo 0969 - Nov. 19, 2019
Pefferlaw Dam
Pier 1 (West Pier) Downstream and Left Sides

Photo 0972 - Nov. 19, 2019
Pefferlaw Dam
Sluiceway Elevation

Photo 0973 - Nov. 19, 2019
Pefferlaw Dam
Right (East) Weir, Apron and Dam Abutment

Photo 2607 - Sept 19, 2019
Pefferlaw Dam
West Entrance and Gate

Photo 2608 - Sept 19, 2019
Pefferlaw Dam
Sign Near West Entrance

Photo 2612 - Sept 19, 2019
Pefferlaw Dam
Looking Upstream from Pefferlaw Road Towards Dam

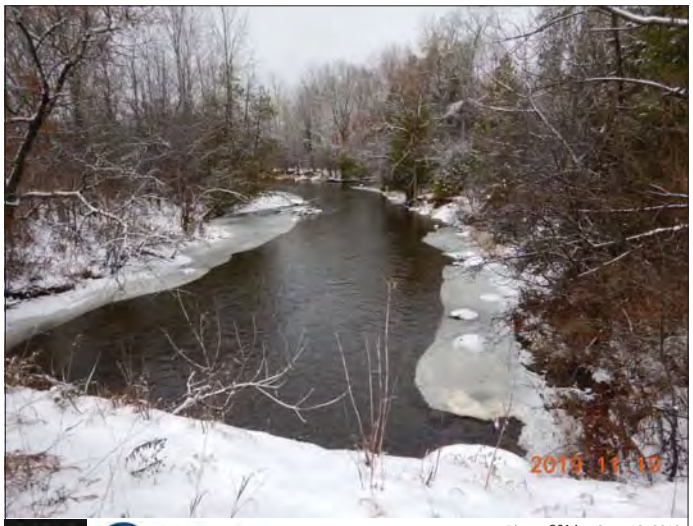


Photo 2614 - Sept 19, 2019
Pefferlaw Dam
Downstream of Pefferlaw Road

Photo 2629 - Sept 19, 2019
Pefferlaw Dam
East Access and Gate

Photo 2631 - Sept 19, 2019
Pefferlaw Dam
Sign near East Access

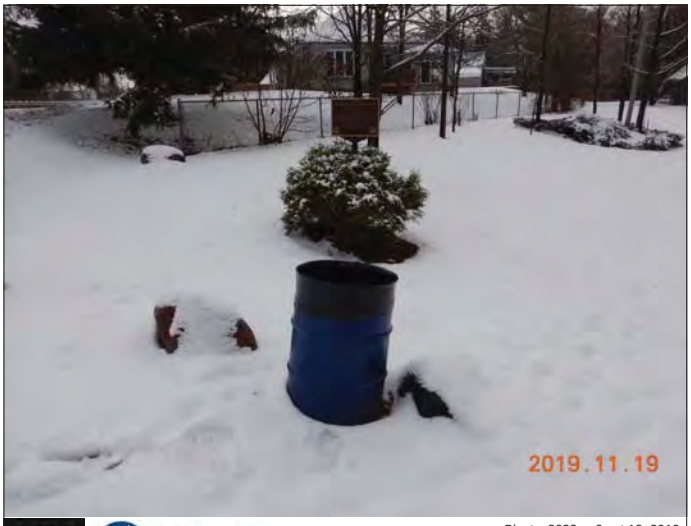


Photo 2632 - Sept 19, 2019
Pefferlaw Dam
Garbage Receptacle Near East Access

Photo 2633 - Sept 19, 2019
Pefferlaw Dam
Commemerative Plaque Near East Gate

Photo 2637 - Sept 19, 2019
Pefferlaw Dam
Park on East Side of Pefferlaw Brook

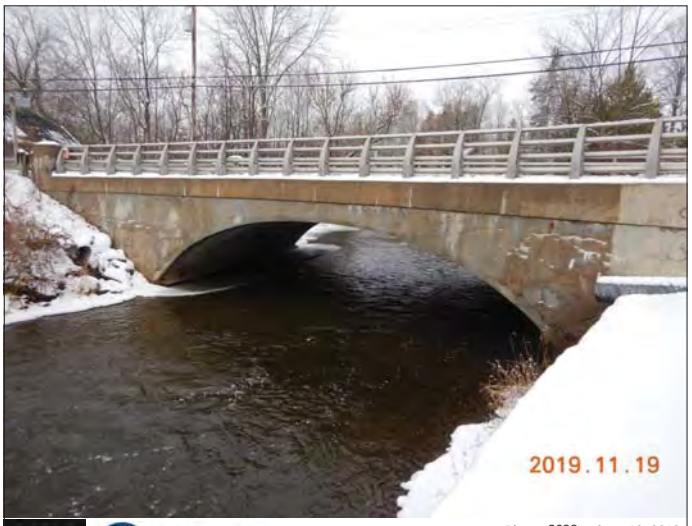


Photo 2638 - Sept 19, 2019
Pefferlaw Dam
Pefferlaw Road Bridge

Photo 2645 - Sept 19, 2019
Pefferlaw Dam
Park Structure

Photo 2648 - Sept 19, 2019
Pefferlaw Dam
Masonry Wall from Former Mill Structure

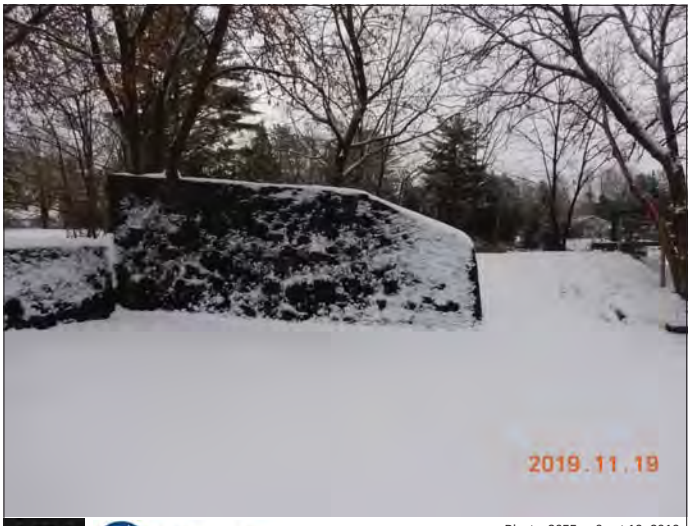


Photo 2655 - Sept 19, 2019
Pefferlaw Dam
Masonry Wall from Former Mill Structure

Photo 2657 - Sept 19, 2019
Pefferlaw Dam
Masonry Wall from Former Mill Structure

Photo 2658 - Sept 19, 2019
Pefferlaw Dam
Masonry Wall of Former Mill Structure

Photo 2659 - Sept 19, 2019
Pefferlaw Dam
Culvert Inlet/Outlet East of Dam

Photo 2660 - Sept 19, 2019
Pefferlaw Dam
Expected Site of Former Mill Intake, East of Dam

Photo 2665 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2666 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2667 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2670 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2671 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2674 - Sept 19, 2019
Pefferlaw Dam
Upstream Right Earth Embankment

