Upper Thames River Conservation Authority

Harrington Dam Class Environmental Assessment DRAFT

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EXECUTIVE SUMMARY

Introduction

The Upper Thames River Conservation Authority (UTRCA) is responsible for the maintenance and operations of Harrington Dam, situated in Zorra Township (**Figure 1-1**). Zorra Townshipo contributes 100% of the operating and maintenance costs of the dam and the costs may be offset where the UTRCA is able to obtain funding for capital projects. Results of a 2007 (Acres) Dam Safety Assessment revealed concerns of insufficient spillway capacity, spillway instability and embankment stability. A subsequent 2008 (Naylor) embankment stability analyses concluded that the Harrington Dam did not meet dam safety guidelines stability criteria. The dam was classified as having a Low Hazard, based on MNR (2011) Dam Hazards due primarily to the rural area in which the dam is situated and the low density of residential dwellings in the area.

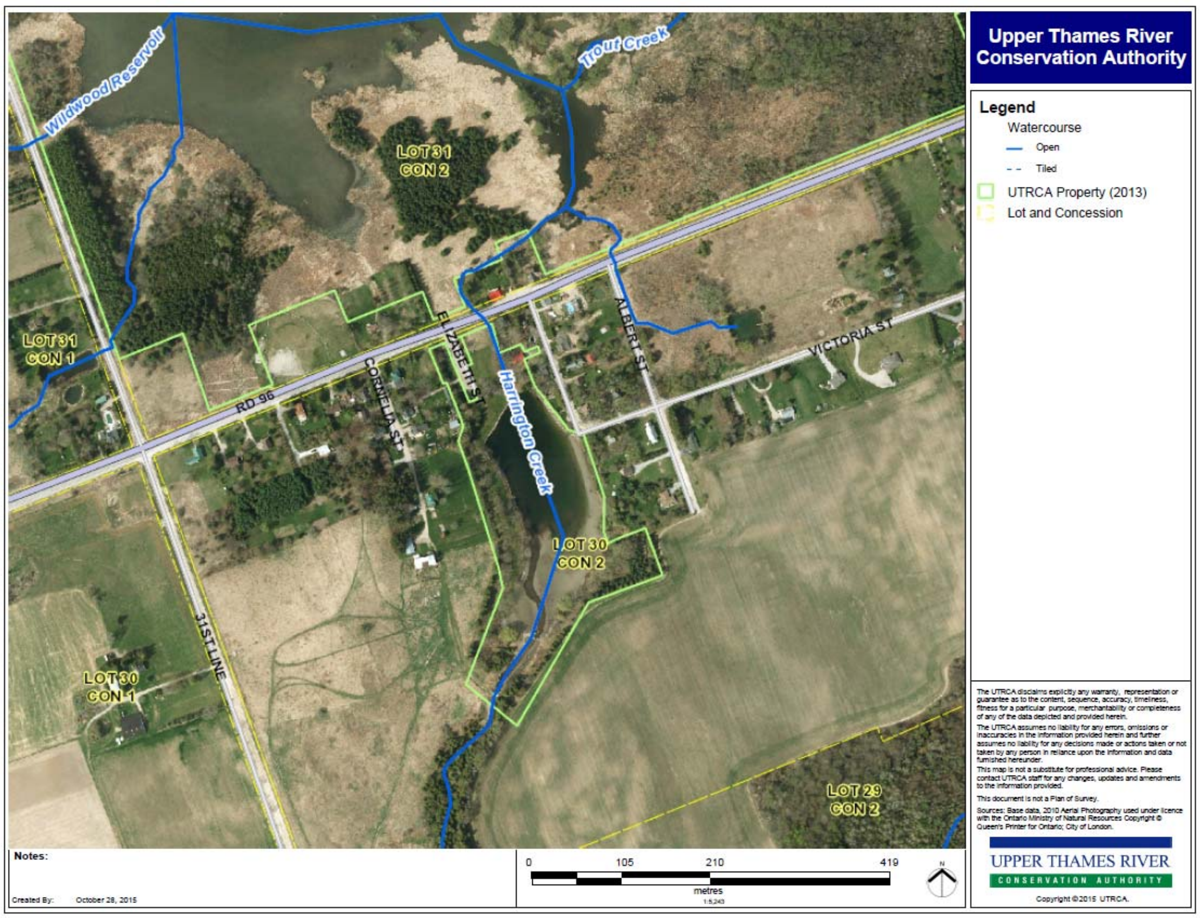

Figure 1-1. Location of the Harrington Dam and Pond within Harrington CA (Source: UTRCA)

The UTRCA, in partnership with Zorra Township, initiated a Class Environmental Assessment (EA) under the Conservation Ontario Class EA process due to the significant concerns related to the structural integrity and hydraulic capacity of the Harrington Dam and embankment. The objective of this EA study was to identify, evaluate, and ultimately to recommend an alternative (including Do-Nothing) that will allow the Upper Thames River Conservation Authority (UTRCA) to move forward with a plan to address the Harrington dam and embankment safety concerns.

Background

The Harrington Conservation Area (HCA), situated within the Village of Harrington, includes a dam, pond and the Harrington Mill. All are under UTRCA ownership. Harrington Conservation Area is a "Day-Use Only" area, with current uses including hiking, birding, fishing, and picnicking.

The Harrington Community Preservation and Historical Club Inc. entered into a lease agreement with UTRCA in 1999 for the long-term restoration of the grist mill and the management and maintenance of Harrington CA. Restoration of the Mill, to date, has been supported through community fundraising, volunteer hours, and a Trillium Grant. The restoration efforts are intended to result in a functioning museum and a working educational site. There is potential to support demonstration operations of the mill by water flow from Harrington Pond.

Existing Conditions

Review of background materials and site conditions was completed to define and confirm the problem statement. Characterization of existing conditions was completed through review of background information; completion of field investigations, data collection, data analyses and monitoring. This included a general assessment of the study area and investigations of Harrington Creek downstream and upstream of the dam, and within the pond.

Harrington Creek flows into Trout Creek and Wildwood Lake. The drainage area of Harrington Pond is ~ 12 km^2 and is made up of mostly agricultural lands. The study area is within 100 m of a Provincially Significant Wetland; wildlife species likely travel between the Wildwood Conservation Area and Harrington Conservation Area. Results of a three season botanical inventory revealed that 40% of the species observed within the 5 ha HCA are non-native; no species at-risk, rare, or uncommon species were found. The overall quality of the vegetation within Harrington CA was rated as moderately poor to average. The pond did not support any native rooted aquatic plants; only a narrow fringe of wetland emergent plants occurred along the shores.

In the community area surrounding the pond, shallow groundwater wells are used by several residential properties. Historically, these wells have been affected by water levels in the dam, including the 1949 dam failure event.

The three season bird survey recorded 42 species of birds within the HCA; all were considered common breeding or permanent residents of the area. Only one species-at-risk bird (Barn Swallow) was observed although no evidence of breeding was found. A snapping turtle, bluebird and milksnake have been observed by community members. Neither the pond nor other parts of HCA provide critical habitat for any sensitive bird or other species. Waterfowl appeared to use the pond on an occasional basis. The pond has been stocked annually with rainbow trout; UTRCA has recently (2016) been notified by the Ministry of Natural Resources that a permit for stocking the pond will no longer be provided; this will affect the annual fishing derby that has traditionally be held in Harrington Conservation Area.Downstream of Harrington Dam, Harrington Creek appeared to have been previously straightened and was considered to be stable. Results of the aquatic assessment indicated that the creek provides both seasonal and permanent habitat for warm water species; the abundance of young of the year fish suggested that this portion of the creek is valuable spawning and nursery habitat for warm water fish. Thirty (30) different species were recorded downstream of the dam. Cold water fish species are unable to successfully reproduce downstream of the dam. Benthic analyses revealed very pollution tolerant taxa in this section of the creek that were indicative of 'fairly poor' water quality. Measurements of water temperature revealed warmer water downstream than upstream of the pond; the pond appears to provide a warming effect.

Bathymetric surveys of Harrington Pond showed that approximately 48% of the available pond volume has filled with sediment. Analysis of the accumulated sediment indicated that the sediment was not defined as hazardous waste according to Schedule 4 Leachate quality criteria (Ontario, 2015). The footprint of Harrington Pond was determined to have no archaeological potential.

Harrington Creek, upstream of the backwater effects that are due to the pond was considered to be geomorphologically ‘in transition’. The creek morphology was influenced by large woody debris with respect to profile controls and channel width; large woody debris is beneficial for aquatic species as it provides in-stream habitat. Results from the aquatic assessment indicated that the creek offers habitat for cold water fish species but that only seven (7) species in all were recorded. Benthic analyses in the same section of creek revealed that pollution sensitive taxa were present that were indicative of ‘fair’ water quality. The water temperature was cooler upstream than downstream of the dam indicating warming of the water through the pond.

The Harrington Conservation Area, in which the dam, mill, and pond are situated, is a beloved focal point of the community that dates back to 1846. The area has supported family and community picnics, fishing derbies, skating, swimming, bird watching, trail use, and canoeing. The Harrington and Area Community Association and its members are keenly interested in preserving the viewscape of the pond, enhancing the pond environment, providing educational opportunities, supporting the operation of the Harrington Mill, and enhancing tourism potential to the area.

Alternative Identification and Evaluation

Through review of study findings, seven potential alternative solutions were identified to address the failure of the dam and its embankment to meet dam safety guidelines stability criteria as identified and discussed in the Acres (2007) and Naylor (2008) studies. These alternative options identified for addressing the deficiencies of the dam and embankment included the following:

1) Do Nothing
2) Remove Dam and Install Rocky Ramp
3) Remove Dam and Construct Natural Channel
4) Remove Dam and Construct One or More Offline Ponds/Wetlands with a Natural Channel
5) Replace Dam with a New Structure Downstream of the Existing Dam
6) Lower the Dam Crest with Natural Channel
7) Reconstruct the Existing Dam in its Current Location and Configuration with New Materials

Evaluation of the potential alternatives was completed for each of the technical, environmental, socio-cultural, and economic categories as defined in MOE (2014). The specific criteria that were evaluated were selected based on study area characteristics and factors considered especially relevant by the study team and/or the community. Ranking of each criterion was undertaken to determine the preferred alternative considering an equal category weighting. Given the high community interest and local cultural value of the dam and pond, the ranking was also evaluated using an altered category weighting (i.e., 40% socio-economic, 20% for all other categories).

The preferred alternative, resulting from both the equal and the weighted evaluation processes, was Alternative 4 (**Figure 7-1**). In this alternative, the dam would be removed and one or more off-line ponds would be created. The channel would be naturalized and flow around the off-line pond. The alternative recognizes the socio-cultural value of the community regarding viewscape of the pond and recreational uses of the area along with environmental benefits that would be achieved with placing a pond off-line (i.e., improved water quality, species diversity, habitat continuity, etc.). The alternative allows for replication and enhancement of the terrestrial environment. Subsequent to the third PIC, an additional alternative was proposed by the community, and considered by the study team. That alternative was a variation of Alternative 7 (i.e., partial rather than full replacement; creation of a spillway at the upstream

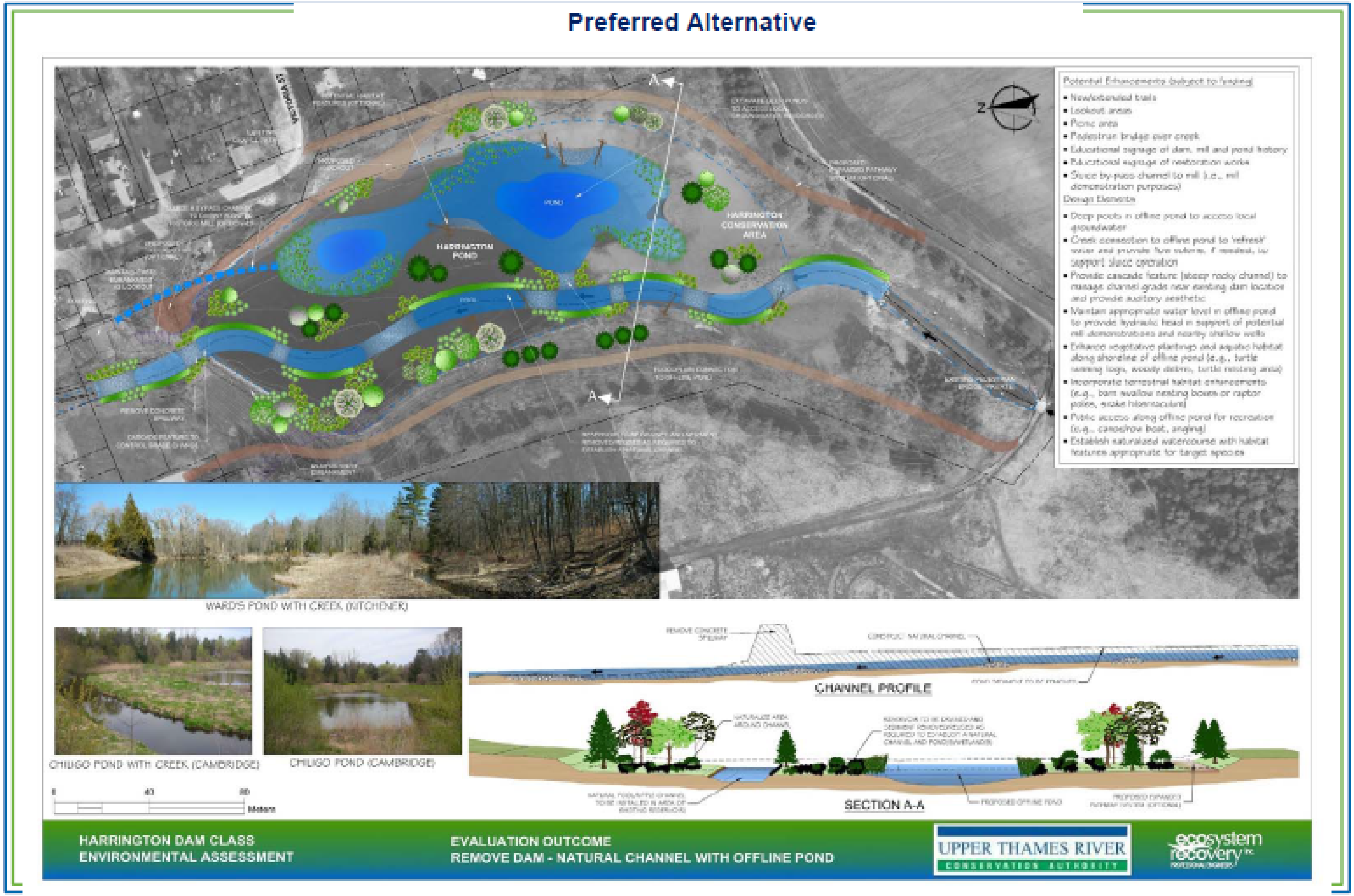

Figure 7-1. Preferred Alternative

end of the pond) and considered a temporary solution rather than long-term. In conjunction with their description of the alternative, the community identified measures for environmental enhancement and recreational potential; many of these would not be exclusive to the variation of Alternative 7. The variation of Alternative 7 was evaluated, informally, to examine how the final scoring would compare to the preferred alternative. While the score, in both the equal and weighted evaluation tables would be higher than Alternative 7, the rank did not increase to be within the top 3 alternatives. Alternative 4 therefore remained the preferred alternative.

Prior to development of detailed design, additional study is required to further characterize Harrington Creek hydrology, examine potential effects on shallow groundwater wells, potential for upwelling into an off line pond, undertake further archaeological assessment, and further examine the hydrological requirements to operate the turbine within the Grist Mill. The offline pond should consider water taking needs required to operate the turbine, within natural constraints. Where possible, the detailed design should address and incorporate elements considered important by the community that include: large pond viewscape, trails and viewing areas for birds, habitat creation (snake, turtles, birds), wheelchair accessible fishing area, unobstructed access to the pond (i.e., avoid overgrown overhanging vegetation), and mosquitos management.

Public Consultation

Public Consultation was undertaken throughout the study process which included not only the immediate community, but also First Nations, and organizations that may be interested in the project and/or agencies that must be consulted during the Class EA process. Extensive Public Consultation was undertaken to communicate study findings and study process to the Harrington Community and to obtain public feedback to consider and incorporate into the study. All public notices, PIC presentation materials and draft reports were posted on the UTRCA website to provide public access.

In addition to three (3) public information centres (PIC), UTRCA organized a field tour of dam removal and restoration projects that have been completed in the jurisdiction of the Grand River Conservation Authority. Upon the request the Harrington Community & Historical Preservation Club (also called the Harrington and Area Community Association) provided a tour to the study team and Zorra Township representatives. After the third PIC, UTRCA met with the Harrington and Area Community Association to further clarify study process and findings and encourage community participation; a three week extension of the comment submission time period was given. Public comment and feedback received during the PIC and questionnaires were reviewed and used to inform the alternative evaluation process and refinement of the preferred alternative. While the preferred alternative is generally accepted by some community members and non-governmental agencies (12%); the majority of the communications (88%) received during the study process oppose dam and pond removal and prefer repair or reconstruction of a dam similar to the existing dam and embankment. The key concerns pertain to the perceived loss of cultural heritage through the loss of a large pond viewscape and loss of opportunity to use pond water to power the restored Mill. The community has expressed concern regarding mosquitos in an off-line pond, loss of wildlife habitat, and the introduction of non-native species to Harrington Creek upstream of the dam (e.g., carp).