Photo 2676 - Sept 19, 2019
Pefferlaw Dam
Right Earth Embankment Crest

Photo 2677 - Sept 19, 2019
Pefferlaw Dam
Right Earth Embankment Crest

Photo 2682 - Sept 19, 2019
Pefferlaw Dam
Monitoring Well on East Side of Park

Photo 2686 - Sept 19, 2019
Pefferlaw Dam
West Access Road

Photo 2687 - Sept 19, 2019
Pefferlaw Dam
West Access Road Gravel Surface

Photo 2693 - Sept 19, 2019
Pefferlaw Dam
Fencing on West Side of Park

Photo 2694 - Sept 19, 2019
Pefferlaw Dam
Fencing on West Side of Park

Photo 2701 - Sept 19, 2019
Pefferlaw Dam
Large Tree on Crest of Left (West) Earth Embankment

Photo 2702 - Sept 19, 2019
Pefferlaw Dam
Large Tree on Right (East) Earth Embankment

Photo 2703 - Sept 19, 2019
Pefferlaw Dam
Downstream Left (West) Earth Embankment

Photo 2704 - Sept 19, 2019
Pefferlaw Dam
Downstream Left (West) Earth Embankment

Photo 2705 - Sept 19, 2019
Pefferlaw Dam
Downstream Left (West) Armour Stone Retaining Wall

Photo 2709 - Sept 19, 2019
Pefferlaw Dam
Gate from Private Property to Park, Left (West) Side

Photo 2712 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Earth Embankment

Photo 2713 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Earth Embankment

Photo 2715 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Earth Embankment

Photo 2717 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Earth Embankment

Photo 2720 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Retaining Wall

Photo 2723 - Sept 19, 2019
Pefferlaw Dam
Upstream Left (West) Retaining Wall

Photo 2724 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2725 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2726 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

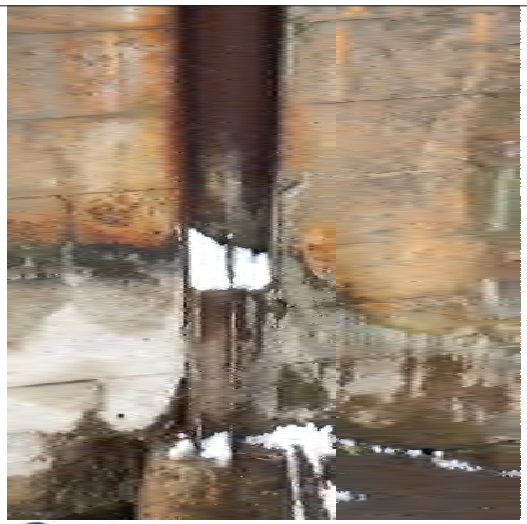


Photo 2727 - Sept 19, 2019
Pefferlaw Dam
Flashboard Gain, Left (West) Side of Left (West) Weir

Photo 2728 - Sept 19, 2019
Pefferlaw Dam
Left (West) Bridge Abutment and Anchor, Downstream Side

Photo 2730 - Sept 19, 2019
Pefferlaw Dam
Left (West) Bridge Abutment and Anchor, Upstream Side

Photo 2731 - Sept 19, 2019
Pefferlaw Dam
Underside of Truss Bridge

Photo 2733 - Sept 19, 2019
Pefferlaw Dam
Left (West) Weir Crest at Left (West) Dam Abutment

Photo 2734 - Sept 19, 2019
Pefferlaw Dam
Left (West) Weir Crest

Photo 2735 - Sept 19, 2019
Pefferlaw Dam
Flashboard Post Hole (Typical)

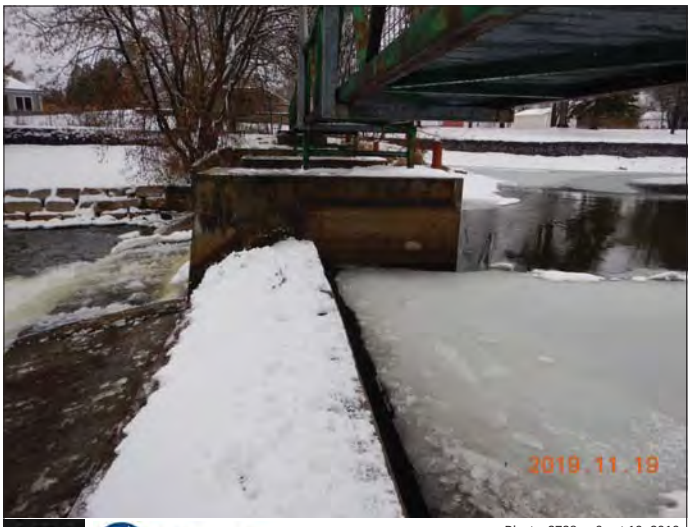


Photo 2738 - Sept 19, 2019
Pefferlaw Dam
Left (West) Weir and Left Side of Pier 1 (West Pier)

Photo 2739 - Sept 19, 2019
Pefferlaw Dam
Left Side of Pier 1 (West Pier)

Photo 2742 - Sept 19, 2019
Pefferlaw Dam
Top of Pier 1 (West Pier)

Photo 2743 - Sept 19, 2019
Pefferlaw Dam
Top of Pier 1 (West Pier) and Truss Support

Photo 2744 - Sept 19, 2019
Pefferlaw Dam
Left (West) Side of Pier 2 (East Pier)

Photo 2747 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Pier 1 (West Pier)

Photo 2751 - Sept 19, 2019
Pefferlaw Dam
Stoplog Sluiceway

Photo 2752 - Sept 19, 2019
Pefferlaw Dam
Stoplog Sluiceway Apron

Photo 2759 - Sept 19, 2019
Pefferlaw Dam
Left (West) Weir and Left (West) Apron

Photo 2760 - Sept 19, 2019
Pefferlaw Dam
Gap Between Left (West) Weir and Left (West) Apron

Photo 2762 - Sept 19, 2019
Pefferlaw Dam
Crack in Left (West) Apron at Downstream End

Photo 2763 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2764 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2765 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2766 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2767 - Sept 19, 2019
Pefferlaw Dam
Left (West) Dam Abutment

Photo 2769 - Sept 19, 2019
Pefferlaw Dam
Downstream of Left (West) Apron

Photo 2771 - Sept 19, 2019
Pefferlaw Dam
Void Below Armour Stone Wall, Left (West) Side

Photo 2773 - Sept 19, 2019
Pefferlaw Dam
Left (West) Side of Dam

Photo 2777 - Sept 19, 2019
Pefferlaw Dam
Fencing on Left (West) Retaining Wall

Photo 2778 - Sept 19, 2019
Pefferlaw Dam
Entrance to Left (West) Side of Truss Bridge

Photo 2779 - Sept 19, 2019
Pefferlaw Dam
Locked Gate on Upstream, Left (West) Side of Truss Bridge

Photo 2780 - Sept 19, 2019
Pefferlaw Dam
Locked Gate on Downstream, Left (West) Side of Truss Bridge

Photo 2781 - Sept 19, 2019
Pefferlaw Dam
Fall Arrest Cable Connection, Left (West) Side