Conclusion

A Class Environmental Assessment study was initiated by UTRCA with the intent of identifying the preferred alternative for addressing the failure of Harrington dam to meet dam safety guidelines with respect to its spillway and embankment. Review of existing conditions through background review and field studies demonstrated environmental impacts of the pond on water quality, fish species diversity, and channel function. No constraints were identified that would limit works associated with any of the potential alternatives. Through the evaluation process, Alternative 4 (remove dam, create off-line pond, naturalize channel) was determined to be preferred. Through the public consultation process, community members have made it clear that they, generally, prefer repair or replacement of the dam and embankment in contrast to the preferred alternative. The Harrington Community indicated that if the dam and pond could be retained that the community would intend to improve the overall pond environment. Some plans were being made as the EA report documents were in completion, to initiate an improvement strategy. Preparation of design drawings for the preferred alternative should consider design elements that would support demonstration operation of Harrington Mill, maximize the viewscape, and enhance habitat. The design should also consider exclusion measures for invasive species (e.g., carp).

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1. Introduction

1.1 Study Problem

The Upper Thames River Conservation Authority (UTRCA) acquired the Harrington dam, situated in Zorra Township, in 1952. The UTRCA is responsible for its maintenance and operations and, in 2002, initiated a Dam Safety Assessment which was completed by Acres in 2007. The assessment raised concerns about insufficient spillway capacity, spillway instability and embankment stability. A suite of recommended repairs, if found to be feasible, were recommended to address these issues. A subsequent embankment stability analysis (Naylor/LVM in 2008) was completed to further investigate the structural integrity of the dam. That study concluded that the Harrington Dam did not meet dam safety guidelines stability criteria. Recommendations included removal or reconstruction of the Harrington Dam.

Due to the significant concerns related to the structural integrity and hydraulic capacity of the Harrington Dam, a Class Environmental Assessment was initiated by the Upper Thames River Conservation Authority, in partnership with Zorra Township. The objective of this study was to identify, evaluate alternatives (including Do-Nothing) and ultimately to recommend an alternative that will allow the Upper Thames River Conservation Authority (UTRCA) to move forward with resolution as to how best to address the dam and spillway deficiencies while balancing technical, environmental, social, and environmental responsibilities.

1.2 Study Area

The Harrington Dam is located in the Harrington Conservation Area (CA) in the town of Harrington, within the Township of Zorra. The conservation area is bound to the north by Oxford Road 96, by Elizabeth Street to the west, by Victoria Street to the east and to the south by a private farm laneway that extends from the end of Elizabeth Street and crosses over Harrington Creek. Residential homes line both the east and west side of the conservation area. **Figure 1-1** shows the location of the Harrington Dam and Pond.

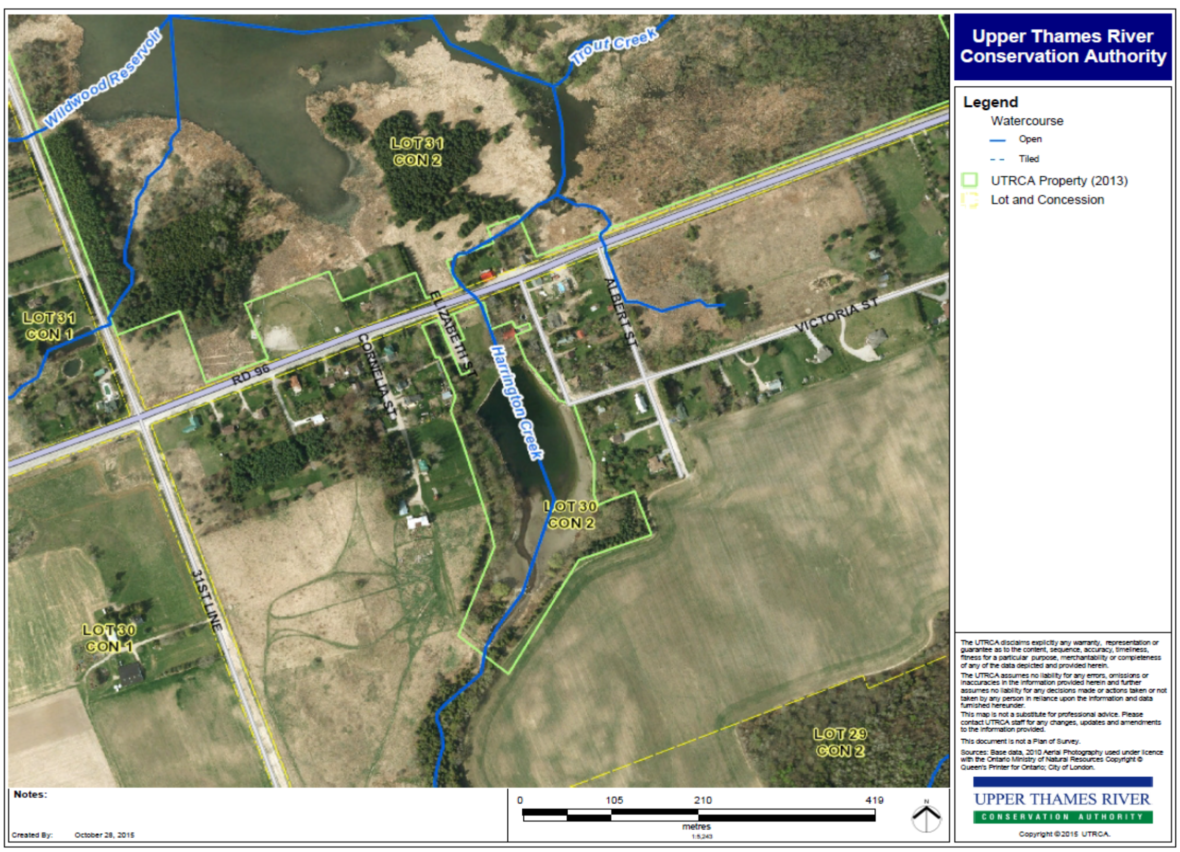


Figure 1-1. Location of the Harrington Dam and Pond within Harrington CA (Source: UTRCA)

1.3 Background

1.3.1 History

The Harrington Dam was constructed in 1846 for a water-powered grist mill operation, including a dam and millrace (Naylor, 1987). Upgrades to the dam were completed in 1949 after a large section of the spillway was undermined and washed away (See **Section 3.8.1** for detailed chronology). Shortly after, the conservation authority became the owner of the land (1952) and mill (1966) after it was purchased from the owner. The mill operated continuously for more than 100 years, except for a short period when the the original mill had burned down or the dam had failed..

After acquiring the Harrington Dam in 1952, the Upper Thames River Conservation Authority (UTRCA) enlarged the pond and undertook major repairs.

In 1995, the provincial operating funding support for Conservation Authority “small dams” was cut and as a result, the Township of Zorra contributes 100% of the operating costs.

In the summer of 2000, the dam was overtopped twice resulting damages to the downstream embankment slopes adjacent to the spillway. As a result of these events, the channel reach at the spillway was eroded due to high outflows; Acres (2007) indicated that only minor damage was reported. Erosion control repairs were completed after the events and one row of stop logs was removed. This was the last time the dam received any repair

1.3.2 Harrington Dam Pond and Conservation Area

Today, the Harrington Dam Pond and conservation area attracts local residents and visitors to the site for recreational purposes including fishing, walking and picnicking. The Harrington Dam is a significant landmark to the local community and adjacent residents. The Harrington Community Association has managed the mill since 1999. This association has contributed to improvements to the structure over the years and has recently acquired provincial funding for restoring the Grist Mill. Restoration of the mill structure and functionally has been proceeding gradually since 1999.

Previous to the recent restoration efforts,

The mill equipment has been now been fully restored and is functioning; the intent is to operate the mill equipment with waterpower in the future (Harrington Community & Historical Preservation Club Inc., 2016, see **Appendix G**). Prior to the recent restoration, the mill has operated, and was then driven by an internal combustion engine. Further background is provided in **Section 3.8.1**.

1.3.3 Dam Safety Assessment

In 2002, Acres International was retained by the Upper Thames River Conservation Authority to undertake a dam safety review for the Harrington Dam. The dam safety assessment (DSA) was carried out based on the draft “Ontario Dam Safety Guidelines” (ODSG) published by the Ministry of Natural Resources under the Lakes and Rivers Improvement Act. The report was completed in 2007 and includes an assessment of the dam and components, detailed site inspections, identification of repairs/maintenance, preparation of an emergency action plan, assessment of operation and equipment, and associated documentation.

Included in the DSA was a review of the sheet piling present under the spillway as evident on the dam design drawings. Section 8.2 of the Acres (2002) report indicates that the sheetpiling extends to a depth of 0.8 m below the base of the apron. Stability analysis detailed in section 7.3.2 of the Acres (2002) report indicates that sheetpiling required additional analysis using flownets to provide a more accurate estimate of uplift pressures and the location of the resultant. As such it is evident that the sheet piling has been considered in assessing the stability of the spillway.

Key highlights of the DSA include:

- The dam classification is small based on height and reservoir size;
- The dam is classified as very low incremental hazard potential (IHP);
- The inflow design flood (IDF) is the 50 year, 3 day summer storm event;
- With two stop logs removed, the dam will overtop during the IDF and has inadequate freeboard;
- The spillway has inadequate capacity to pass the IDF;
- Adequate freeboard is not provided at the pedestrian bridge;
- The right downstream slope does not meet stability criteria;
- The spillway does not meet stability criteria;
- There are residences adjacent to the downstream creek with those on the left (west) side at risk.

Based on dam safety assessment, Acres (2002) developed recommendations including: concrete repairs, installation of riprap on the upstream slope, raise the height of the left and right embankment crests, sign installation, repair low-level outlet, installation of a new pedestrian bridge, raise spillway abutments, support grating at spillway, compaction of material next to spillway at the left and right embankment, and other spillway and embankment repairs. A rigorous stability analysis was recommended for dam embankments. The costs associated with maintenance repairs to ensure ongoing safe operation were estimated to be about $320,600 (Acres, 2007) and was updated to $522,650 by Burnside in 2010. This number was based on cost estimates of the general scope of work and similar projects in Ontario. Costs for replacement and for removal were respectively $1,414,750 and $247,750 (Burnside, 2010)

In 2008 Naylor Engineering Associates Ltd was retained by the UTRCA to carry out a visual inspection, geotechnical investigation and embankment stability assessment of the Harrington Dam. This assessment was carried out based on the recommendations in the 2007 dam safety report. The findings of their investigation include the following:

- The dam and pond comprises loose silt and sand fill over peat, topsoil, clay, silt, sand, sand and gravel, and till;
- Groundwater was measured within the dam fill and sub-artesian pressure in the soil below the dam;
- The dam embankment is not considered stable under existing conditions;
- The dam is not suitable for retrofit, a new dam and embankment would be required;
- Dam decommissioning is a viable option;
- Recommendations included for the re-construction of the dam as well as for decommissioning.

Based on findings and recommendations from the dam safety assessments, it is clear that any proposed works (reconstruction or decommissioning) would require approval under the Lakes Rivers Improvements Act. (MNRF, 2011). An overview of this act is provided in **Section 1.3.5**.

1.3.4 Hazard Classification

In August 2011, the Ministry of Natural Resources released the “Dam Safety Review Best Management Practices” document. Under the jurisdiction of the Lakes and Rivers Improvement Act (LRIA), the Ministry of Natural Resources has the authority to govern design, construction, operation, maintenance and safety of dams in Ontario. The best management practices have been developed to ensure safe management of Ontario dams. As part of the dam safety review (DSR) process, all factors affecting the safety of a dam are reviewed based on current knowledge and standards.

Results of the original Harrington Dam DSR (Acres International, 2007) classified the dam hazard as follows:

- Loss of Life: VERY LOW
- Economic and Social Losses: VERY LOW
- Environmental Losses: VERY LOW

Using the updated (2011) Dam Hazard Classification, the hazards for Harrington Dam were re-classified as follows (See **Appendix H** for detail):

- Life safety: LOW
- Property Losses: LOW
- Environmental Losses: LOW
- Cultural-Built Heritage Losses: LOW

The low hazard associated with dam failure is due, primarily, to the rural area in which the dam is situated and the permanent dwellings in the area.

1.3.5 Legislative Network

The Ministry of Natural Resources, through the Lakes and Rivers Improvement Act (LRIA), regulates alterations, improvements, and repairs to existing dams. Under Section 16 of the LRIA, “no person shall alter, improve, or repair any part of a dam… unless the plans and specifications … have been approved” by the Ministry of Natural Resources and Forestry. Likewise, under Section 2(1)(b) of Ontario Regulation 454/96, Ministry (MNR, 2007) approval is required to make alterations, improvements, or repairs to a dam that holds back water in a river, pond, or stream if these may affect the dam’s safety, structural integrity, the waters or natural resources. Section 2(2) of Ontario Regulation 454/96 further specifies that LRIA Section 16 approval is required before a person operates a dam in a manner different from that contemplated by previously approved plans and specifications (see: https://www.ontario.ca/page/dam-management, https://www.ontario.ca/page/alterations-improvements-and-repairs-existing-dams for additional information).

Any works submitted for LRIA approval requires supporting reports, supporting analyses and calculations, and drawings that are completed by a Professional Engineer. LRIA approval may be issued if the proposed works meet the standards outlined in the LRIA technical bulletins (https://www.ontario.ca/page/alterations-improvements-and-repairs-existing-dams#section-2). Ministry standards for dam safety in Ontario are outlined in the LRIA Administrative Guide (MNR 2011) and associated technical bulletins (http://www.owa.ca/assets/files/policy/LRIA-Administration-Guide.pdf).

1.4 Study Objectives

The Upper Thames River Conservation Authority, in partnership with Zorra Township have proposed to complete a Class EA study under the Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Projects (January 2002, amended June 2013). The goal of the study is to generate and evaluate various alternatives that will address the documented dam safety concerns. While addressing the identified issues, opportunities for cultural, environmental and aquatic improvements are intended to be explored.

The specific objectives of a dam focussed Environmental Assessment such as this study are to identify alternatives that:

- Address the dam stability concerns identified in the DSA studies;

- Recognizes the cultural significance of the pond;
- Provide environmental enhancements wherever possible;
- Provide opportunity to integrate historical functions and use of the pond within the Harrington CA;
- Minimize environmental impacts during, and post construction;
- Require low future maintenance activity and cost; and
- Minimizes capital costs

2. Environmental Assessment Process

2.1 Ontario's Environmental Assessment Act

The Harrington Dam study is subject to the provisions of Ontario's *Environmental Assessment Act*. The Act requires that an environmental assessment of any major public sector project that has the potential for significant environmental effects be undertaken prior to implementation to determine the ecological, cultural, economic and social impact of the project.

The Act exists to "provide for the protection, conservation, and wise management of Ontario's environment". The act mandates clear terms of reference, focused assessment hearings, ongoing consultation with all parties involved — including public consultation — and, if necessary, referral to mediation for decision. Environmental assessment is a key part of the planning process and must be completed before decisions are made to proceed on a project.

To comply with the requirements of the Act, two types of environmental assessment processes can be applied to projects:

1. **Individual Environmental Assessment** (under Part II of the Act): This process includes the development of a project-specific Terms of Reference that is submitted for review and approval to the Minister of the Environment. This process is typically applied to large, unique or complex projects that do not have precedents that demonstrate a predictable and manageable environmental impact.

2. **Class Environmental Assessment**: This process applies to routine projects that have predictable and manageable environmental effects, and follow a Terms of Reference that has been previously approved for certain types of projects. Provided that the approved Class EA process is followed, the project will comply with Section 13(3) a, Part II.1 of the *Environmental Assessment Act*.

2.2 Conservation Ontario Class Environmental Assessment Process

Conservation Ontario has developed the Class Environmental Assessment for Remedial Flood and Erosion Control Projects parent document to specify a planning and design process which ensures that environmental effects are considered when undertaking remedial flood and erosion control projects.

According to the Conservation Ontario Class EA document, a remedial flood and erosion control project includes projects undertaken by Conservation Authorities which are required to protect human life and property from impending flood or erosion problems.

The Conservation Ontario Class EA process includes the following tasks:

- Initiate the Class EA and publish Notice of Intent;
- Prepare a baseline environmental inventory including the characterization of existing conditions, such as hydraulics, natural environment (terrestrial, aquatic and wildlife ecology) and geomorphology;
- Develop alternative remedial measures and select the preferred measure;
- Conduct a detailed analysis of environmental impact;
- Prepare study report documentation.

The Conservation Ontario Class EA process is illustrated in **Figure 2-1**.

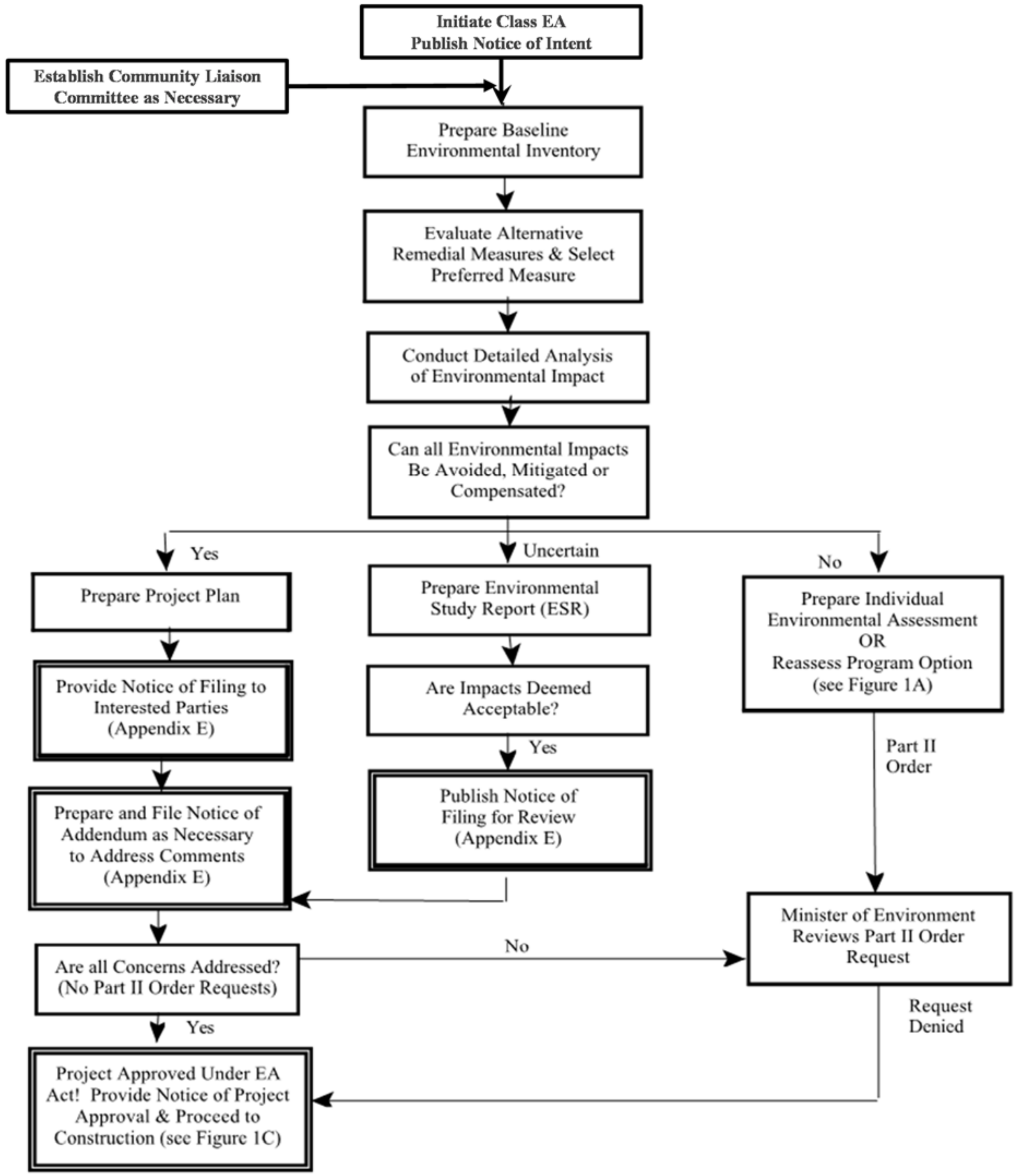


Figure 2-1. Conservation Ontario Class EA Process (http://conservationontario.ca/images/Policy__Planning/Class_EA/Class_EA_June_2013.pdf)

2.3 Part II order

A project that is carried out following an approved Class Environmental Assessment process will comply with Part II of the *Environmental Assessment Act*, and will thus not require an Individual Environmental Assessment and approval from the Minister of the Environment. However, if during the project planning and consultation process there are agency or public concerns that cannot be resolved through consultation, negotiation, or revisions to the Environmental Study Report, then the concerned party may make a request to the Minister of Environment for a Part

II Order to comply with Part II of the Environmental Assessment Act (i.e., a higher level of assessment) before proceeding with the proposed undertaking. Such a request is called a “Part II Order”.

The request for a Part II Order should be made only when there are outstanding significant environmental issues that cannot be resolved during the class EA process. The Part II Order must focus on potential environmental effects of the project, and must not be made for the sole purpose of delaying or stopping the project or include issues that are not related to the project.

The request must be made in writing to the Minister of the Environment, within 30 days after the proponent has issued a Notice of Completion of the environmental study report. The proponent must also be copied on the request. Ministry staff will review the request, consider evaluation criteria, consult with other technical staff and make a recommendation to the Minister. Depending on the project, the ministry’s review typically lasts between 30 and 66 days. The Minister can:

- Deny the Part II Order request, with or without conditions;
- Refer the matter to mediation; or
- Require that an Individual EA be prepared in order to comply with Part II of the Act.

If a Part II Order request is made prior to filing of the Notice of Completion, the requestor will be advised to bring the concerns to the attention of the proponent (i.e., the UTRCA).

3. Existing Conditions

Existing and historical conditions of Harrington Dam, the pond, and adjacent area were characterized to provide an effective basis for the evaluation of potential alternatives that could address the concerns identified through the Dam Safety Assessment (Acres, 2007). Components included in the characterization focused on the geology and physiography, hydrotechnical (i.e., hydrogeology hydrology and hydraulics), fluvial geomorphology, aquatic and terrestrial environments, water quality, and socio-cultural settings.

The data required to characterize site conditions were gathered through a combination of site visits, field investigations, and desktop reviews of existing reports and mapping and are summarized in this chapter. The characterization of existing conditions was completed through a collaborative effort with UTRCA staff. Reports prepared by UTRCA are provided, in full, in **Appendices A, B, C** and **D**. A summary is provided in the sub-sections below.

3.1 Drainage Network and Watershed.

The Harrington dam study area is situated along Harrington Creek which flows north into Trout Creek and Wildwood Lake. The Trout Creek subwatershed of the Upper Thames River (see **Figure 3-1** and **Figure 3-2)** drains an area of approximately 161 km^2 and is located in the centre of the Upper Thames River Conservation Authority watershed. Trout Creek outlets into the North Branch of the Thames River in the town of St. Mary's. The watershed includes portions of the Townships of Zorra (44%), Perth South (32%), Perth East (22%), the Town of St. Mary's (3%) and the City of Stratford (1%). Land use within the Trout Creek watershed is primarily agriculture (75%) with other land uses including natural vegetation (20%), urban (2%), water (2%), and aggregates (<1%). An overview of the watershed is provided in **Appendix A**.

The drainage area to the dam and pond is approximately 12 km^2 and is made up of mostly agricultural lands. The Harrington Pond catchment area includes the Lakeside/Wildwood Complex (a provincially significant wetland), and both the Happy Hills and Lost Concession significant natural areas. Included within the drainage network upstream of Harrington Pond are Harrington Creek, McCorquodale-Innes Drain and Young Drain.

Review of topographic elevations on the Young and McCorquodale-Innes drains indicates a range between 375-380 m above mean sea level on the western reach of the drains, and approximately and elevation of 360 m on the eastern reach (boundary of the Mud Creek subwatershed), with a low elevation of 330 m at Harrington Pond.

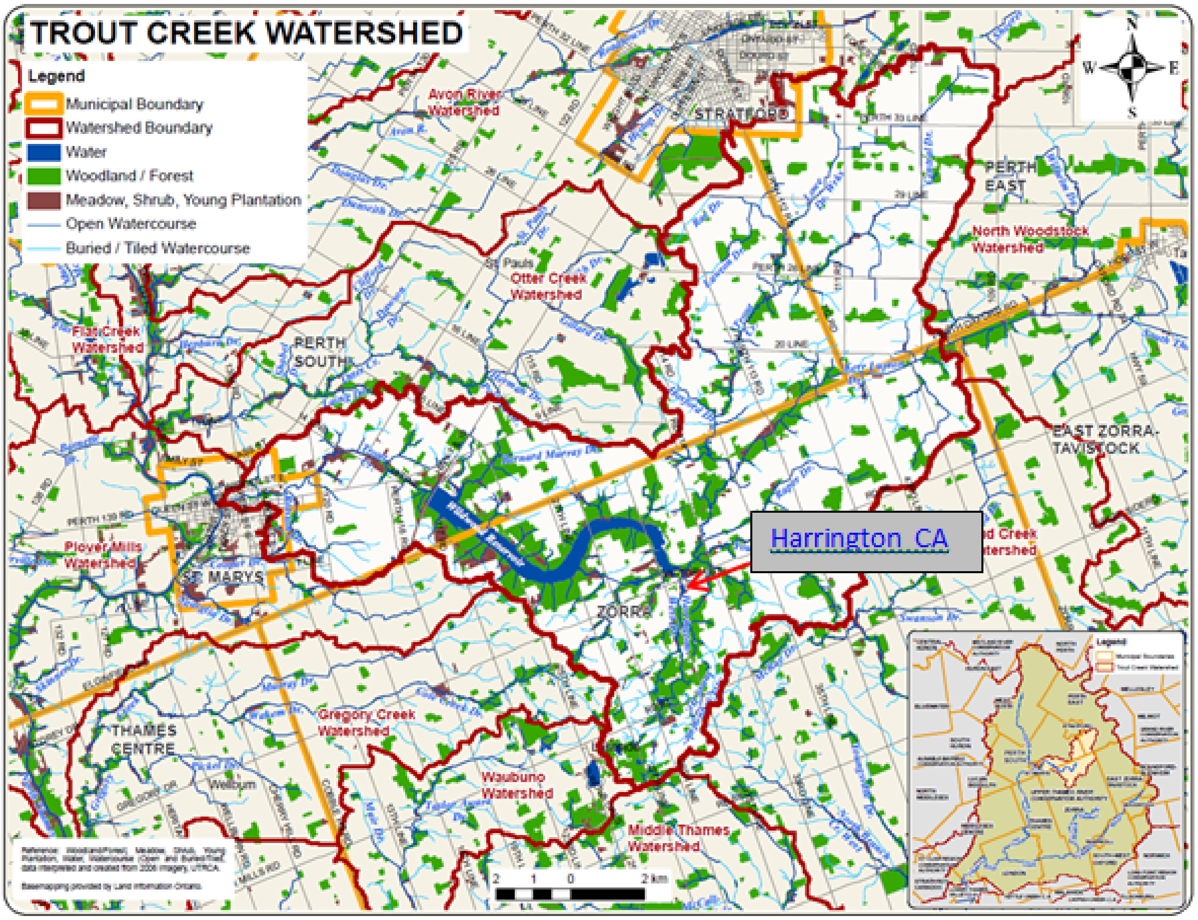


Figure 3-1. Trout Creek watershed with Harrington CA highlighted (Source: UTRCA)

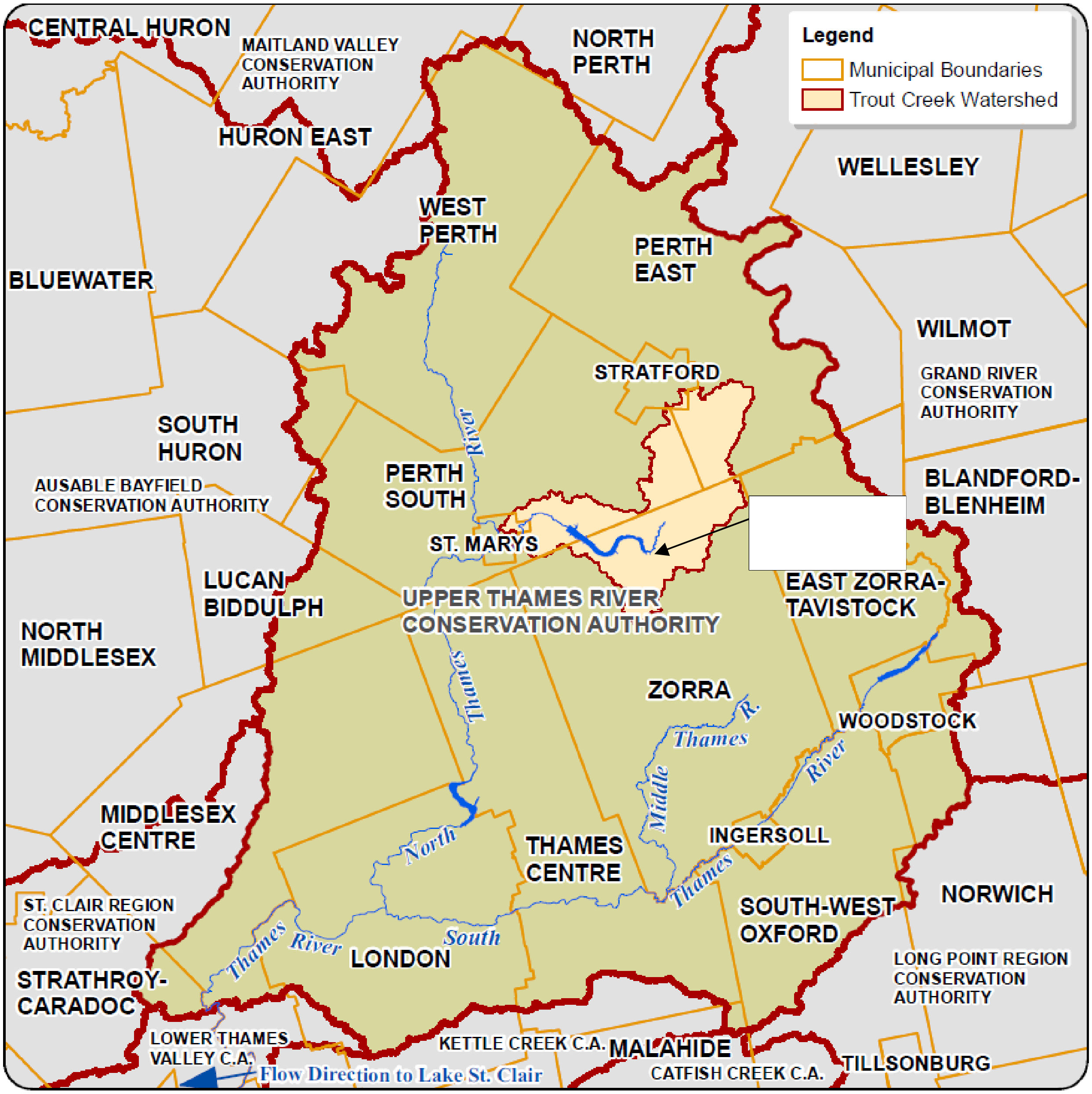


Figure 3-2. Trout Creek watershed in relation to the Upper Thames watershed (Source: UTRCA)

3.2 Physiography, Geology and Subsurface Materials

An overview of study area geology was provided in the Naylor (2008) report which has been extracted below:

> *The Harrington Conservation Area is situated in the Oxford Till Plain Physiographic Region of Southern Ontario. The region is occupied by a drumlinized till plain with glacial meltwater valleys. The dominant soil materials is Tavistock Till which is a gritty clayey silt till. Deposits of glaciofluvial sand and gravel, outwash and ice contact stratified drift, glaciolacustrine silt and clay, and recent streambed alluvium and peat exist throughout the area.*
>
> *The region is underlain by Middle Devonian carbonate formations. The predominant rock type is limestone of the Lucas Formation. The soil cover over these rocks is approximately 30 m thick, at*

Harrington West and the bedrock is exposed in the ancient river valleys in St. Mary's. The bedrock is approximately 400 million years old and was formed in a shallow sea environment.

Insight into subsoil conditions was also provided in the Naylor (2008) report and was described as follows (borehole and cross-section data are provided in **Appendix E**:

In general, the subsurface stratigraphy at the site comprises fill overlying peat, topsoil, sand, sand and gravel, and glacial till.

Fill was encountered in all boreholes and handholes that were drilled on, and around, the dam.

Topsoil was encountered beneath the fill… the topsoil is 900 mm thick and comprises black silt with some organics.

Peat was encountered from 3.8 to 4.8 m depth in Borehole 2 and from 1.8 to 2.1 m below existing grade in Borehole 3. Both of these boreholes were drilled on the west embankment of the dam near the spillway. The peat comprises black amorphous peat. The insitu moisture content of the peat was 90%, indicating that the peat is saturated.

Sand was encountered beneath the fill in Boreholes HT BH1, HT BH2 and HT BH3 at depths of 6.1, 6.0, and 1.4 m respectively. Sand was also encountered in Borehole 3 at a depth of 2.1. The sand material comprises fine to coarse sand with some silt and gravel, and is 0.6 to 1.6 m thick…. The moisture content of the sand indicated saturated conditions at the time of fieldwork.

Sand and gravel were encountered beneath the fill in Borehole 4 at depth of 1.2 m… The sand and gravel generally comprises a brown sand and gravel with some silt and trace clay.

Silt and clay deposits were encountered at 4.0 m depth in HT BH2. The deposit is 2.0 m thick and comprises a stiff, tan coloured silt and clay as described by Acres.

Glacial till was encountered beneath the fill, sand or peat in Boreholes 1 to 3, and beneath the sand in Boreholes HT BH1, HT BH2 and HT BH3. The glacial till extended below the termination depths of the boreholes. The glacial till texture ranged from grey silt with some clay and trace sand and gravel to a brown sandy silt with some gravel.

Mapping of the surficial geology of the study area was provided by UTRCA (2015) and is shown on **Figure 3-3**.