Photo 2782 - Sept 19, 2019
Pefferlaw Dam
Fall Arrest Cable

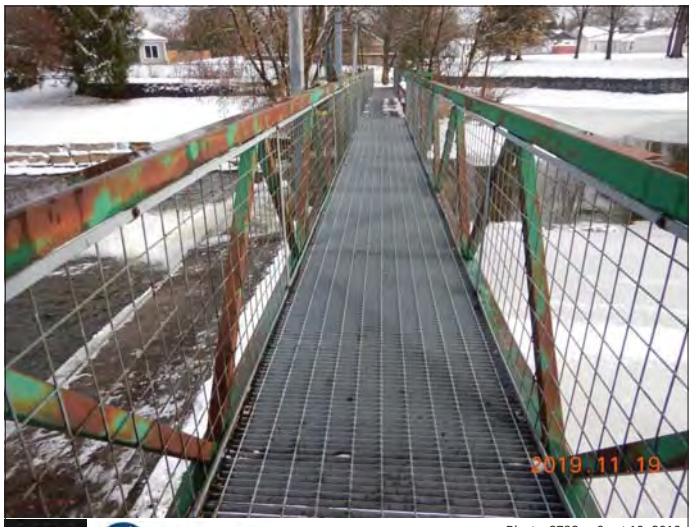


Photo 2783 - Sept 19, 2019
Pefferlaw Dam
Typical Deck Grating and Railing

Photo 2786 - Sept 19, 2019
Pefferlaw Dam
Fall Arrest Cable Mid Support

Photo 2787 - Sept 19, 2019
Pefferlaw Dam
Fall Arrest Cable Mid Support Connection

Photo 2790 - Sept 19, 2019
Pefferlaw Dam
Remnants of Fish Ladder Bracket

Photo 2792 - Sept 19, 2019
Pefferlaw Dam
Top of Upstream Side of Pier 1 (West Pier)

Photo 2793 - Sept 19, 2019
Pefferlaw Dam
Top of Downstream Side of Pier 1 (West Pier)

Photo 2794 - Sept 19, 2019
Pefferlaw Dam
Operating Deck and Stoplog Storage Above Sluiceway

Photo 2795 - Sept 19, 2019
Pefferlaw Dam
Winch Mounting Bar Bracket, Downstream Left

Photo 2796 - Sept 19, 2019
Pefferlaw Dam
Winch Mounting Bar Bracket, Upstream Left

Photo 2797 - Sept 19, 2019
Pefferlaw Dam
Stoplogs Chained to Truss Bridge

Photo 2798 - Sept 19, 2019
Pefferlaw Dam
Stoplog Condition

Photo 2799 - Sept 19, 2019
Pefferlaw Dam
Stoplog Condition

Photo 2801 - Sept 19, 2019
Pefferlaw Dam
Stoplog Gain Cover Lock

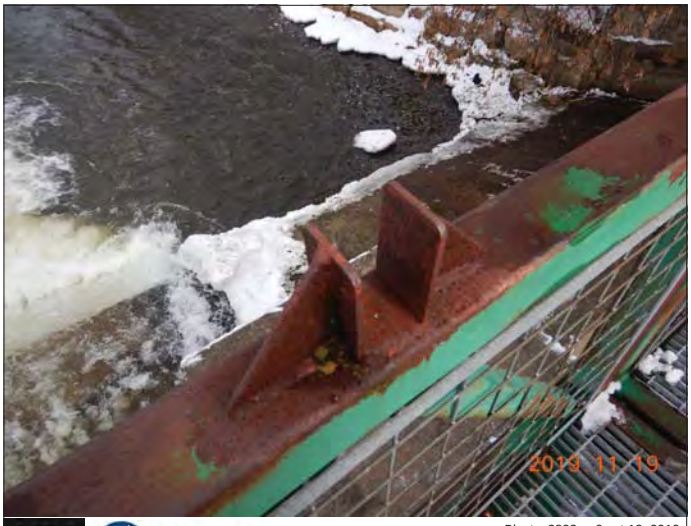


Photo 2803 - Sept 19, 2019
Pefferlaw Dam
Winch Mounting Bar Bracket, Downstream Right Side

Photo 2804 - Sept 19, 2019
Pefferlaw Dam
Winch Mounting Bar Bracket, Upstream Right Side

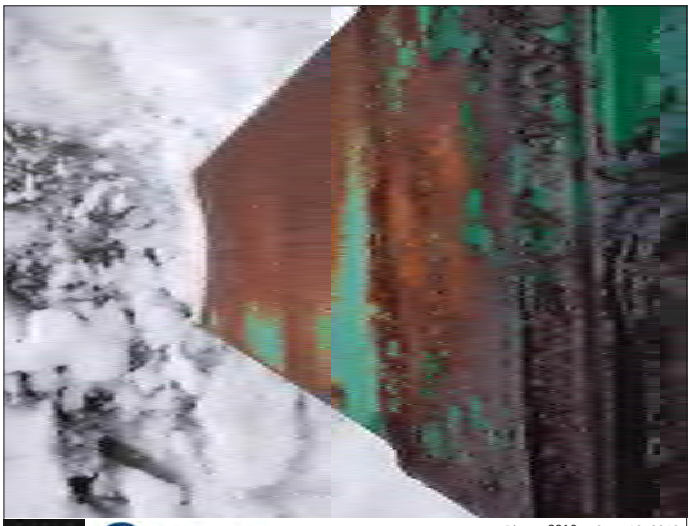


Photo 3916 - Sept 19, 2019
Pefferlaw Dam
Support Post for Truss Bridge, Typical Upstream Side

Photo 3916 - Sept 19, 2019
Pefferlaw Dam
Cracks in Vertical HSS Sections of the Truss Bridge

Photo 2812 - Sept 19, 2019
Pefferlaw Dam
Gate Access on Right (East) Dam Abutment

Photo 2814 - Sept 19, 2019
Pefferlaw Dam
Access to Right (East) Side of Truss Bridge

Photo 2817 - Sept 19, 2019
Pefferlaw Dam
Right (East) Bridge Abutment

Photo 2818 - Sept 19, 2019
Pefferlaw Dam
Right (East) Bridge Abutment and Retaining Wall

Photo 2819 - Sept 19, 2019
Pefferlaw Dam
Upstream Right (East) Retaining Wall and Dam Abutment

Photo 2820 - Sept 19, 2019
Pefferlaw Dam
Right (East) Weir Crest

Photo 2821 - Sept 19, 2019
Pefferlaw Dam
Pier 2 (East Pier) Right (East) Side

Photo 2823 - Sept 19, 2019
Pefferlaw Dam
Stoplog Gain Cover and Opening from Below

Photo 2824 - Sept 19, 2019
Pefferlaw Dam
Top of Pier 2 (East Pier), Downstream Side

Photo 2828 - Sept 19, 2019
Pefferlaw Dam
Chain Link Fencing on Right (East) Embankment

Photo 2829 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Dam from Right (East) Side

Photo 2832 - Sept 19, 2019
Pefferlaw Dam
Right (East) Apron

Photo 2851 - Sept 19, 2019
Pefferlaw Dam
Undercutting in Right (East) Apron

Photo 2833 - Sept 19, 2019
Pefferlaw Dam
Right (East) Apron

Photo 2834 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2835 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2836 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2838 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2839 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2840 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2841 - Sept 19, 2019
Pefferlaw Dam
Right (East) Dam Abutment

Photo 2842 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Right (East) Weir

Photo 2843 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Right (East) Weir

Photo 2844 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Right (East) Weir

Photo 2845 - Sept 19, 2019
Pefferlaw Dam
Right (East) Apron

Photo 2846 - Sept 19, 2019
Pefferlaw Dam
Right (East) Apron

Photo 2847 - Sept 19, 2019
Pefferlaw Dam
Sluiceway and Right Side of Pier 1 (West Pier)

Photo 2850 - Sept 19, 2019
Pefferlaw Dam
Downstream Side of Pier 2 (East Pier)