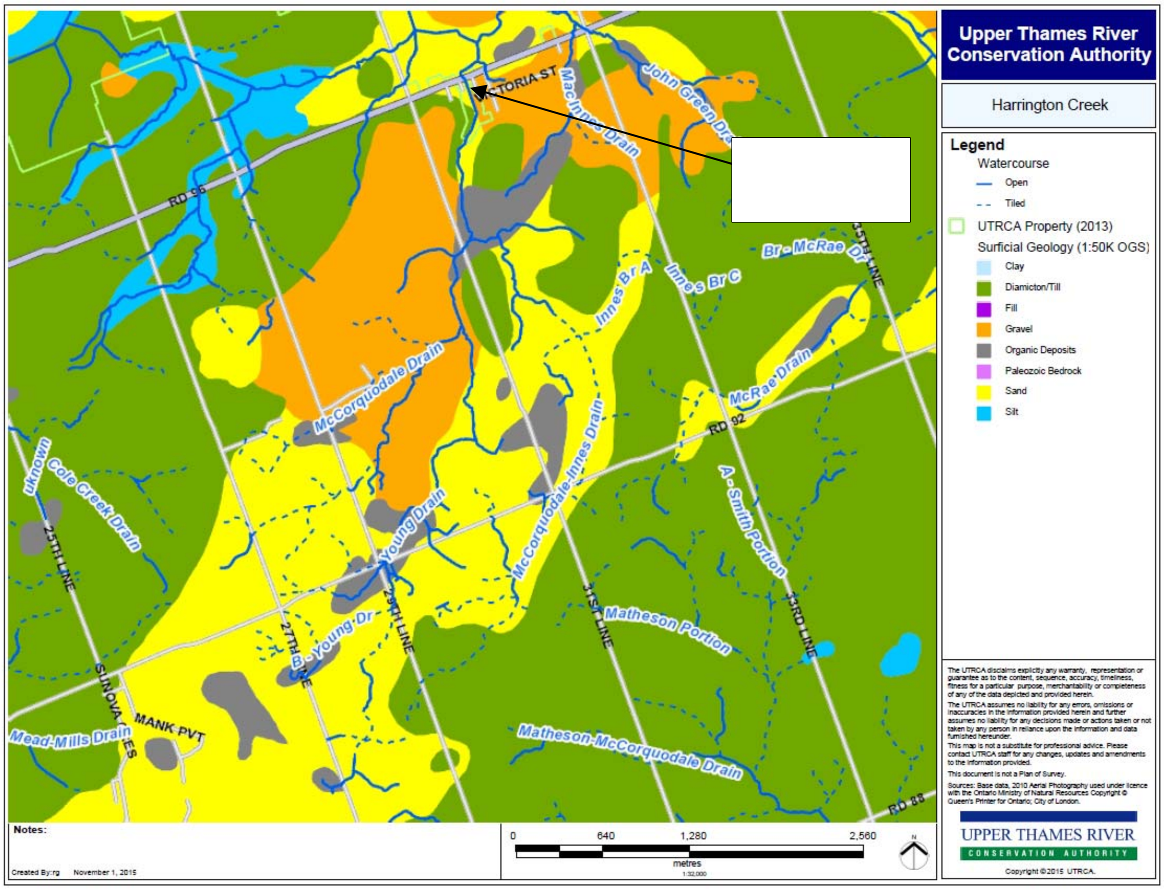


Figure 3-3. Surficial geology of the area around Harrington CA (Source: UTRCA)

In general, the catchment area was characterized by UTRCA as sandy soils that extend from the southern to northern end of the study area, with gravel in the northwestern edge. The sandy soils that dominate the catchment area suggests high infiltration and high groundwater recharge potential.

3.3 Harrington Dam and Pond

As noted in **Section 1.3**, the Harrington Dam was constructed in 1846. UTRCA became the owner of the land in 1952. Upgrades to the dam were completed in 1952 after a large section of the spillway was undermined and washed away in the late 1940s.

The dam controls a drainage area of 12 km^2 of mostly agricultural lands. The surface area of the reservoir is about 0.03 km^2 (length of ~300 m) with an estimated volume of 20,000 m^3.

The dam structure consists of a three bay, reinforced concrete gravity spillway with a 65 m long earthen embankment to the west and a 20 m long earthen embankment to the east. The side slopes of the embankment are approximately 2 to 6:1 (horizontal: vertical). The entire dam is founded on overburden. There is approximately 3.3 m of head water across the dam with 1.1 m of freeboard. The spillway is approximately 4.0 m high and has a trapezoidal concrete section. Stop logs are located on the crest between two sets of steel stanchions. Above the concrete spillway, a low level pedestrian bridge provides access above the spillway.

The main spillway includes concrete wing walls extending to a short, concrete apron. At the end of the concrete apron, rip-rap has been installed to control the energy of the flow as it leaves the concrete spillway. Gabion baskets are located at the east bottom embankment, at the end of the concrete wing walls. A low-level 700 mm diameter outlet pipe is located on the left wingwall looking downstream.

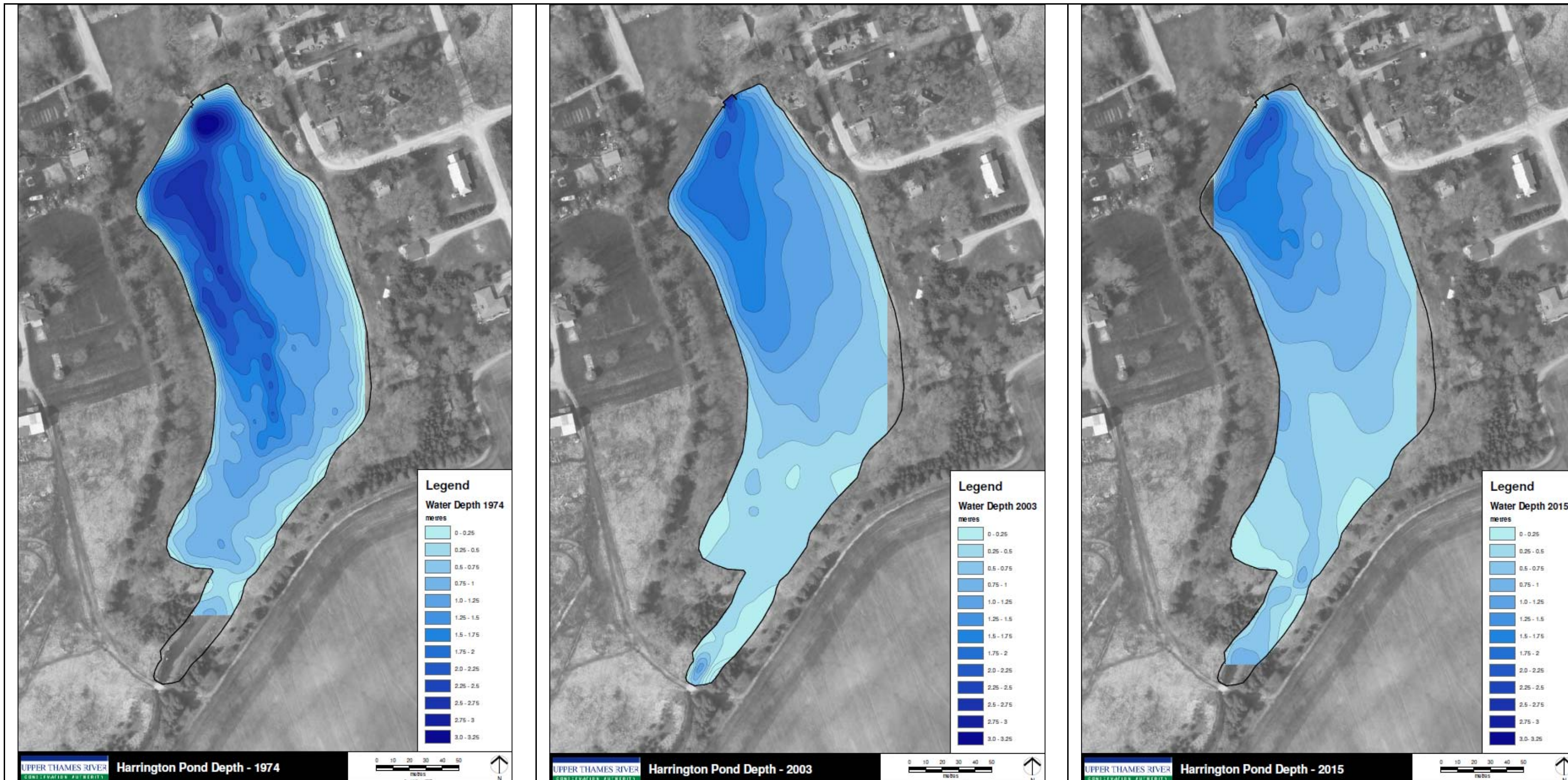
To the east of the spillway, an abandoned millrace is located on the east embankment. The concrete channel millrace was dismantled at the downstream end and filled in at the crest of the dam after the 2000 flooding and during mill building repairs. Evidence of the upstream inlet location remains.

3.3.1 Sedimentation

The pond bed elevation was assessed in 1974, 2003, 2006, and again as part of the current (2015) study. Figures showing water depth in 1974, 2003 and 2015 were prepared by UTRCA and are illustrated in **Figure 3-4**. While the actual values may not be clearly legible, the figures show a decrease in area of deep water (dark blue) and a corresponding increase in shallow water (light blue) over time.

Results of the water depth assessments were plotted on a profile through Harrington Pond **(Figure 3-5**). The figure shows that infilling depth appears to be somewhat greater immediately upstream of the dam.

The bathymetric data were used to quantify the volume of sediment that had been deposited between 1974 and 2015 (i.e., 18,410 m^3). This data was used to determine an average rate of infilling (i.e., 292 m^3/yr) (**Figure 3-6)**. Based on the data, it is clear that the Harrington pond is ~ 48% full of sediment. Complete filling-in of the pond, at the existing sedimentation rate, would occur in ~ 70 years. It is important to keep in mind that the impetus for this study is the safety of the dam structure and not the sedimentation.



1974	2003	2015

Figure 3-4. Comparison of water depth between 1974 and 2015 bathymetric surveys

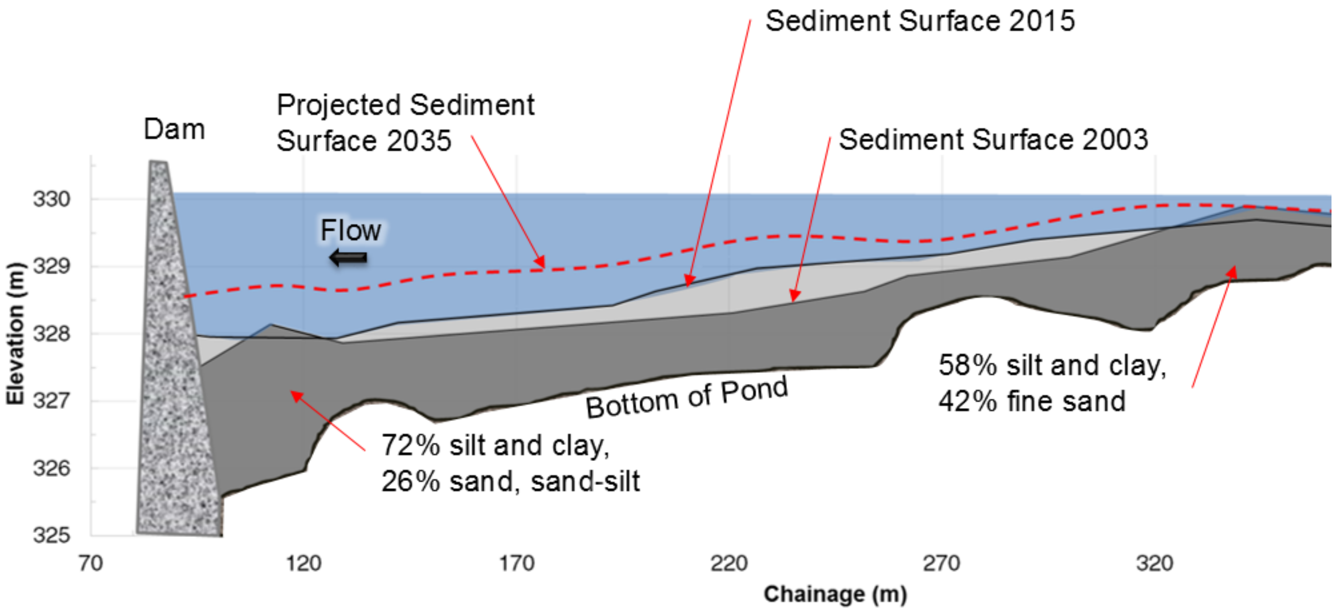


Figure 3-5. Sediment profiles in Harrington pond

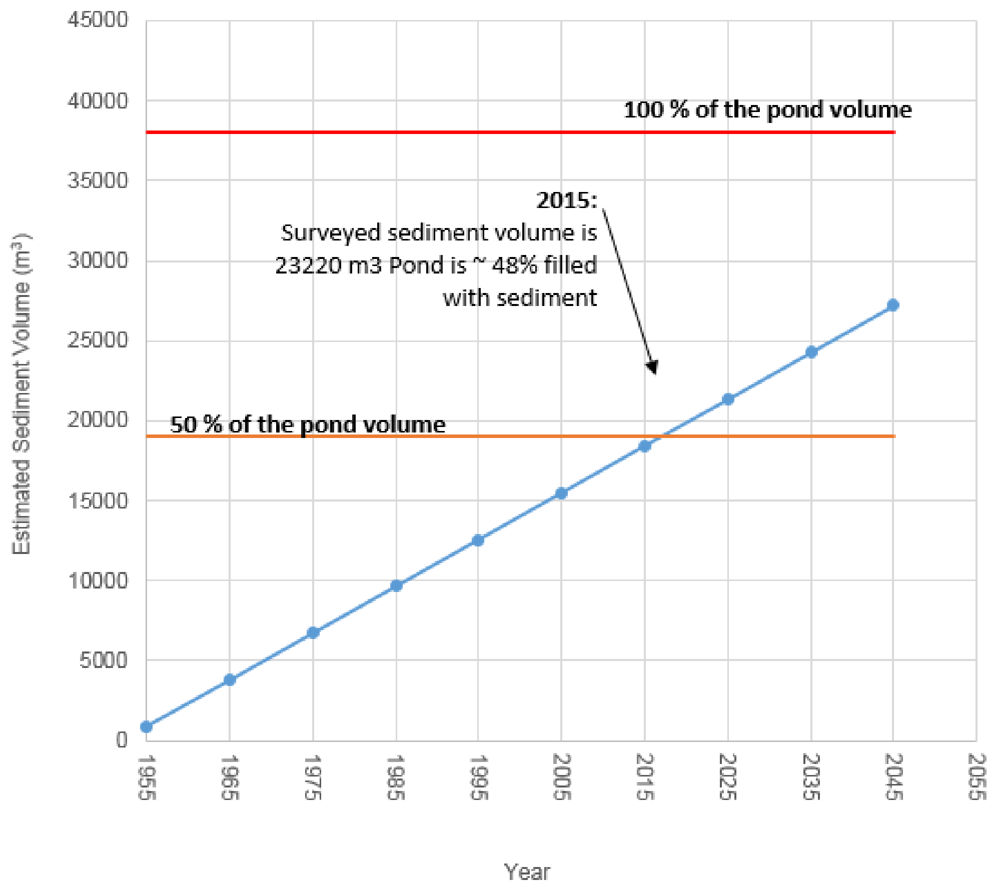


Figure 3-6. Rate of pond infilling

3.3.2 Pond Sediment Quality and Grain Size

Sampling of Harrington pond sediment was completed to assess sediment quality for the context of sediment management in the event of dredging. The analytical results are based on one sediment sample collected in each of the upstream and downstream ends of the pond. The intent of the sampling was to investigate parameters including: metals and inorganics, volatile organic compounds, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), organo-chlorinated pesticides, conductivity, pH, sodium adsorption ratio (SAR), grain size analysis and TCLP (Toxic Characteristic Leaching Procedure).

The sediment testing results were summarized and compared to MOE (2011) Table 2 standards, O. Reg. 153/04 under Part XV.1 of the Environment Protection Act; the results are compiled in **Appendix I**.

The sediment testing, when compared to MOE Table 2 standards, shows that two parameters (Cyanide – a weak acid dissociable) and Boron (hot water extraction) were outside of standard limits considering reuse of the material for agricultural, residential, or Industrial/commercial/community property use. Cyanide exceeded the agricultural re-use limit of 0.051 ug/g at the both the upstream and downstream sampling locations (i.e., 0.091 and 0.092 ug/g respectively). Boron marginally exceeded the agricultural re-use limit of 1.5 at the upstream sampling site (i.e., 1.52ug/g) and was below the limit at the downstream sampling location within the pond (i.e., 1.18 ug/g).

Numerous parameters included in the sediment samples were not detectable below a set limit due to the constraints of the lab testing and samples. The MOE parameter limit was, at times, below the detection limit of the lab and/or samples. In such cases, whether or not the samples exceeded the MOE limits is unknown. Additional sediment analyses should be considered during detailed design, to further evaluate the opportunities for sediment management if sediment dredging is required.

The TCPL was also applied to the samples to identify the potential management strategy of the sediment in conjunction with works required to implement an alternative. The TCLP results are included with the sediment testing results in **Appendix I** and are compared to Schedule 4 Leachate quality criteria (Ontario, 2015), O. Reg. 461/05 under the Environmental Protection Act which forms the basis for the definition of hazardous waste. The TCLP results did not exceed regulation limits set out in Schedule 4 and was thus not defined as hazardous waste.

Based on the sediment quality results, disposal options for the sediment are limited to landfilling and/or beneficial reuse (this requires further investigation).

Grain size analyses of the sediment samples were completed to determine the percentage of sands, and silts and clays. Results of the sampling indicated that the sediment was dominated by silt and clay; sands comprised the remainder of the materials. The distribution in grain sizes varied between the upstream and downstream samples collected in the pond; pond (upstream): 58% silt and clay, and 42% fine sand (sandy silt, trace clay) and pond (downstream): 74% silt and clay, and 26% sand (silt and sand, trace clay) (See **Figure 3-5**). These grain size gradations indicate that the coarser material is deposited in the upstream portion of the pond and finer sediment is deposited in proximity to the dam; this is expected since sediment load from Harrington Creek will drop from suspension as flows enter a slower velocity area.

3.3.3 Inundation Limit

Analyses were completed to assess the area that may be flooded due to a breach in the dam. Two scenarios were assessed including an average pond water level (i.e., elevation of 330 m) with a discharge rate of 50 cms and the pond assuming a 50 year IDF (i.e., elevation 331.13 m). The anticipated flood area is illustrated in **Figure 3-7.** The breach simulation was also undertaken in the Dam Safety Study. The breach analysis does not include the potential effect of volumes of sediment or erosion that may be released to downstream and that may contribute to greater flooding still.

Figure 3-7. Inundation Limit for Dam Failure Scenarios

3.4 Hydrotechnical Environment

3.4.1 Hydrology

At the Harrington Dam, the surface drainage area, consisting primarily of agricultural landuse, is approximately 12 km^2. An estimate of the peak flood flows and hydrographs for the 2 to 500 year return period flows was undertaken as part of the Acres (2007) report. Since the study area is not located at, or near, an appropriate Water Survey of Canada monitoring station, the estimate of flood flows was based on modeling as outlined in the Acres (2007) report. Acres (2007) determined that the Inflow Design Flood (IDF) is the 50 year, 3 day storm event (i.e., 30.9 cms).