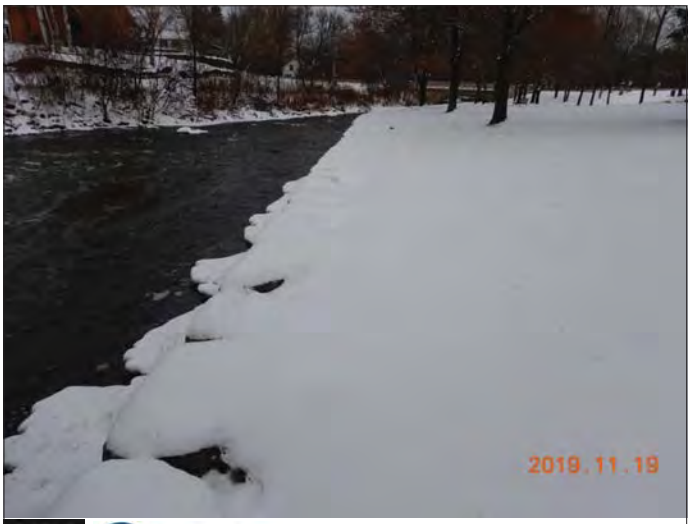


Photo 2854 - Sept 19, 2019
Pefferlaw Dam
Right (East) Armour Stone Retaining Wall

Photo 2856 - Sept 19, 2019
Pefferlaw Dam
Typical Flashboard Post

Photo 2857 - Sept 19, 2019
Pefferlaw Dam
Typical Flashboard

Photo 2858 - Sept 19, 2019
Pefferlaw Dam
Typical Winch Mounting Bar

Photo 2859 - Sept 19, 2019
Pefferlaw Dam
Typical Winch

Photo 2860 - Sept 19, 2019
Pefferlaw Dam
Typical Winch

Lake Simcoe Region conservation authority

Photo 2864 - Sept 19, 2019
Pefferlaw Dam

Typical Winch Name Plate

Lake Simcoe Region conservation authority

Photo 2865 - Sept 19, 2019
Pefferlaw Dam

Typical Winch

Lake Simcoe Region conservation authority

Photo 2866 - Sept 19, 2019
Pefferlaw Dam

Typical Winch J-Shaped Mounting Plate/Bracket

Appendix B

Dam Inspection Form B2

Form B2

Dam Inspection Report

Date:	November 19, 2019
Name of Dam:	Pefferlaw Dam
Municipality:	Town of Georgina, Regional Municipality of York
Location:	Pefferlaw, Ontario
GPS Coordinates:	643765 m E, 4908276 m N, UTM Zone 17T
Inspected By:	David Green, P.Eng., Zach Staples, P.Eng.
Weather:	1°C, overcast with snow on ground and dam structure

1 – Earth Embankment

The inspection of the earth embankment sections of the dam was limited due to the presence of snow on the ground. Snow was removed in a number of areas and the grassed surface of the embankment was verified. The embankment surface appears to be well vegetated (established grass) and sink holes, rodent holes and settlement were not noted but would have been covered by snow during the inspection.

As further described in Section 9, erosion was noted on the upstream left and right embankments at the normal summer water level and there was erosion noted behind the left and right downstream armour stone retaining walls.

There are a number of large trees growing on the embankment and immediately adjacent to the concrete structures. The root systems from these trees have the potential to cause damage to the concrete sections of the dam and encourage piping through the earth sections of the dam. Additionally, if one of the large trees were to fall and pull up the root ball, the ability of the earth embankment to retain the head pond may be compromised.

There is a portion of the right (east) embankment that is retained by the stone foundation wall of the former mill. The stone wall generally appears to be in fair condition.

2 – Concrete Structures (wingwalls, piers, deck, spillways, apron, etc.)

Note: The majority of the concrete structures were covered in snow upon arrival of the dam inspection crew. Wills' staff cleared off as much snow as possible to facilitate the inspection of the concrete sections of the dam; however the inspection was limited in some areas.

Upstream Left (West) Retaining Wall – The upstream left (west) retaining wall is generally in good condition. There is medium scaling above the high water mater, revealing the large round aggregate used in the concrete.

Left (West) Dam Abutment – The left (west) dam abutment is generally in fair to poor condition. There is a large spall measuring approximately 500 mm by 400 mm by 200 mm deep at the interface of the upstream face of the left (west) weir and the left

(west) abutment. There are a number of smaller spalls near the base of the wall at the winter water level. There is some delaminated concrete near the flashboard gain.

There is a wide crack at a construction joint that extends across the height of the wall extending from the interface with the left (west) weir to the top of the wall. There are two large spalls above the downstream crest of the weir along the wide crack measuring approximately 400 mm by 600 mm (exposed and corroded steel reinforcing, large round aggregate) and 450 mm by 700 mm. There is another spall at the base of the abutment (where it meets the apron) that measures approximately 600 mm by 200 mm.

Left (West) Bridge Abutment – The left (west) bridge abutment is generally in good condition. There is a spall around the bearing seat for the truss bridge (upstream side), exposing the bearing anchor and reducing the bearing area of the truss support.

Upstream Right (East) Retaining Wall – Limited inspection, snow and vegetation prevented clear access. The upstream right (east) retaining wall generally appears to be in good condition.

Right (East) Dam Abutment – The right (east) abutment is in poor to very poor condition. There is evidence of patch repairs at this wall area. The majority of the wall surface is delaminated and there are several large spalls. There is some map cracking with efflorescence at the far downstream end of the wall, with a 300 mm by 1000 mm by 300 mm deep void. There is a masonry wall perched on the downstream edge of the right (east) abutment that is in very poor condition.

Right (East) Bridge Abutment – The right (east) bridge abutment is generally in fair to good condition. There is medium scaling along the face of the abutment, and there is a wide crack in the precast concrete block that is supporting the cast in place abutment.

Left (West) Weir – Inspection of the left (west) weir was limited as it was partially snow covered during the inspection. There is a large gap (25 mm) at the construction joint where the flat section of the weir crest meets the sloping section of the weir crest. There is also a wide crack located approximately 200 mm downstream of the construction joint. There is a 600 mm wide strip along the sloping section of the weir that is delaminated in the area that was exposed by Wills' snow removal. The flat section of the weir crest contains a number of square holes for the installation of the flashboard posts. There appears to be a construction joint approximately 60 mm below the downstream weir crest on the downstream face of the weir. The downstream face of the weir is in good condition, however, there is a 30 mm gap at the interface of the weir and the apron. Video from the underwater inspection did not identify any undercutting of the upstream side of the weir.

Left (West) Apron – The left (west) apron was cleared of snow to facilitate the inspection. The entire surface of the apron is severely eroded on the face (100%). There is a wide crack at the downstream left side of the apron. The cracked area is

approximately 1600 mm by 2300 mm. The downstream edge of the apron is approximately 800 mm high. Video from the underwater inspection identified the possibility of some cracks with efflorescence and some minor spalls. There was also one location that appeared to show some minor undercutting of the apron.

Right (East) Weir – The upstream face of the weir is generally in good condition with some bug holes. The weir crest is in good condition. The downstream face of the weir is in fair to good condition with honeycombing noted near the interface with the abutment (1.2 m^2).

Right (East) Apron – There are some medium width cracks along the apron surface. The apron is undermined by approximately 1500 mm and it would appear as though the end of the apron has spalled off. Video from the underwater inspection appears to indicate that the undermining is restricted to the right side of the apron and does not extend to the sluiceway. The top of the apron is approximately 700 mm off the river bottom.

Pier 1 (West Pier) – The downstream face and top surface of the pier is in good condition. The upstream, west and east faces are also in good condition with some map cracking, cracks with efflorescence and pitting above the high water mark. Video of the underwater inspection did not indicate any undermining of the pier or significant concrete deterioration below the winter water level.

Pier 2 (East Pier) – The downstream face of the pier is in good condition with some cracking. The top surface of the pier was partially snow covered for the inspection but appears to be in good condition. The upstream, west and east faces are also in good condition with some scaling at the water line and minor map cracking with efflorescence above the high water mark. Video of the underwater inspection did not indicate any undermining of the pier or significant concrete deterioration below the winter water level.

Sluiceway and Apron – Due to the presence of fast flowing water, snow and ice, the sluiceway and the apron downstream of the sluiceway could not be fully inspected. Video from the underwater inspection indicated that there may be severe erosion of the concrete surface in this area (similar to the left (west) apron surface).

3 – Wooden and Metal Structures (decks, gains, railings, conduits, etc.)

Truss Bridge – The east and west pedestrian spans are in fair condition, with coating failure and minor corrosion throughout.

The operation span is in poor condition. The northwest, southwest, and southeast truss end posts have deformed/bowing out with wide cracking a corner of the square HSS. The edges of the cracks are corroded.

The south face of the square HSS support of the operation span at the southwest support is deformed. This appears to have been in this condition for some time.

Deck Grating – The galvanized steel deck grating is supported by and secured to the truss bridge. The grating is in fair condition with some surface rust and damaged sections. A deck panel on the operation span has broken welds.

Pier Nosings – The pier nosings appear to be galvanized steel are generally in fair to good condition with minor corrosion and section loss (<10%) below the high water mark.

Gain Liners – The gain liners are in fair condition with failure of the coating, surface rusting and minor section loss below the high water mark.

Fall Arrest System – The fall arrest support posts appear to be galvanized steel, are mounted to the truss bridge and appear to be in good condition. The steel cable is secured at both ends and in the middle and appears to be in good condition. All connections for the cable appear to be secure.

Railings – The deck railings are formed as part of the truss bridge. Welded wire mesh has been added to the inside of the truss to cover the gaps between the truss sections. The railing on the dam deck is approximately 1700 mm high. The welded wire mesh is in good condition, however, as described above, the truss bridge is in poor condition.

Chain Link Fence – The chain link fencing on the dam wingwalls is in good condition and measures approximately 1220 mm high. The chain link fence between the park and the private property to the west is damaged (bent upper rail and disjointed connection at the end post).

4 – Gates and/or Stop Logs (identified looking downstream left to right)

Stoplogs – The dam is supplied with six (6) 11 in high by 8 in wide wooden stoplogs. Five (5) stoplogs are used for operation and one (1) spare remains on the deck. Five (5) stoplogs were stored on the deck at the time of the inspection (winter drawdown) and were chained and locked to the railing. Each stoplog end has a steel mounting bracket this is used to lift the logs. The steel mounting brackets show signs of surface rust and section loss while the wooden stoplogs show signs of deterioration. The stoplog gain cover is level with the remainder of the dam deck and is locked. The frame and grating show signs of surface rust but generally appear to be in fair condition.

Flashboards – One (1) typical flashboard post and one (1) typical floashboard was on site for the inspection. Both showed signs of deterioration due to their age. LSRCA staff indicated that they are being replaced for the next operating season.

5 – Water Level Gauge (reading and condition)

There is no water level or flow gauge located at the Pefferlaw Dam site. Operators use the flow data from the "Pefferlaw Brook Near Udora" (02EC018) Water Survey of Canada stream gauge to anticipate the need for operations at the dam.

6 – Winches (type and number)

The dam is equipped with two (2) Jeamar heavy duty hand winches. The winches are stored off site at the operator's workshop in East Gwillimbury (1 hour from site). Only one (1) of the two (2) winches was on site at the time of the dam inspection. The name plate on the winch provided was scratched and difficult to read; however, the operator indicated that the capacity of the winches is 2100 lbs.

The winch provided exhibited signs of damage/repair, surface rust and paint chipping; however the operator indicated that the winches were generally in good working order and that they are greased at the end of each year.

The winches are installed onto the dam for log operations and removed after log operations are complete. A J-shaped mounting plate/bracket bolted to the winch slides over a mounting bar (also stored off site at the operator's workshop) that is installed into steel brackets on the truss that supports the deck. The mounting bars have end plates that would prevent them from moving horizontally and the weight of the stoplogs would prevent the mounting bar from moving vertically. The J-shaped mounting plate/bracket and the mounting bar have surface rust and chipping paint but are generally considered to be in fair condition.

7 – Valves (type and number)

This dam is not equipped with a valve.

8 – Boom (driftwood, chains, anchors)

This dam is not equipped with a debris or public safety boom.

9 – Erosion (upstream and downstream)

Erosion was noted on the upstream left and right sides of the earth embankment at what is expected to be the normal summer water level.

Erosion was noted on the downstream left and right sides behind the armour stone retaining walls. The full extent of this erosion could not be determined at the time of the inspection due to the presence of snow on site. The area with the most significant erosion noted was downstream of the left wing wall where there was a large void under/behind the armour stone.

10 – Seepage or Leaks

Inspection for seepage and leaks was limited due to the presence of snow on the ground and the fact that the headpond has been drawn down for winter. No seepage or leaks were identified by the inspection team or reported by the dam operator.

11 – Access Route

The main dam access is via an approximately 3 m wide gravel access road located on the west side of the Pefferlaw Brook. The access road is gated and locked to prevent entry by unauthorized vehicles; however, pedestrians are able to walk

around the gate to access the park area surrounding the dam. Inspection of the gravel access road was limited due to the presence of snow on the ground; however the presence of the gravel surface was verified.

There is a secondary access on the east side of the Pefferlaw Brook. The access is gated and locked to prevent entry by unauthorized vehicles; however, pedestrians are able to walk around the gate to access the park area surrounding the dam. There is no formal access road to the dam as part of the secondary access.

12 – Safety Issues (public and operator)

Public Safety – There is no safety boom located upstream of the dam. The reservoir is used primarily by the private property owners surrounding the head pond for non-power boating. Access to the head pond by members of the public is possible through the park adjacent to the dam or from upstream in the Pefferlaw Brook.

There is expected to be significant public interaction with the deck of the structure due to its location within the park and the convenience for members of the public to cross the Pefferlaw Brook at this location. Access to the deck of the dam is not restricted.

There is no signage on the pedestrian approaches to the dam warning about the hazards posed by the dam.

Members of the public could climb the stoplogs that are stored on the deck of the dam. If they do, the railing in that area is not high enough to prevent them from falling.

Operator Safety – The dam is equipped with a fall arrest system; which is located above the overflow weir/flashboards. The fall arrest system does not cover dam operators during stoplog operations and the operators indicated that they tie off to the railing. The height an operator could fall from the deck to the downstream sill is just over 3.0 m.

13 – Signage

There is standardized dam safety signage located on the upstream and downstream sides of the control structure. The signs read "DANGER, Keep Out, Swift Currents & Undertow May Occur at Anytime", identify the LSRCA as the dam owner, provide contact information for the dam owner and identify that 911 should be called in an emergency. Both signs are in good condition.

There is a "NO DIVING FROM BRIDGE, SHALLOW WATER" sign located on the upstream side of the dam to the left of Pier 1 (West Pier). The sign is in poor condition and appears to have been vandalized.

There are signs near the entrances to the park, near the gated access points, BYT THE Town of Georgina that indicate "NO SMOKING BEYOND THIS POINT".

14 – Divestment and/or Decommissioning Opportunities

None.

15 – General Remarks

The LSRCA has been operating and maintaining the dam since 1982. The primary purpose of the dam is as a flood and ice control structure; however, the headpond created by the dam also creates recreational opportunities and contributes to the general aesthetic of the area.