An artesian well is located about 70 m downstream from the dam. This well structure is 1.3 m above the ground. Flow from the artesian well is conveyed through a pipe and discharges into Trout Creek near the Country Road 28 crossing.

The surface water hydrology of Harrington Creek was studied by UTRCA staff (see separate report in **Appendix A**). The purpose of the analyses was to determine average flow rates and the unit area flow rate for each catchment area, to assess the response of the stream to drought and low water conditions, to assess the contribution of the stream to the overall flow from its subwatershed, and to examine the effect of the water control structures on upstream and downstream flow rates. A summary of key findings is provided below.

- Analyses have demonstrated that the 1248 hectare catchment area of Harrington Creek contributed greater unit area flow rates to the North Branch of the Thames River than other nearby tributaries such as at those monitored at the following stream gauge stations:
  - i) Trout Creek near Fairview
  - ii) Avon River above Stratford

    iii) Fish Creek
    iv) Trout Creek near St. Mary's

- Based in monitoring undertaken from 2008-2011, 2012 and in 2015, Harrington Creek, downstream of the Harrington Dam, contributed 10.2%, 12.4%, and 10.5%, respectively of Trout Creek Subwatershed streamflow.
- It was determined that Harrington Creek has a high resiliency to drought/low water as evidenced by a significantly smaller percent decrease in flow than that experienced at other watercourses in the watershed.
- Flow measurements during base flow conditions indicated that the flow upstream of the backwater effects of Harrington Dam was approximately 93% of the flow measured at the location downstream of Harrington Dam. This represents a 7% increase in flows through the pond (i.e., from upstream to downstream), which is likely attributable to groundwater contributions.
- Due to the low magnitude of flows measured during the field investigations by UTRCA staff, the accuracy limitations of the flow velocity meter, and inflow to Harrington Creek in between the upstream and the downstream measurement locations, it is recommended that monitoring be continued to increase the confidence in assessing the flow characteristics Harrington Creek.

3.4.2 Groundwater

The UTRCA reviewed internal thematic mapping and Ministry of Environment and Climate Change (MOECC) well records to characterize the general hydrogeological setting of Harrington Conservation Area and the local surrounding area. The well location information suggests that some residences may share or do not have documented wells. The wells shown on the Harrington Dam are Bore Holes for the past Dam Safety investigations.

The well records were examined and data were plotted on **Figure 3-8**. Position information for wells within MOEE well records may not be precise on the maps. The recorded water depths of the wells were plotted on **Figure 3-9**. For the purpose of the current study, an inventory of the shallow wells was not completed but may need to be undertaken in conjunction with detailed design of the preferred alternative since shallow wells may be affected by a change in head pressure due to Harrington Pond (note: impacts are mitigatable through the installation of deep wells). Anecdotal observations provided by the public, through the public information centres (see **Appendix J**) suggest that, in times of previous dam failure, shallow water wells were affected.

The catchment area is characterized by sandy soils that extend from the southern to northern end of the area, with gravel in the northwestern edge (**Figure 3-3**). The sandy soils that dominate the catchment area suggest high infiltration and high groundwater recharge (**Figure 3-10**).

Figure 3-8. Known wells in the area of Harrington CA (Data Source: MOECC)

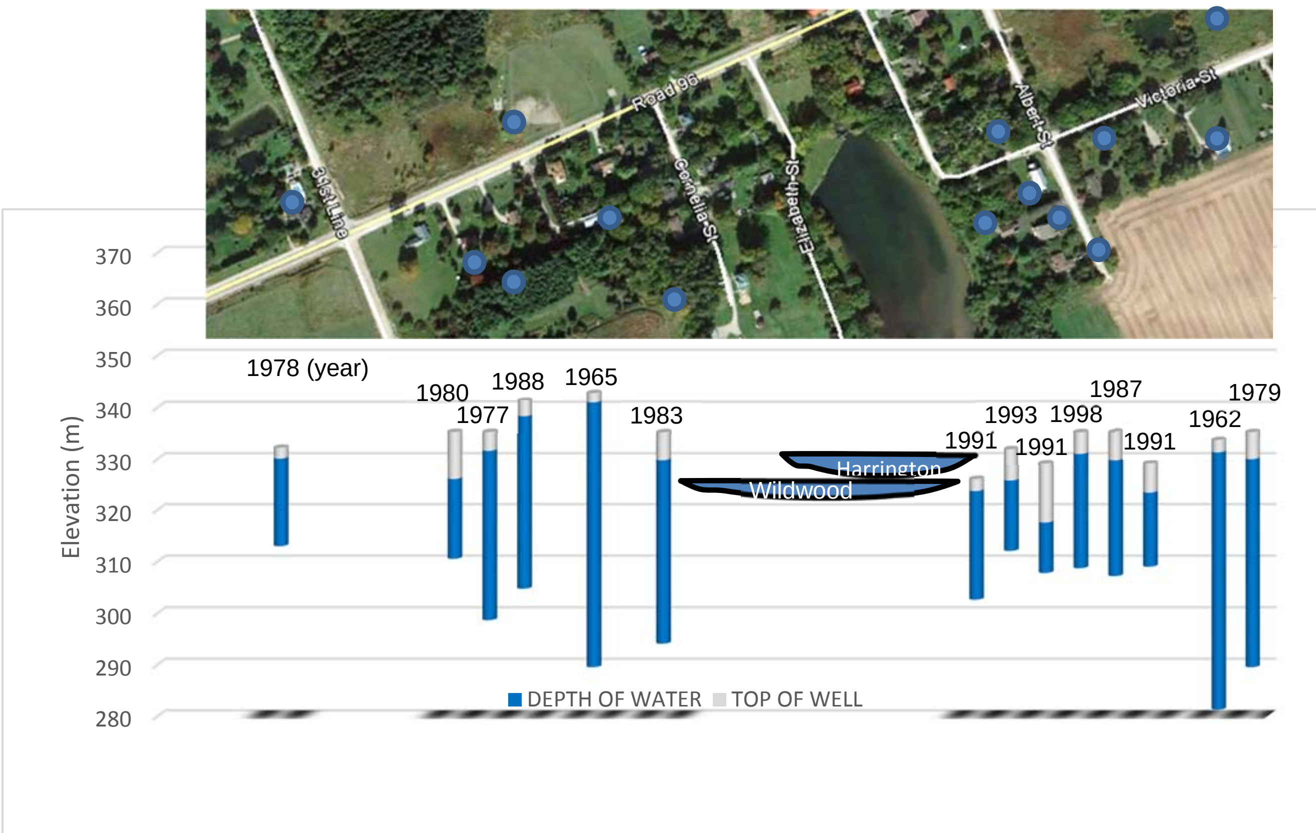


Figure 3-9. Well records in the vicinity of Harrington Dam.

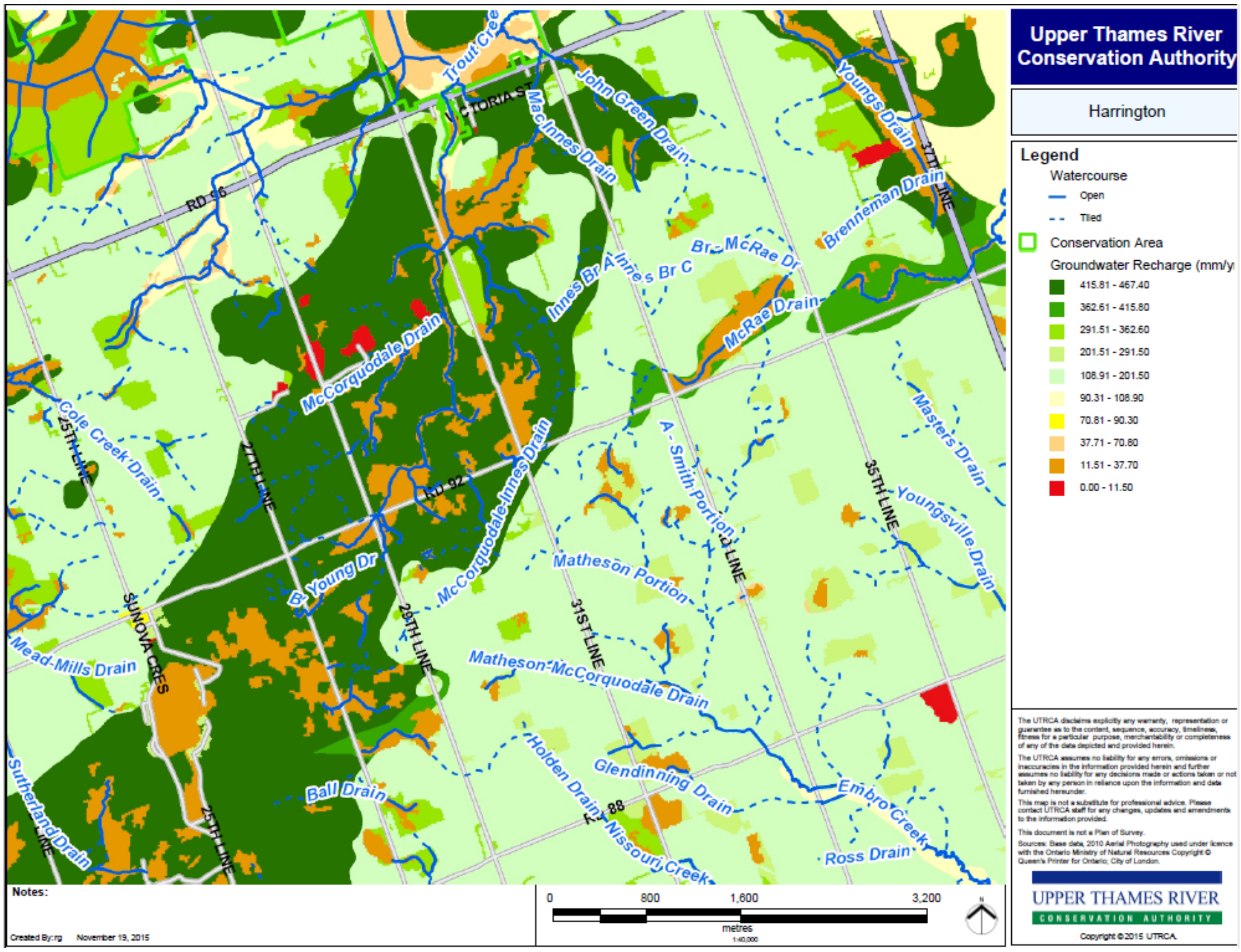


Figure 3-10. Groundwater recharge (mm/y) of the area around Harrington CA

3.5 Fluvial Geomorphology

The intent of the fluvial geomorphic assessment was to characterize channel form and gain insight into channel processes along Harrington Creek in the vicinity of Harrington Pond. Harrington Creek drains into Wildwood Lake, north of Road 96; it is a tributary of Trout Creek.

3.5.1 Historical Conditions

A review of historical channel conditions was completed to gain insight into changes that have occurred within the study area. UTRCA provided airphotos dated from 1955, 1972, 1989, 2000, and 2010; additional aerial imagery was available from Google Maps (2013). Key observations are summarized below; a collection of historical airphotos of the study area is provided in **Appendix F.**

- In 1955, Harrington pond was clearly visible in the airphoto. Downstream of the Harrington pond outlet, Harrington Creek appeared to have been straightened and was situated along a hedgerow. Upstream of Harrington pond, a trail/bridge exists over the creek; backwater conditions appear to extend somewhat upstream of the bridge. In general, Harrington Creek was slightly sinuous and appears to be situated in an agricultural field within a wooded creek corridor.
- No changes to the creek or pond planform are evident from the 1972 and 1989 photos

- In 2000, the upstream west end of Harrington pond appears to have been modified. Shading within the pond may reflect wind on the water or draw-down.
- In 2010, Harrington pond size has decreased in length since the 2000 image; this results in a longer backwater channel that extends into the pond. The smaller pond size may reflect time of year and/or drought conditions. As of 2013, Harrington pond returned to a size similar to that of the 2000 aerial photo.

3.5.2 Existing Conditions

A geomorphic field investigation was undertaken on June 16, 2015 to assess existing conditions along Harrington Creek, both upstream and downstream of Harrginton Pond. Three reaches were identified through the field assessment. A brief summary of dominant channel characteristics within each reach is provided below. The reach delineation is demonstrated on **Figure 3-11**; the surveyed channel bed profile is illustrated in **Figure 3-12**, which includes a profile through Harrington Pond based on 2015 water depth mapping provided by UTRCA.

Figure 3-11. Reach delineation along Harrington Creek

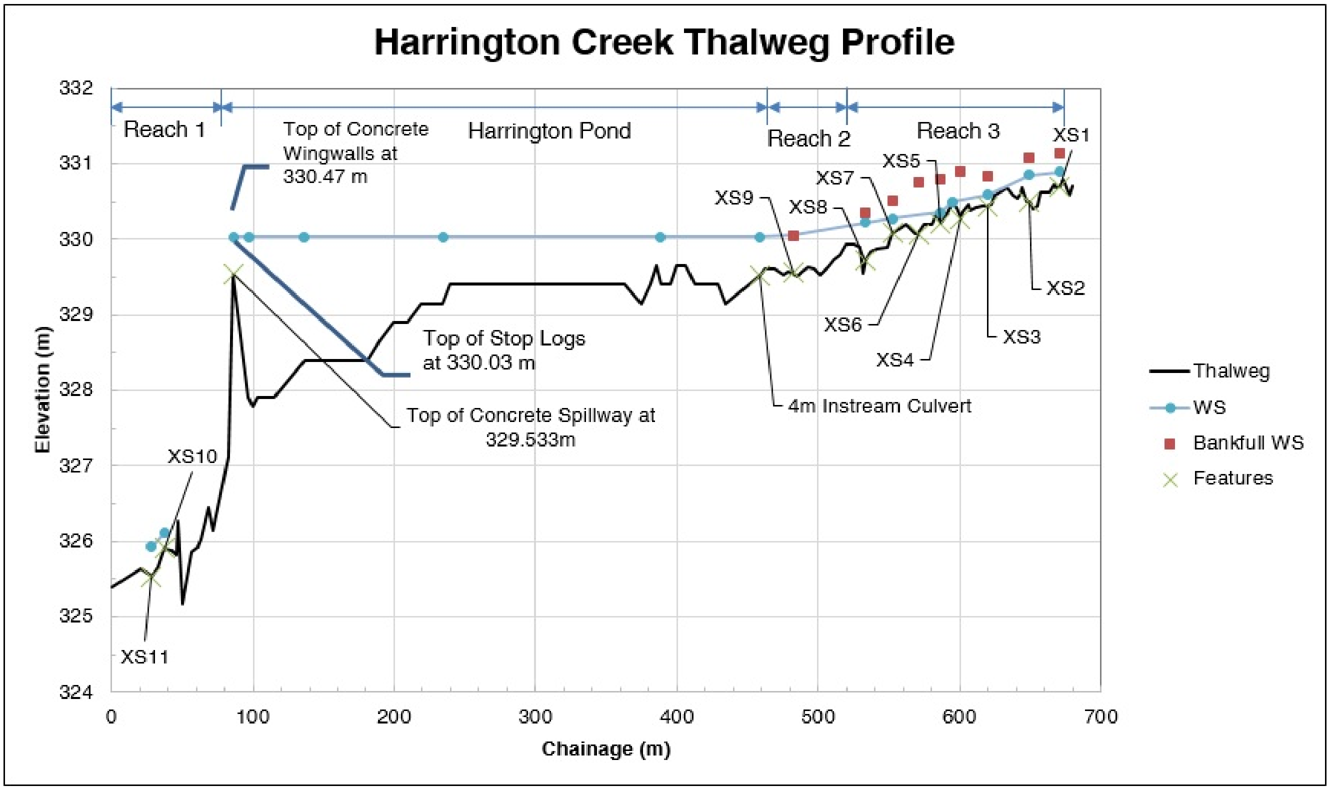


Figure 3-12. Channel bed profile along Harrington Creek

Reach 1. Downstream of Harrington Pond

- At the outlet of Harrington pond, water flows over a 2.42 m high concrete outlet structure. From the dam to Road 96, the watercourse was relatively straight, likely reflecting the channel condition associated with historic mill activity. Harrington creek crosses under Oxford Road 96 through a twin box culvert approximately 100 m downstream of the dam.
- The bed morphology consisted of pool and riffle sequences and bed materials consisted of cobble and gravel. The cross-sections were trapezoidal and banks were steeper and higher along the west side of the channel. The bankfull channel was set within a deeper channel cross-section. Banks were well vegetated with trees and shrubs.
- The secondary channel is the tailrace of the mill outlet and may be occupied during periods of high flow.
- Overall, the creek was considered stable, downstream of Harrington Pond.

Reach 2. Harrington Pond Trail Bridge to 79 m Upstream

- Along this reach, Harrington Creek appears to be influenced by backwater conditions from the pond. Channel banks were well vegetated with grasses and herbaceous plants; the fine and dense rooting network extended to the water surface. Bank materials consisted of silty clay sediment that was considered very soft/moist. The relatively low banks indicated good floodplain accessibility during high flows. Cedar trees flanked the bankside vegetation along the east side.
- The cross-sections were uniform in configuration and increased gradually in width along this reach. A bankfull channel was not well defined since it appeared that flows higher than the channel bank spread over the vegetated west floodplain. This floodplain was very moist, suggesting frequent flooding, poor drainage and/or high groundwater content.

- The bed morphology through this reach was poorly defined. Bed materials consisted entirely of fine sediment (silt, sand) that had formed into ripples. Further upstream, occasional cobbles and branches/logs were observed on the channel bed. A vegetated (grass) bar was observed in the channel, towards the upstream limit of the backwater influence.
- Overall, the reach was considered to be stable. Given the low energy grade (see **Figure 3-12**), both aggradation and channel widening processes are gradually affecting channel form and processes.

Reach 3. From 79 m to 220 m Upstream of Pedestrian Bridge

- The upstream limit of the backwater conditions appeared to extend to a shallow and low gradient riffle feature. Harrington Creek, within this reach, was situated within a predominantly wooded (cedar) forest. Subtle terracing was observed in the floodplain in a few locations, suggesting that, in the long term, Harrington Creek has likely gradually migrated over its floodplain and downcut.
- Overall, Harrington Creek had a somewhat sinuous planform configuration; no well-developed meander bends were observed. In several locations, large woody debris appears to have caused the channel to bifurcate or split. Accumulations of fine sediment (silt/sand) were observed in the ‘lee’ side of logs or fallen trees in the channel.
- The channel banks were generally well vegetated with herbaceous plants, mosses and cedar trees. The bank were generally low, enabling access during flood flows.
- The cross-sections within Reach 3 were generally considered to be wide and relatively shallow. The configuration tended to be relatively uniform, with no asymmetric forms observed.
- The channel bed configuration consisted of riffles and shallow pools. Overall, the bed morphology appeared to be poorly developed. This is likely due to the influence of large woody debris and the high channel width-depth ratio which reduces scour potential of pools.
- Throughout the reach, accumulations of sand (very fine to medium size) and silt were observed as lateral deposits (i.e., along the banks). Occasional larger cobble and boulders were observed on the channel bed.
- Application of the Rapid Geomorphic Assessment (RGA) for this reach indicated that the channel is ‘in transition’. The dominant process within the reach was aggradation. Gradual widening of the cross-sections is also prevalent due to hydration effects.

3.6 Natural Environment

Assessment of natural environment conditions within the study area was completed by UTRCA staff. A summary of the key findings is provided in the sub-sections below and details are presented in **Appendix C** and **D**.

3.6.1 Aquatic Ecology

Electrofishing and benthic surveys were carried out during the spring, summer, and fall of 2015 at the sampling sites shown on **Figure 3-13**. A list of recorded fish and benthic species, separated by sampling location, is provided in **Appendix C**.

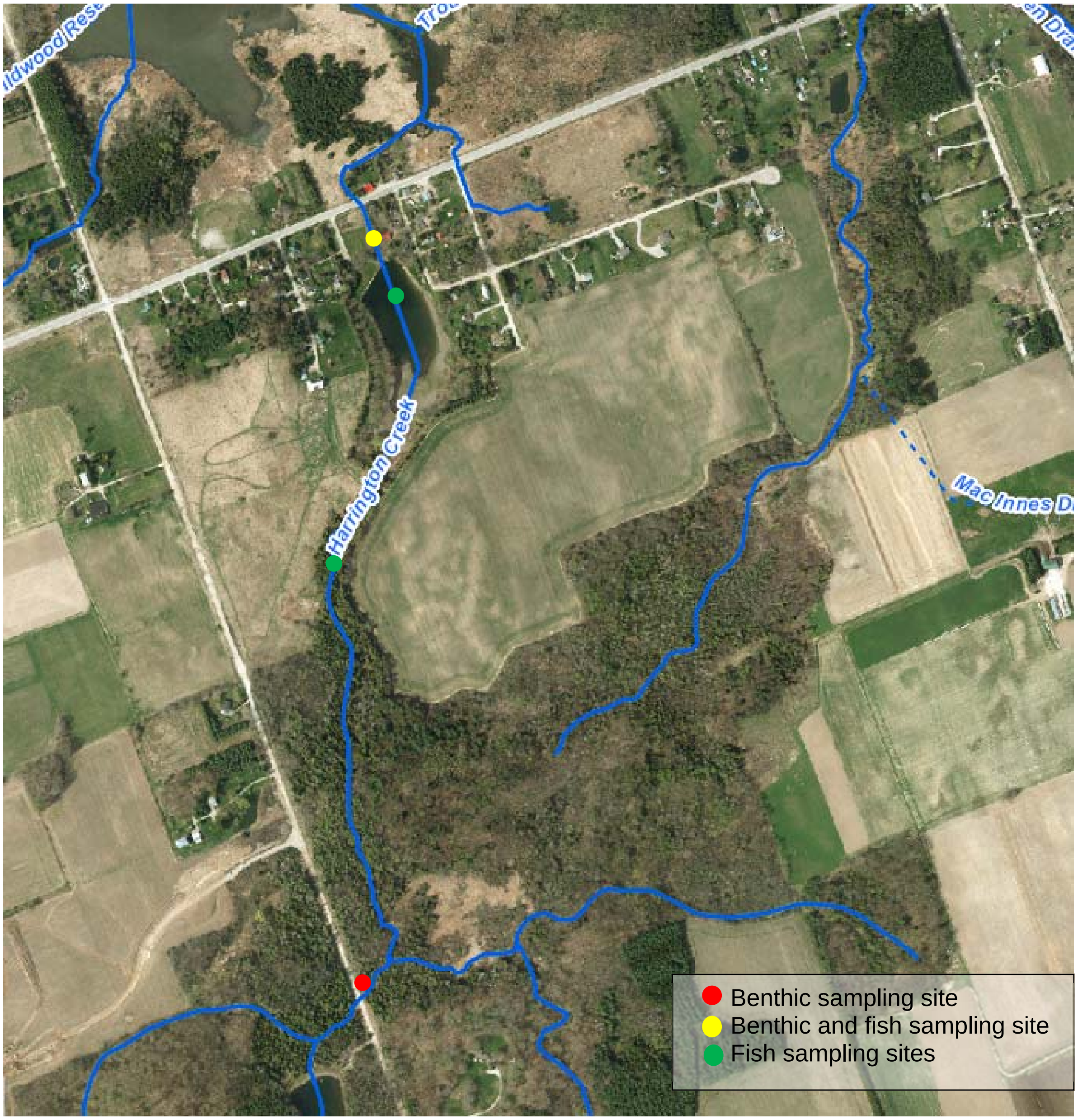


Figure 3-13. Harrington Dam area Benthic and Fish Sampling Sites (Source: UTRCA, Appendix C)

3.6.1.1 Fisheries Resources

An electrofishing survey of the Harrington Pond and both upstream and downstream of the pond was conducted on April 15, 2015. The area downstream of the dam was surveyed again July 22, August 16, and October 19, 2015, while two upstream sites were sampled again November 11, 2015. All specimens were identified to species, recorded, and released. Sample records, including historic records, are tracked in an MS Access database and are provided in **Appendix C**.

Brook Trout and Mottled Sculpin were recorded upstream of the dam in 2015 as well as in previous years, indicating that Harrington Creek does offer suitable habitat for cold water species. Adult Rainbow Trout (remnant from fish derby stocking), Brook Trout, and sculpin found below the dam indicate that the numerous groundwater seeps counteract the warming effect of the pond, creating pockets of cool water habitat where these individuals are thriving.

The stream reach below Harrington Dam appears to provide both permanent and seasonal habitat for warm water species. Most of the minnow and darter species are likely year-round residents while game fish such as Large and Smallmouth Bass, Northern Pike, and Yellow Perch appear to be seasonal residents. The presence of many young-of-the-year of these species in summer samples indicates this is valuable spawning and nursery habitat and an important source of recruitment for Wildwood Lake game fish. Other species likely to be spring and summer residents only include Common Carp and sucker and bullhead species. While adults have been found below the dam the absence of young-of-the-year of Rainbow Trout, Brook Trout, and Sculpin below the dam suggests that some individual adults of these cold water species likely passed over the dam and then were unable to move back upstream due to the dam. On the downstream side of the dam small breeding population numbers and unfavourable habitat conditions then become limiting factors preventing successful reproduction downstream of the dam.

Over the years our fish data has consistently indicated that there is a difference in species diversity upstream and downstream of the dam. Upstream the number of species found is low, only seven. Downstream species diversity is much higher with 30 species having been recorded. The species lists can be found in **Appendix C.** The low species diversity upstream is fairly typical of trout dominated systems but also likely reflects the impact of the barrier to fish movement presented by Harrington Dam. On a seasonal basis they would utilize more of the downstream habitat for feeding. UTRCA aquatic biology staff have observed that some of the largest Brook Trout specimens, in the UTRCA watershed, have been found on other watercourses where Brook Trout have unrestricted access to healthy prey populations, such as those found upstream of Wildwood Lake.

During a mid-May (5/14/2015) visit to Harrington CA, extensive carp spawning activity was observed in the shallow upper parts of the pond, indicating that the pond supports a large population of this invasive species. A lack of aquatic macrophyte growth and high turbidity levels also likely can be attributed to the carp population. As Common Carp prefer warm, vegetated areas of slow moving rivers and lakes the current conditions in the pond upstream of the Harrington Dam provide ideal conditions for Common Carp.

3.6.1.2 Benthic Resources

Benthic invertebrate sampling was conducted in the spring (May 8) and fall (September 23), 2015, at a site upstream of Harrington Pond and at a site downstream of the dam. Sampling was conducted using a traveling kick and sweep method, and samples handled and analyzed, using methods consistent with Provincial (OBBN) and Federal (CABIN) protocols. Samples were preserved in the field, randomly subsampled in the lab, and identified to the Family taxonomic level. Resulting data was entered into and analyzed using an MS Access database. Sample records (including historic records) with calculated Family Biotic Index (FBI) are provided in **Appendix C**: Harrington CA Fish and Benthic Records. The water quality ranges for the FBI values can be seen in **Table 3-1**.

For the two 2015 samples, the average FBI upstream of the pond was calculated to be 5.11, indicating “fair” water quality, and 6.22 downstream of the dam, indicating “fairly poor” water quality. The pollution sensitive taxa (caddisflies and stoneflies) found above the pond are replaced by very pollution tolerant taxa, primarily aquatic worms, below the dam, indicating a dramatic pond impact on water quality.

Table 3-1. Water quality ranges for FBI values

< 4.25	Excellent
4.25 – 5.00	Good
5.00 – 5.75	Fair
5.75 – 6.50	Fairly Poor
6.50 – 7.25	Poor
> 7.25	Very Poor

Only one historic downstream sample exists, with an FBI = 5.40, indicating “fair” water quality, but sampling has occurred extensively at the site upstream of the pond since 1997, with an average FBI = 5.37. This value is considerably better than the long term UTRCA average of FBI = 5.99, as well as the average of UTRCA 2015 sites evaluated to date of FBI = 5.68. A value of FBI = 6.17 was calculated for the 2012 Trout Creek Watershed Report Card (the catchment in which Harrington Creek is located). Harrington Dam, therefore, lowers Trout Creek water quality rather than improving it as unencumbered flows would do.

Table 3-2. Comparison of FBI values for Harrington CA, and Trout Creek and UTRCA watersheds (Source: UTRCA, Appendix C)

Harrington Creek upstream of Harrington Pond	4.68	5.53	5.11	Fair
Harrington creek downstream of Harrington Dam	6.73	5.71	6.22	Fairly poor
Trout Creek watershed 2012	N/A	N/A	6.17	Fairly poor
UTRCA watershed 2015	N/A	N/A	5.68	Fair
Provincial Guideline (target only)	N/A	N/A	< 5.00	Good

3.6.2 Terrestrial Ecology

This study examined the vegetation and bird and other wildlife at Harrington CA to flag any rare or sensitive species that might be impacted if the Harrington Dam and reservoir area were changed.

A three-season botanical inventory was completed in 2015 of this 5 ha site. Of the 219 plant species found, 40% are non-native. No species-at-risk or rare or uncommon species were found that would be a limiting factor to future site works or conservation area changes. Overall, the quality of the vegetation, which is a diverse mix of small habitat types, is rated as moderately poor to average.

The Harrington Pond/Reservoir itself does not support any native rooted aquatic plants and has only a narrow fringe of wetland emergent plants along the southern edges and a sparse cover of rooted aquatic plants (a non-native pondweed). The large population of Common Carp in the reservoir is likely a cause as these fish muddy the water and uproot plants. The wetland emergent plants found along the pond’s shores are common along flowing waterbodies and in wetlands in the area. Many of these plant species would likely naturally re-establish along Harrington Creek and would not be a limiting factor to future site changes.

Harrington CA is within 100 m of a Provincially Significant Wetland known as the Lakeside Wildwood Complex. Thus, construction activities need to consider impacts on the wetland. It is likely that many wildlife species travel between the wetland and Harrington CA due to the close proximity. Only the treed edge (southeast edge) of Harrington CA is part of a larger significant natural heritage feature as defined by the Oxford Natural Heritage System (ONHS 2006). The remainder of the CA (pond/day use area) is not part of that feature. Neither the Provincially Significant Wetland nor natural heritage feature designations would be limiting factors to future site changes.

A three season bird survey was undertaken in 2015 as well. The 42 species of birds recorded in the CA are mostly common breeding or permanent residents of the area. One species-at-risk, the Barn Swallow (Threatened), was seen in Harrington CA, but there was no evidence of breeding within the CA. The reservoir or other parts of Harrington CA do not provide critical habitat for any sensitive bird species. Use of the pond by native waterfowl seemed to be on an occasional basis for feeding and resting versus nesting and rearing young. The fish biomass in the pond is largely unavailable to fish-eating birds such as kingfishers and herons due to the size of the fish (i.e., large, mature carp dominate).

While no sensitive wildlife species were recorded by the biologists, there have been reports from the public that Snapping Turtles use the reservoir. The Snapping Turtle is a species of Special Concern. Should the dam be removed, a slow, summer-time drawdown of the reservoir should safeguard any individuals by allowing them to move into nearby stream habitats, and ultimately, back into the restored creek within Conservation Area.

Other species noted by the public were Milksnake and Eastern Bluebird. Neither are Species at Risk and do not rely on ponds, instead preferring fields and forest edges. Concern was also noted by the public regarding the impact of dam removal on other wildlife such as Mute Swan (non-native), beaver or muskrat, and eagles. Many of these species are not exclusive to ponds and can carry out their functions in stream habitats. During planning for any projects these species can be further investigated as to existence, location, use of the Conservation Area, and avoidance, habitat protection or creation during the time before in field works are undertaken. Specific periods of construction during nesting or rearing could be avoided

In conclusion, there are no sensitive plants, plant communities, birds or wildlife that would be threatened from changes to the environment in Harrington Conservation Area.

A detailed report of the vegetation, bird, and other wildlife inventory can be found in **Appendix D**: Harrington Conservation Area Vegetation and Bird Inventory 2015.

3.7 Water Quality

A series of five water samples were collected at four locations in the area of Harrington CA: one upstream of the pond, two in the pond, and one downstream of the dam (see map in **Figure 3-14**). This monitoring provides a snapshot of water quality, and is limited to the conditions of April to October 2015. Harrington Pond also had one year of historical data from 1989, which has been included in the evaluation of the results.

Most samples were taken during low flow conditions. The dry conditions in the summer and fall of 2015 resulted in minimal opportunity to monitor runoff conditions. There was some variation in flow based on minimal rain but only one date had rain with runoff conditions (June 1).

Samples were analysed at ALS Laboratories in London. Samples were analyzed for Nitrate, Nitrite, Total Kjeldahl Nitrogen, Total Phosphorus, Orthophosphate, *E. coli*, Chloride, and Suspended Solids. Field measurements were taken with an YSI multi-parameter meter for Dissolved Oxygen, pH, Conductivity, and Temperature. Continuous temperature measurements were taken from June 1 to September 23 using a datalogger recording in half hour intervals.

The results for all of the parameters that were monitored can be found in **Appendix B** (i.e., Harrington Pond Water Quality Assessment).

In general, the water quality in the Harrington-West Drain, where it was sampled upstream, downstream, and in Harrington Pond, showed good results for 2015, with numbers typically better than the average seen in Upper Thames watershed streams. The headwaters of this area which includes a significant wetland complex and natural areas would likely contribute to the relatively good quality of this stream.

The results for 1989 and 2015 were very similar for all parameters with the exception of nitrate which is slightly higher in 2015 compared to the 1989 data.

Temperature differences are apparent between upstream and downstream of the pond based on continuous measurements and show a greater difference as the summer progressed, likely as a result of the warming effect of the pond (See **Figure 3-15**).

Ponds can act as a settling basin for sediment and associated contaminants such as phosphorus, and these can accumulate in the bottom sediments. These contaminants can be re-suspended when disturbed such as during more extreme flow conditions. Sampling of the bottom sediments would give an indication of any accumulation.