The dam operators work out of their shop in East Gwillimbury, which is a 1-hour drive from the site in normal weather conditions.

There is no target water level for the head pond, however operators do follow an operating plan for when to install/remove the stoplogs and flash boards (spring/fall operations). The dam is rarely operated outside of the spring/fall operating seasons.

There are the remnants of the fish ladder downstream of the overflow weir with some mounting brackets remaining on the pedestrian bridge truss.

A Public Safety Risk Assessment and a Public Safety Plan have not been prepared for this site; however, there is significant public interaction with the dam.

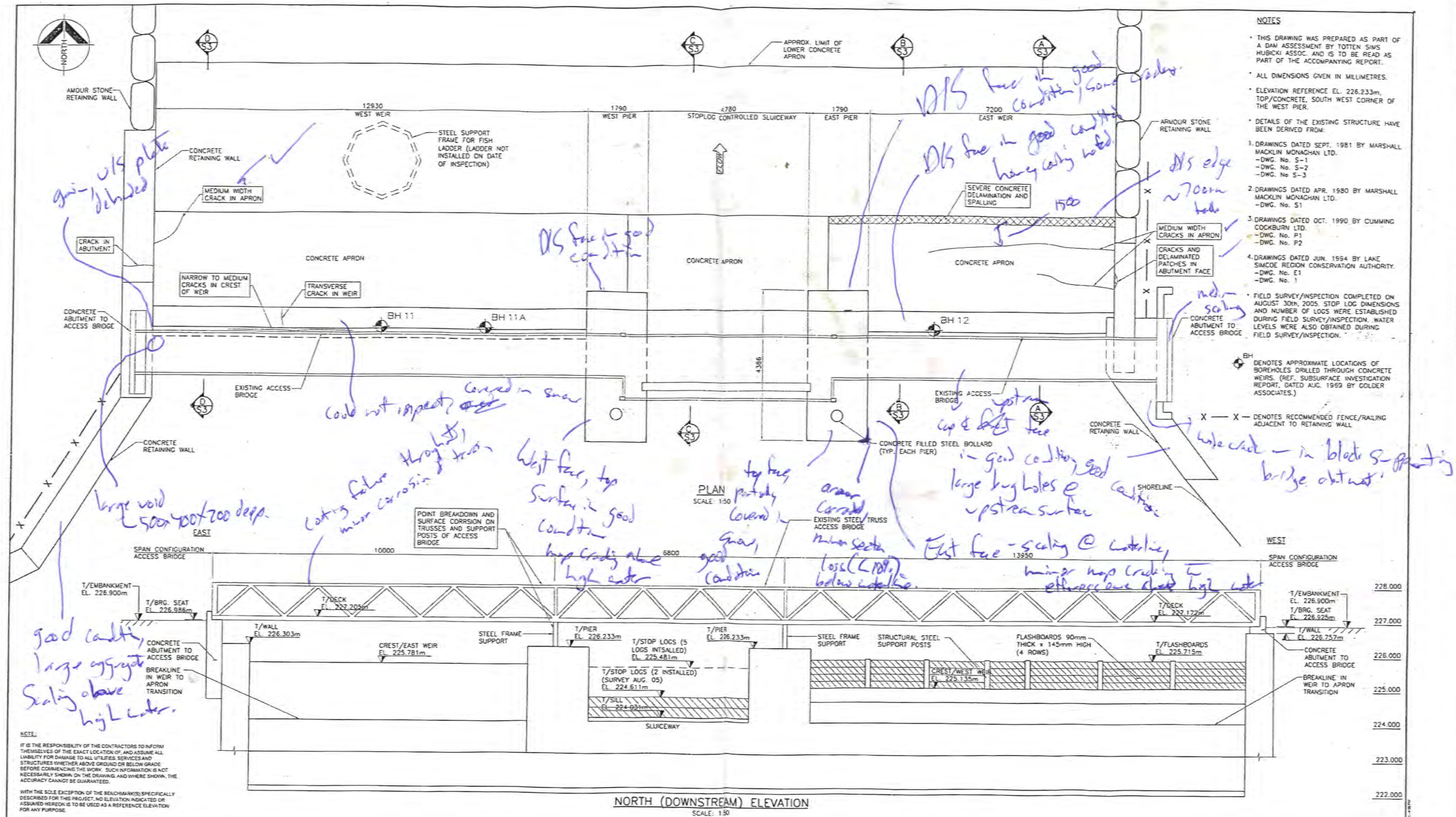
The latest Dam Safety Review (DSR) was completed by TSH in 2008 using the 1977 Lakes and Rivers Improvement Act Guidelines (MNR) as well as the Draft 1999 Ontario Dam Safety Guidelines (MNR). The DSR concluded that the Hazard Potential Classification (HPC) for the dam was Low; however, dam breach modelling was not undertaken as part of the analysis. Based on the HPC of Low an Inflow Design Flood (IDF) of the 100-year peak flow was selected. TSH indicated that the dam has adequate hydraulic capacity for the IDF. The structural stability assessment of the concrete gravity dam sections indicated that some sections do not meet the required factors of safety for some loading conditions.

16 - Recommendations

1. Remove the trees from the earth embankment and from adjacent to concrete or masonry structures and remediate the voids left by the root systems.
2. Undertake a concrete condition assessment for the dam, including concrete coring and detailed surface mapping, and based on the results of the concrete condition assessment prepare a detailed rehabilitation design for the concrete components of the structure.
3. Undertake a structural evaluation of the truss bridge within one (1) year and develop a detailed repair or replacement design for the truss bridge and dam deck. Depending on the results of the structural evaluation, temporary repairs, the removal of the stoplogs stored on the deck or temporary suspension of dam operations may be required.
4. Repair the chain link fence along the west property line.
5. Replace the flashboards and flashboard posts, as planned. Note: Future replacement of the stoplogs may be required.
6. Repair the erosion on the upstream left (west) and right (east) sides of the earth embankment.
7. Repair the erosion behind the downstream left (west) and right (east) armour stone retaining walls.
8. Complete a Public Safety Risk Assessment and based on the results of the assessment prepare a Public Safety Plan and implement the recommended additional public safety measures. Additional public safety measures that could be identified during the Public Safety Risk Assessment and may need to be considered as part of the Public Safety Plan include: signage on the pedestrian approaches to the dam and at the entrance to the park, a public safety boom in the head pond and additional railings/fencing around the stoplog storage area on the deck.
9. Confirm, through the structural evaluation of the truss bridge, that the truss/railing has sufficient capacity to act as a fall arrest anchor point for use by operators during stoplog operations. If the anchor point does not have sufficient capacity, implement additional operator fall protection measures.
10. Complete a new Dam Safety Review that incorporates a new hydrology and dam breach study, concrete gravity dam stability assessment and earth embankment stability assessment. The dam safety review should be completed in accordance with the Lakes and Rivers Improvement Act Technical Bulletins and Best Management Practices (MNR, 2011).

Appendix C

Field Notes and Sketches



NOTES

- THIS DRAWING WAS PREPARED AS PART OF A DAM ASSESSMENT BY TOTTEN SIMS HUBICKI ASSOC. AND IS TO BE READ AS PART OF THE ACCOMPANYING REPORT.
- ALL DIMENSIONS GIVEN IN MILLIMETRES.
- ELEVATION REFERENCE EL. 226.233m, TOP/CONCRETE, SOUTH WEST CORNER OF THE WEST PIER.
- DETAILS OF THE EXISTING STRUCTURE HAVE BEEN DERIVED FROM:
  1. DRAWINGS DATED SEPT. 1981 BY MARSHALL MACKLIN MONAGHAN LTD.
     - DWG. No. S-1
     - DWG. No. S-2
     - DWG. No S-3
  2. DRAWINGS DATED APR. 1980 BY MARSHALL MACKLIN MONAGHAN LTD.
     - DWG. No. S1
  3. DRAWINGS DATED OCT. 1990 BY CUMMING COCKBURN LTD.
     - DWG. No. P1
     - DWG. No. P2
  4. DRAWINGS DATED JUN. 1994 BY LAKE SIMCOE REGION CONSERVATION AUTHORITY.
     - DWG. No. E1
     - DWG. No. 1
- FIELD SURVEY/INSPECTION COMPLETED ON AUGUST 30th, 2005. STOP LOG DIMENSIONS AND NUMBER OF LOGS WERE ESTABLISHED DURING FIELD SURVEY/INSPECTION. WATER LEVELS WERE ALSO OBTAINED DURING FIELD SURVEY/INSPECTION.

BH — DENOTES APPROXIMATE LOCATIONS OF BOREHOLES DRILLED THROUGH CONCRETE WEIRS. (REF. SUBSURFACE INVESTIGATION REPORT, DATED AUG. 1969 BY GOLDER ASSOCIATES.)

X — X — DENOTES RECOMMENDED FENCE/RAILING ADJACENT TO RETAINING WALL

NOTE:

IT IS THE RESPONSIBILITY OF THE CONTRACTORS TO INFORM THEMSELVES OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.

WITH THE SOLE EXCEPTION OF THE BENCHMARK(S) SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

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No. | DATE | BY | ISSUES / REVISIONS