Figure 3-14. Harrington Pond Water Quality Survey Sites 2015 (Source: UTRCA)

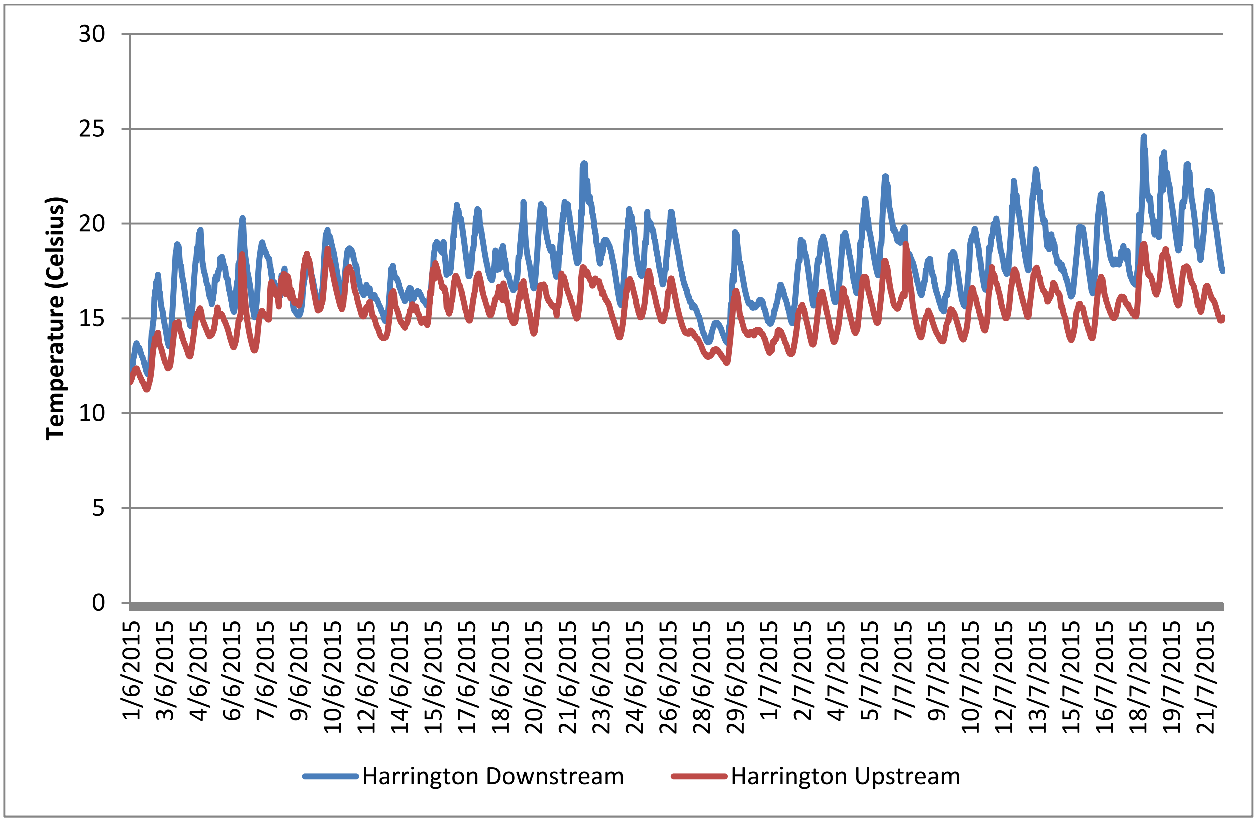


Figure 3-15. Continuous Temperature Upstream and Downstream of the Pond in Summer 2015 (Data source: UTRCA)

3.8 Socio-Cultural Environment

3.8.1 History of Study Area

The cultural history of the study area is documented in several sources and was also conveyed by members of the public through the public consultation process. A summary is provided below, with a copy of anecdotal information submitted by the public placed in **Appendix G**.

In a document that speaks to the history of the Harrington area, titled “Class of 1840”, a story is told about two young men that arrived in Zorra Township in 1802, which at that time was “almost a solid wilderness”, to search out a home. The men rested a night on a “…spring creek of clear water (that) flowed northward through the spot and it is known today as the village of Harrington”. The men also interacted with residents of an Indian camp that was “twenty rods down the valley by the creek” (Rounds, 1990).

The village of Harrington was created in 1855, though the original grist mill was established years before, in 1846. According to the “Gazeteer and Directory of the Counties of Oxford and Norfolk and Woodstock, 1867”, Harrington contained a handful of shops and a church, along with the mill (Rounds, 1990).

The area that comprises the current Harrington Conservation Area was historically privately owned by a few different landowners prior to being purchased by the Upper Thames River Conservation Authority in 1952. A summary of the conservation authority's chronology, which includes the mill and dam, is as follows (Upper Thames River Conservation Authority, 1973 and 2010 and from the Stratford Beacon Herald (August 19, 2014 issue):

- The original mill was built in 1846 by a man named Demerest. The mill used an overshoot water wheel
- In 1880, the water driven turbine was replaced with a water wheel for power generation
- In 1899, a Chopper and Roller replaced the stone previously used for grinding grain
- The mill was purchased by Mr. Robert Duncan in 1920.
- The mill was destroyed by fire in 1923 and was replaced that same year.
- In 1903, the dam broke and was repaired
- In 1923, fire caused extensive damage to the mill and the mill was rebuilt
- In 1948, Milton Betteridge suggested that the Harrington dam site be acquired as a conservation area. Inspection of the property by UTRCA representatives revealed the 10.7 meter spillway had been undermined and washed away. Works to repair the dam plus enlarge the pond from 1.6 to 3.2 hectares were estimated to cost approximately $10,000.
- In 1949, the dam broke and was repaired
- In 1952, almost 5 hectares of property was purchased by the UTRCA, including the dam and pond (owned by Mr. Duncan) and adjoining property owned by Mrs. Levi Nimock and George Robinson. Work started in July of 1952 to repair the spillway and enlarge the pond. Work was completed by the end of that same year.
- Provincial operating funding support for recreation dams was cut in 1995. The Township of Zorra now contributes 100% of the dam operating costs.
- In 1966, the Authority purchased the mill from Mr. Duncan; the mill was closed and abandoned
- The mill was in continuous operation from 1846 to 1966, except for a brief period of time in 1923 when it succumbed to fire, and two other times when the mill dam broke (1903 and 1949). A diesel engine was used in the latter years of the mill's operation when the water supply was too low to operate the turbine.
- In 1999, the UTRCA entered into a lease agreement with the Harrington and Area Community Association (HACA) for the long-term restoration of the mill and the maintenance of Harrington Conservation Area grounds.
- The Harrington Dam was overtopped twice in the summer of 2000 with subsequent repair work performed on the downstream embankment slopes adjacent to the spillway.

Prior to the recent restoration efforts of the mill structure and functions, the mill had also operated some time in the past; it was then driven by an internal combustion engine. Various options had been presented in the past to return to operation of the water turbine to demonstrate original operation of the mill. The demonstration would show operation of the turning or free-wheeling of the turbine, passage of water through the turbine, connection of the turbine with the shafts and belts that drive the various mill machinery, a complete working mill through driving of the grindstone, and could illustrate opoerations at different gate settings controlling the water flow, or control of the water flow depending on the availablility of water. Contemporary permitting conditions of the Province of Ontario for use of water may, for example, consider stream water volume withdrawal limitations, biological needs, water quality, and administrative controls.

Through the public consultation process, members of the public recalled the following anecdotes:

- Recreational use of the pond area included camping, courting, picnicking, walking, relaxing; grass maintenance had occurred until 25 years ago (S. Graham)
- "As a child I learned to swim, skate and paint landscapes at the pond; the pond was the centre of the community (S. Graham-Hewitt)

- The pond is a water source for fire fighting
- “ we all learned to swim and fish and skate there, and we visited regularly for recreation and to see the cemetery” (J. Hewitt)
- “ the United Church held its Sunday School picnics on the grass flats abutting the pond… catch fireflies… apple trees on the pond banks dropped masses of fruit and my brother started up a year’s long competition by showing us how to whip them across the water with a homemade slingshot….community parties… hours spent in the water… climbed the cement slope of the falls, grabbing long algae with fingers and toes… learned to fish… had a rowboat… canoes… skating, hockey… the pond was an integral part of the community when I was growing up. It was the place where we met and played and celebrated.” (J. Hewitt, April 2016)

3.8.2 Current Uses

Harrington Conservation Area is a “Day-Use Only” area, with current uses including hiking, birding, fishing, and picnicking. In early 2015, a 1.5 km hiking trail was created around the pond. Harrington CA has been a fishing and picnic area for generations; a yearly fishing derby for children is presented by the Tavistock District Rod and Gun Club (the pond being stocked with various sizes of rainbow trout for the occasion), and Harrington and Area Community Association (HACA) holds an annual BBQ as a fundraiser for restoration of the mill. UTRCA has recently (2016) been notified by the Ministry of Natural Resources that the pond will no longer be stocked; this will affect the annual fishing derby that has traditionally be held in the area.

An informal trail traverses the perimeter of the pond. The trail entered private property and crosses the in-stream culvert to the south of the pond, however the community group signed a 5 year lease program with the owner (George Robinson) to formalize the trail. Additionally, the UTRCA repaired property fencing along the border of the CA and farm property and installed styles along the trail to limit other vehicle uses.

The Harrington Community Preservation and Historical Club Inc. entered into a lease agreement with UTRCA in 1999 for the long-term restoration of the grist mill and the maintenance of Harrington CA. Restoration of the Mill, to date, has been supported through community fundraising, volunteer hours, and a Trillium Grant. The restoration efforts are intended to result in a functioning museum and a working educational site. Tours are now available upon request. There is potential to support demonstration operations of the mill by water flow from Harrington Pond.

The Township of Zorra launched a memorial tree planting program. The program ensures that a few trees are planted each year that have so far concentrated on the perimeter areas of the property. In July 2015, a “Memorial Tree Sign” was unveiled within the Harrington CA. Through a new program run by the Township of Zorra, in the future, memorial trees purchased through UTRCA may be planted within the CA.

3.8.3 Other Uses

Water from Harrington Pond is now used by The Township of Zorra for firefighting purposes. The Township has been exploring an alternative year-round source (e.g., a reservoir or holding tank). The Township Fire Chief has indicated that the Township would await the outcomes of the EA (Pers. Comm. Zorra – UTRCA, 2013-15).

3.8.4 Archaeological Assessment

A Stage 1 Archaeological Assessment was conducted to determine the archaeological potential of the study area, to identify previously known archaeological sites (if any), and to provide recommendations for further assessment if necessary. The results of the archaeological assessment for Harrington Dam are summarized in **Figure 3-16** and in **Appendix G**.

The background review revealed no record of previously completed work, reports or known archaeological sites within the study area. The Harrington Dam study area has the potential for archaeological sites based on location, drainage and topography and the application of land-use modelling. The Harrington-West Drain, Trout Creek, historically surveyed roadways (Elizabeth Street, Victoria Street, and Road 96) and an area of early Euro-Canadian settlement represent local indicators of archaeological potential.

The existing condition of the study site exhibits a reduced archaeological potential due to permanently wet lands and lands consisting of extensive land alterations. In terms of archaeological potential, Harrington Dam study area is characterized as containing 3.19 ha of archaeological potential and 2.47 ha of land identified as areas of no archaeological potential. The 3.19 ha is subdivided into 0.25 ha of the Harrington Dam parcel and 2.94 ha located within 300m of a feature of archaeological potential and it is noted that, in the event of any works proposed, a pedestrian survey for the Harrington Dam parcel and for the remainder of the archaeological potential lands, test pit surveying would be required (ARA, 2015).

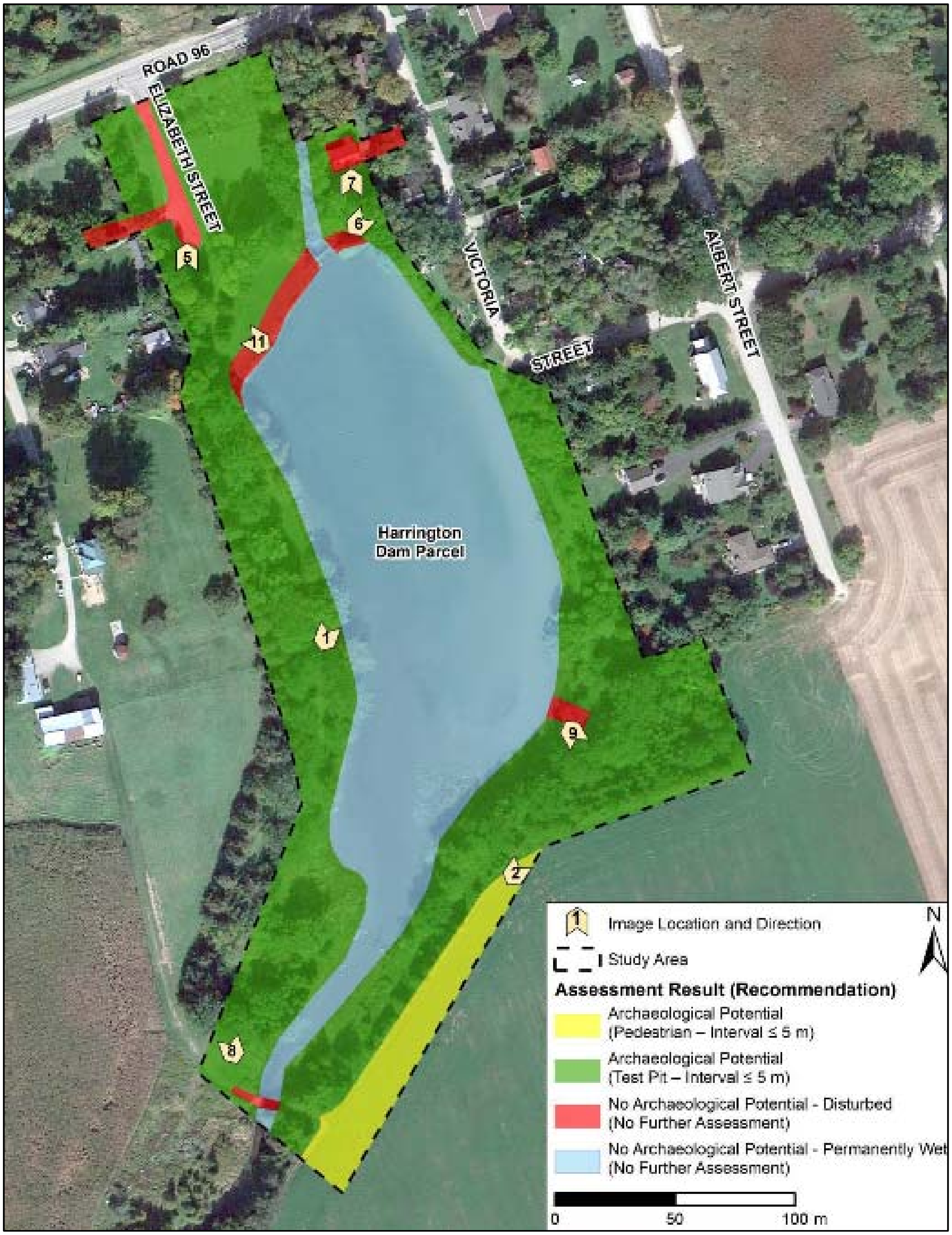


Figure 3-16. Archaeological Assessment Results for Harrington Dam CA

4. Alternative Solutions

Alternative solutions were developed for Harrington Dam, to address the identified issues with the dam structure, and to achieve the objectives of the project with consideration of the environmental, social, economic, and technical aspects of the dam. Previous studies have identified concerns about insufficient spillway capacity, insufficient freeboard, embankment stability and flood flow conveyance through the emergency spillway. A subsequent embankment stability analysis (Naylor/LVM in 2008) was completed to further investigate the structural integrity of the dam; the study indicated that the dam does not meet current standards and is not considered stable under existing conditions.

4.1 Alternatives

Alternative solutions to address the identified issues are presented below for further evaluation and consideration. The alternative are illustrated in **Figures 4-1 to 4.7**:

4.1.1 Alternative 1: Do Nothing

No significant works would be undertaken to address stability issues at the dam, or to enhance the natural or social environment in the project area. The existing aesthetic and current recreational uses would be maintained, although, over time, the aesthetic would deteriorate due to continued infilling. The risk of dam failure would persist with associated environmental consequences (flooding, erosion, uncontrolled/unmanaged sediment movement). The liability of UTRCA in case of dam failure would increase; insurance payments may also increase.

In a worst case scenario (i.e., passage of the 50 yr IDF flow), there is potential for three buildings to be affected by flood flows (see **Figure 3-7,**

Figure 4-1). In the event of failure, mitigation of sediment exposed on-site will need to occur; this could include regrading of the site and removal of the berm and dam structure. Environmental impacts due to a dam breach would include release of sediment into the downstream water course which will increase water turbidity, embed substrate materials, suffocate fish eggs (depending on time of year in which failure would occur), and infill pools. Potential clean-up of the downstream channel may be necessary to mitigate the damage and/or destruction of downstream aquatic habitat.

There would be no improvement to water quality (temperature), fish passage potential, or to the continuity of sediment conveyance through the watercourse. Regular monitoring would be completed and adjustments in operational procedures would be undertaken, as necessary to address geotechnical concerns (e.g., loss of material or seepage will require removal of stop logs to reduce pressure; this will result in a lowering of the pond surface); these management strategies are not anticipated to be effective in mitigating risk to public safety. Similarly, the quality of habitat for waterfowl and some amphibians will deteriorate over time.

Culturally, this alternative will decrease the pond aesthetic over time (i.e., continued infill, potential odour), lead to a reduction in pond volume which would reduce available water volume to operate the grist mill for demonstration, and also decrease potential recreational uses purposes. In the case of failure, the open water viewscape would be lost and a reduction in potential water power to operate the Mill would occur.

Costs associated with this alternative (See Section 4.2) are relatively low with respect to long term full costs, including average annual maintenance costs such as repairs to the concrete structure and site restoration in the event of failure.

4.1.2 Alternative 2: Remove Dam and Install Rocky Ramp

The existing earthen dam and concrete spillway would be decommissioned and removed to eliminate the risk of dam failure. A rocky ramp would be created at the existing spillway structure; the ramp would manage the grade differential between the downstream channel and proposed upstream elevation. The rocky ramp would enable passage of a larger number of species present in the downstream channel to migrate, into the upstream portion of Harrington Creek; not all species will be able to negotiate the rocky ramp (i.e.,weaker swimming fish). Within the existing footprint of the pond, a natural channel would be re-established that will enable a continuity of sediment transport through the watercourse. The surrounding area/floodplain would be restored with natural vegetation and provide enhancements to improve diversity of terrestrial habitat. Sediment that is dredged or excavated may be reused on-site, where feasible to create floodplain materials. It is expected that some sediment will require off-site disposal.

With removal of the dam, then we would expect that coldwater aquatic species would utilize a larger proportion of the creek and provide access to upstream channel sections from which they have been excluded. Removal of the dam is expected to benefit the local Brook Trout population. With removal of the dam, the habitat conditions favourable to carp will be reduced.