CLIENT: LAKE SIMCOE REGION CONSERVATION AUTHORITY

DRAWN BY:	CHECKED BY:
D. J. RICHMOND	M. SHALLHORN
DESIGNED BY:	APPROVED BY:
SCALE: AS SHOWN	DATE: JAN. 2006

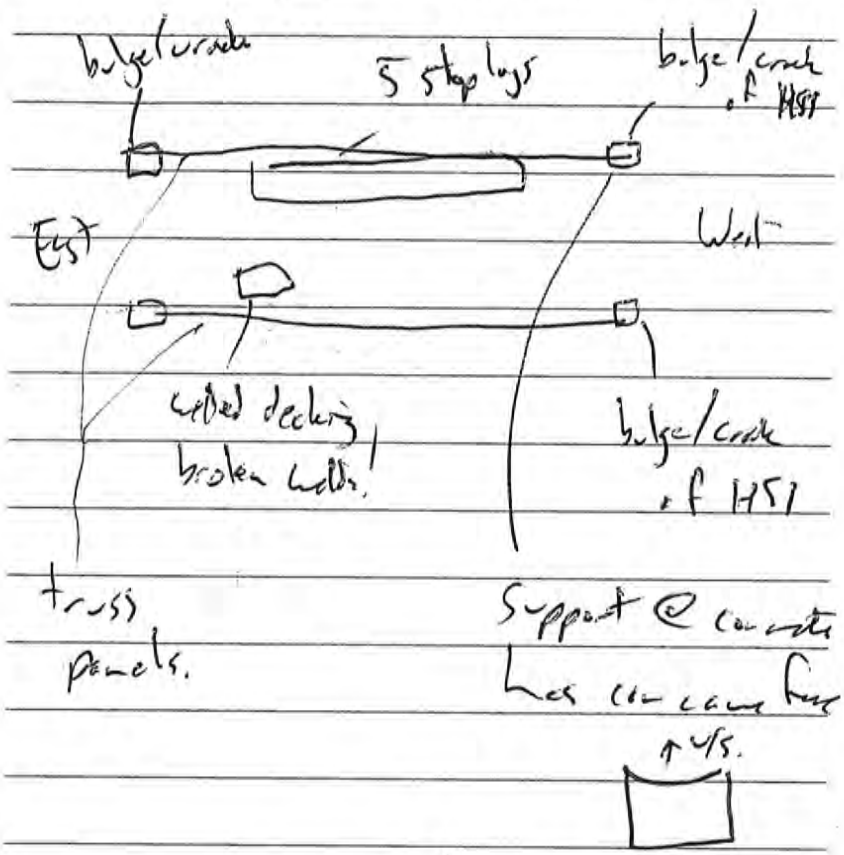
PROJECT: DAM SAFETY ASSESSMENT
PEFFERLAW DAM
PEFFERLAW BROOK WATERSHED

DRAWING: PLAN & ELEVATION

PROJECT No.: 42-70902

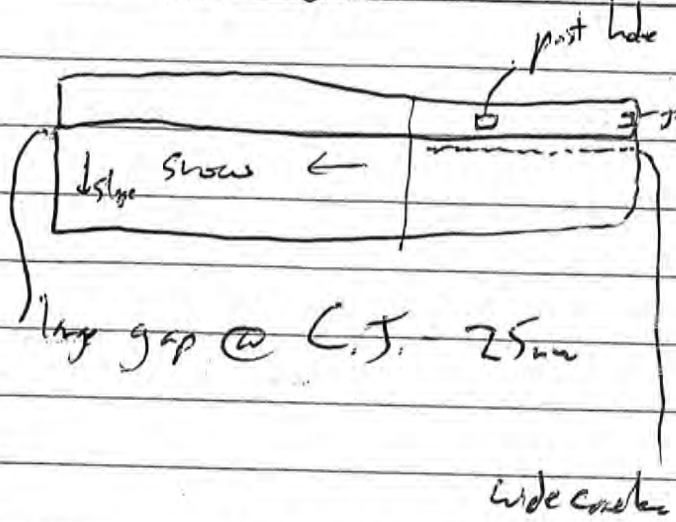
DRAWING No.: S2

Operation Span

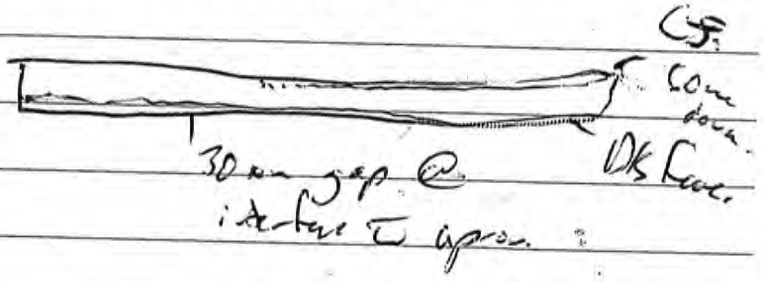


~300+ total stop logs

West Weir

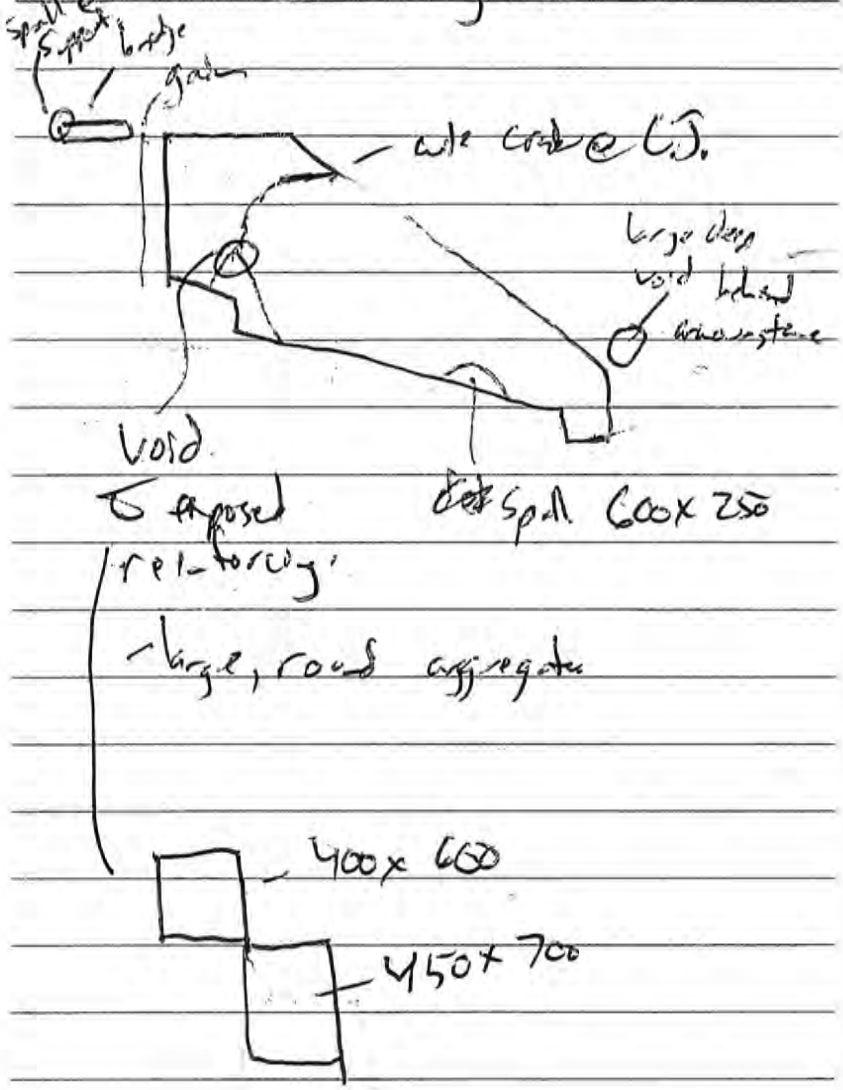


- 600mm strip along slope debonded in exposed areas



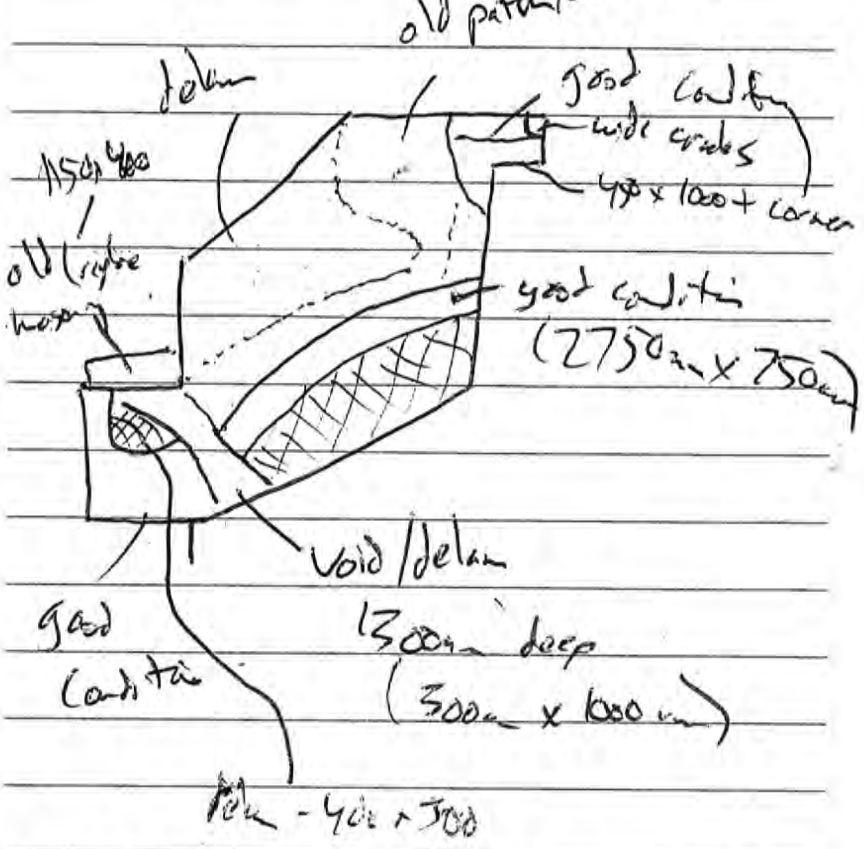
STONE

West Wingwall.



STONE

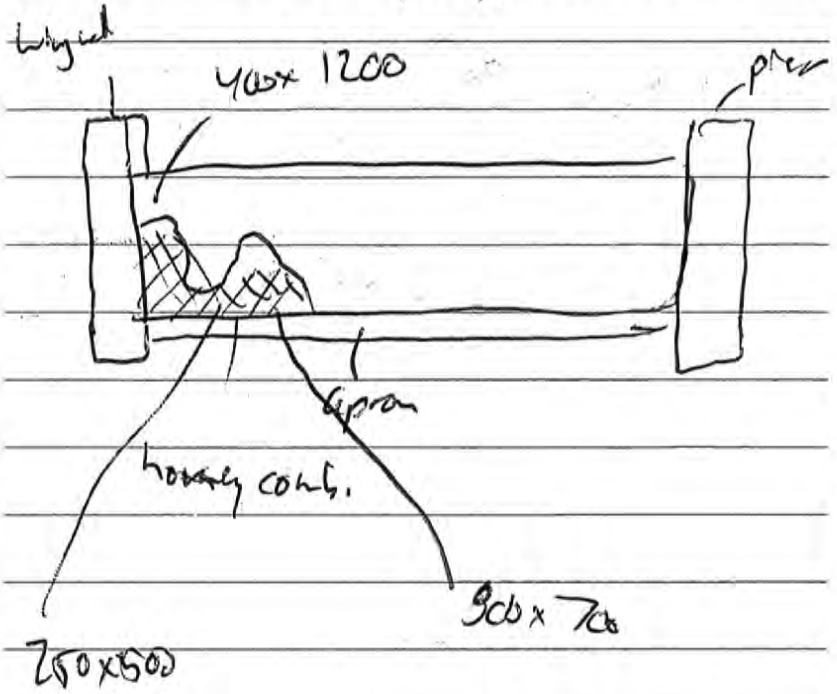
Pedestrian Test. Wingwall



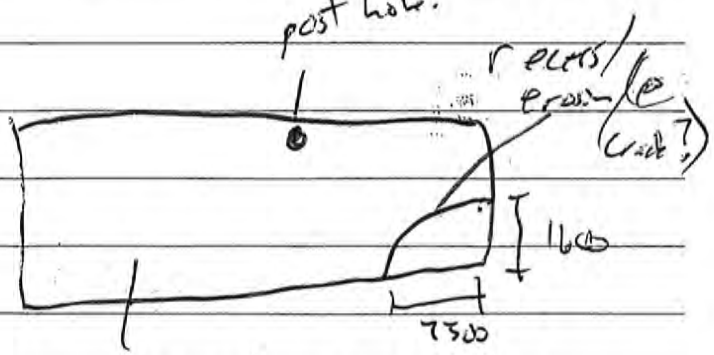
Notes: large, round exposed aggregate.
Past path repair.

STONE

Test Spilling, DIS Facr.



West Apron



Severely eroded face (100%.

D/S edge ~ 900 mm.