Open water habitat for waterfowl and some amphibians would be lost. Improvements to water quality will occur and may be enhanced (e.g., enhanced riparian vegetation to provide shade. In this alternative, a loss of hydraulic pressure due to the pond could impact nearby shallow wells; further investigation into potential impacts will need to be undertaken and appropriate mitigation strategies developed in detailed design, if necessary.

Culturally, this alternative results in a loss of the large open water aesthetic that is important to the community, and especially for properties situated along the east side of the pond (i.e., Victoria Street). Traditional recreational uses of the area (e.g., canoeing, swimming, skating, and fishing) will no longer be viable. Recreational use of the park area will change and, if funding is available, could consist of trail development, bird watching view points and educational signage (i.e., including history of the area. Removal of Harrington Pond will change the setting for the mill and reduce the potential to support mill operations.

The cost of implementing Alternative 2 is considered moderate, in comparison to other alternatives. The costs include removal of the existing concrete spillway, construction of the rocky ramp, some sediment removal and site stabilization. Removal of the pond could impact nearby shallow wells; further investigation into potential impacts will need to be undertaken and appropriate mitigation strategies developed in detailed design, if necessary

4.1.3 Alternative 3: Remove Dam and Construct Natural Channel

In this alternative, the existing dam and concrete spillway would be removed. Within the footprint of the existing pond and dam structure, a naturalized channel would be constructed. This channel would be based on principles of natural channel design and would re-establish a geomorphically suitable watercourse (planform, profile, sections) with relevant aquatic habitat features, enable a continuity of sediment transport, and maintain upstream water temperatures. The elevation change through the pond footprint and into the downstream channel would be gradual, and potentially enable all fish to migrate to the upstream portion of the creek. Opportunities for terrestrial enhancement and habitat creation exist (e.g., snake, birds) in the area. Open water habitat for waterfowl and some amphibians (e.g., turtle) would be lost. Invasive fish species that occur downstream of the dam will gain access to upstream portions of the creek.

With removal of the dam, then we would expect that coldwater aquatic species would utilize a larger proportion of the creek and provide access to upstream channel sections from which they have been excluded. Removal of the dam is expected to benefit the local Brook Trout population. A naturalized channel that includes riffles and runs, , is not favourable to carp.

Culturally, this alternative results in a loss of the large open water aesthetic that is considered important to the community, and especially for properties situated along Victoria Street. Traditional recreational uses of the area (e.g., canoeing, swimming, skating, and fishing) will no longer be viable. Opportunities for public recreation enhancement can be developed, if funding is available, to develop new recreational areas, pathways, viewing areas, and educational signage (i.e., including history of the area). Removal of Harrington Pond will change the setting for the mill and reduce the potential to support mill operations.

The cost of implementing Alternative 3 is considered moderate, in comparison to other alternatives. The existing pond would be removed, thereby alternating the aesthetic view of the area. Removal of the pond could impact nearby shallow wells; further investigation into potential impacts will need to be undertaken and appropriate mitigation strategies developed in detailed design, if necessary. Sediment that is dredged or excavated may be reused on-site, where feasible to create floodplain materials. It is expected that some sediment will require off-site disposal.

4.1.4 Alternative 4: Remove Dam and Construct One or More Offline Ponds/Wetlands with a Natural Channel

The existing earthen dam and concrete spillway would be decommissioned and removed. One or more offline ponds and/or wetlands, along with a naturalized channel, would be constructed within the footprint of the existing pond. The offline ponds/wetlands would be connected to the watercourse during storm event flows to provide hydrologic connectivity and encourage mixing of water within the offline pond and/or wetland.

Within the re-established watercourse, relevant aquatic habitat features could be re-established, upstream water temperature would be maintained, and a continuity of downstream sediment transport would occur. The surrounding lands would be restored with natural vegetation and terrestrial habitat enhancements (e.g., for snake, turtle, birds). fish species that occur downstream of the dam will gain access to upstream portions of the creek. Removal of the dam is expected to benefit the local Brook Trout population. A naturalized channel that includes riffles and runs, , is not favourable to carp.

Culturally, this alternative results in a change to the open water viewscape that residents from the area currently enjoy. Some of the traditional recreational uses may change, depending on the size of the pond. Additional opportunities for recreation, trails, educational signage and viewpoints could be established; some elements may require additional funding. The open water feature will provide a visual reference to the historical operation of Harrington Mill; if the pond is adequately sized, then water from the pond can be used to support mill operations.

The cost for implementing Alternative 4 would be considered high. Although open water features would be established, removal of the pond could impact nearby shallow wells; further investigation into potential impacts will need to be undertaken and appropriate mitigation strategies developed in detailed design, if necessary. Sediment that is dredged or excavated may be reused on-site, where feasible to create floodplain materials. It is expected that some sediment will require off-site disposal.

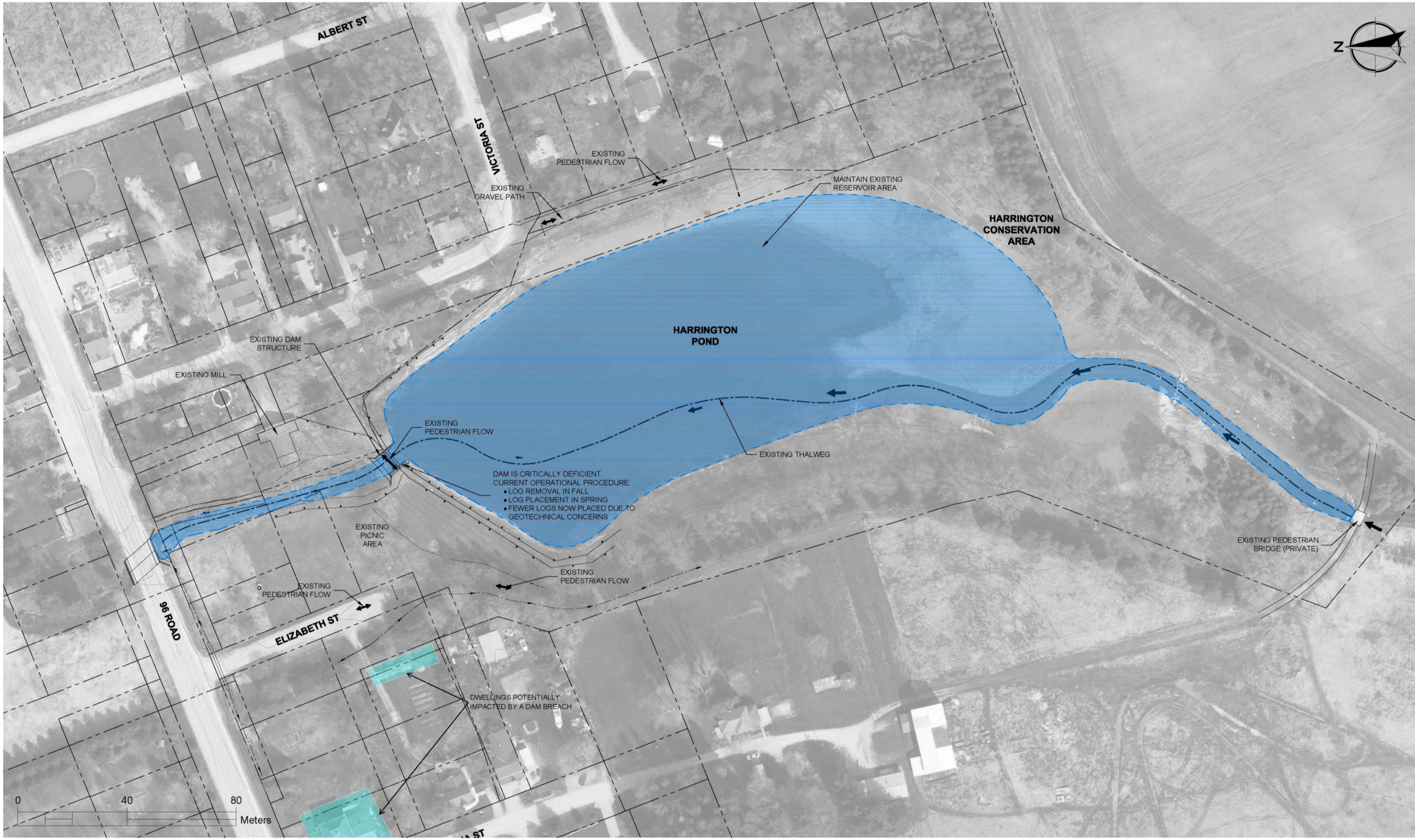
4.1.5 Alternative 5: Replace Dam with a New Structure Downstream of the Existing Dam

In this alternative, a new earthen dam and spillway would be constructed downstream of the existing dam; this would be located within the conservation area. This will require new materials and will need to comply with updated engineering standards. Once the new dam is constructed, the existing earthen dam and concrete spillway would be decommissioned and removed, maintaining the reservoir in roughly its current configuration. By maintaining the pond, no risk to nearby shallow wells will occur.

The dam would continue to contribute to habitat fragmentation and to poor water quality (e.g., temperature). An option exists to create a fish pass structure that would enable upstream passage of fish from the creek into the pond (note: only a portion of fish species will be able to negotiate the ramp, which may include invasive species). Mitigation of the thermal effects that are due to the pond could occur through the construction of a bottom draw structure within the new dam. Habitat conditions for carp will persist. Habitat for waterfowl and amphibians will be unaffected.

Culturally, this alternative maintains the current open water viewscape that residents from the area currently enjoy and enables a continuation of the traditional recreational uses of the pond (e.g., swimming, fishing, canoeing, skating). Additional opportunities for recreation, trails, educational signage and viewpoints could be established; some elements may require additional funding. Operation of the Harrington Mill will not be impacted by the proposed works. The open water feature will provide a visual reference to the historical operation of Harrington Mill; Water from the pond can be used to support mill operations.

Construction of a new dam would impose a very high restoration cost in comparison to the other alternatives identified in this study. Since the existing pond will remain ‘online’, sediment accumulation will continue and require periodic cleanout. The dam would continue to limit the continuity of sediment transport. Sediment that is dredged or excavated may be reused on-site, where feasible to create floodplain materials. It is expected that some sediment will require off-site disposal.

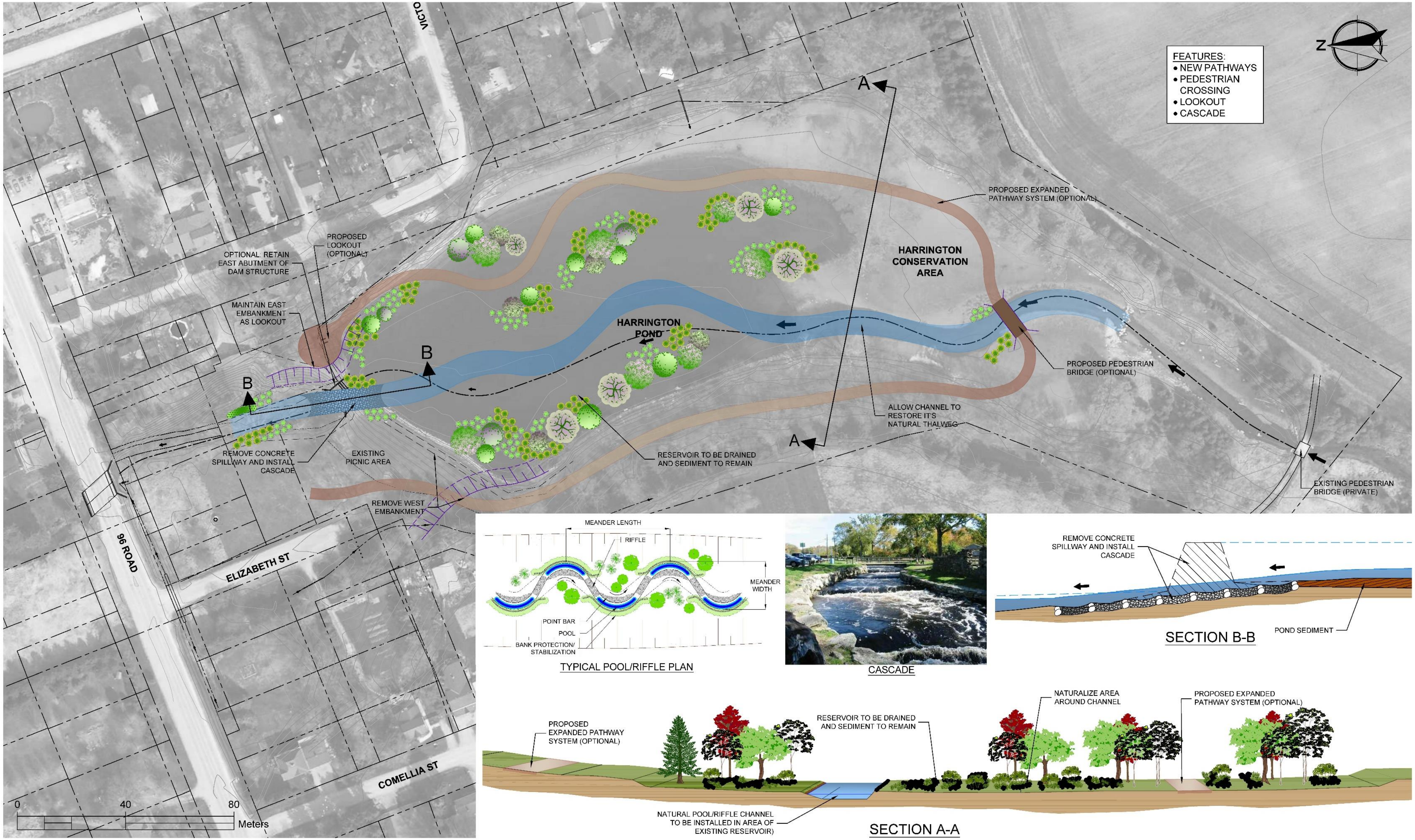


HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 1: DO NOTHING

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-1

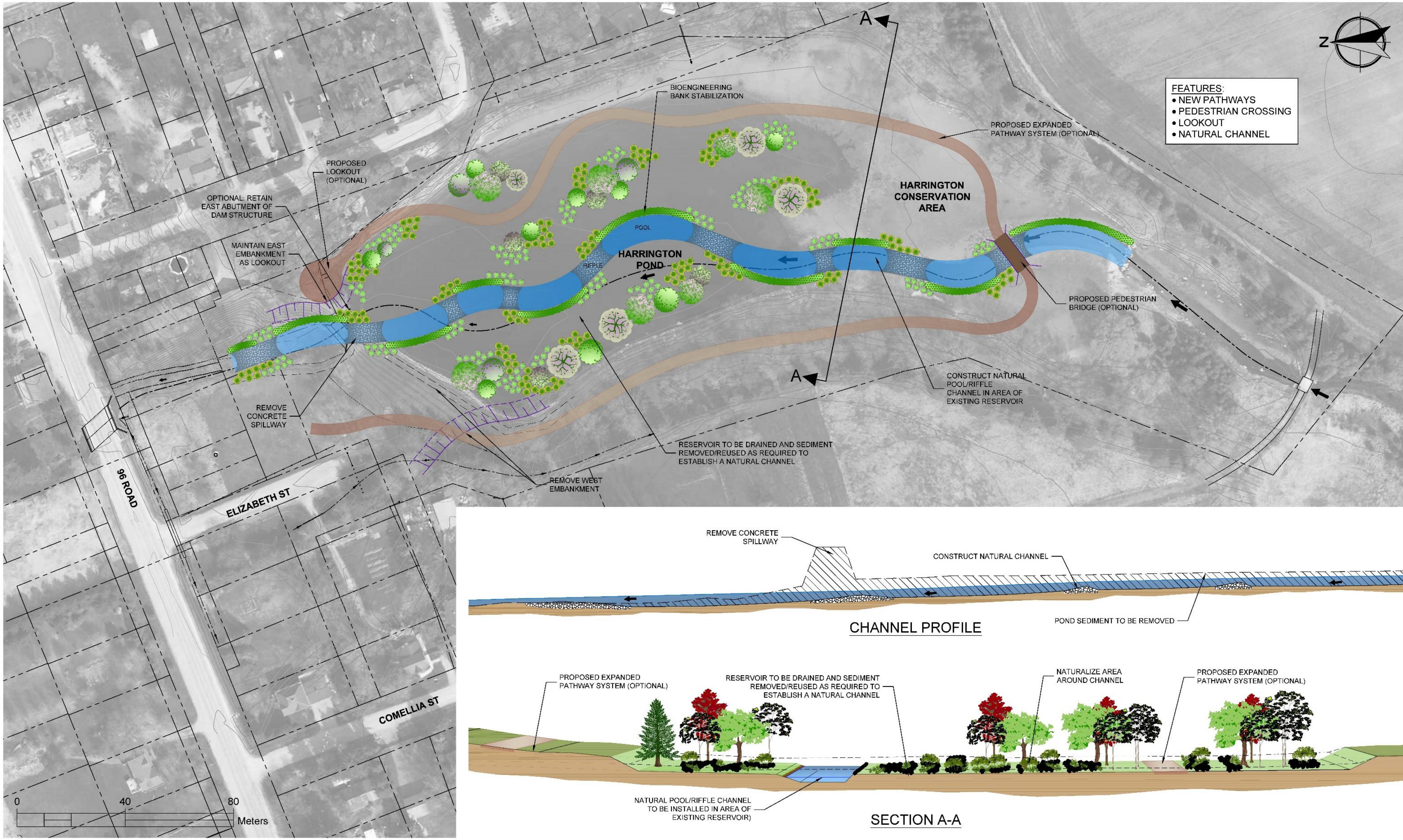


HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 2:
REMOVE DAM AND INSTALL ROCKY RAMP

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-2

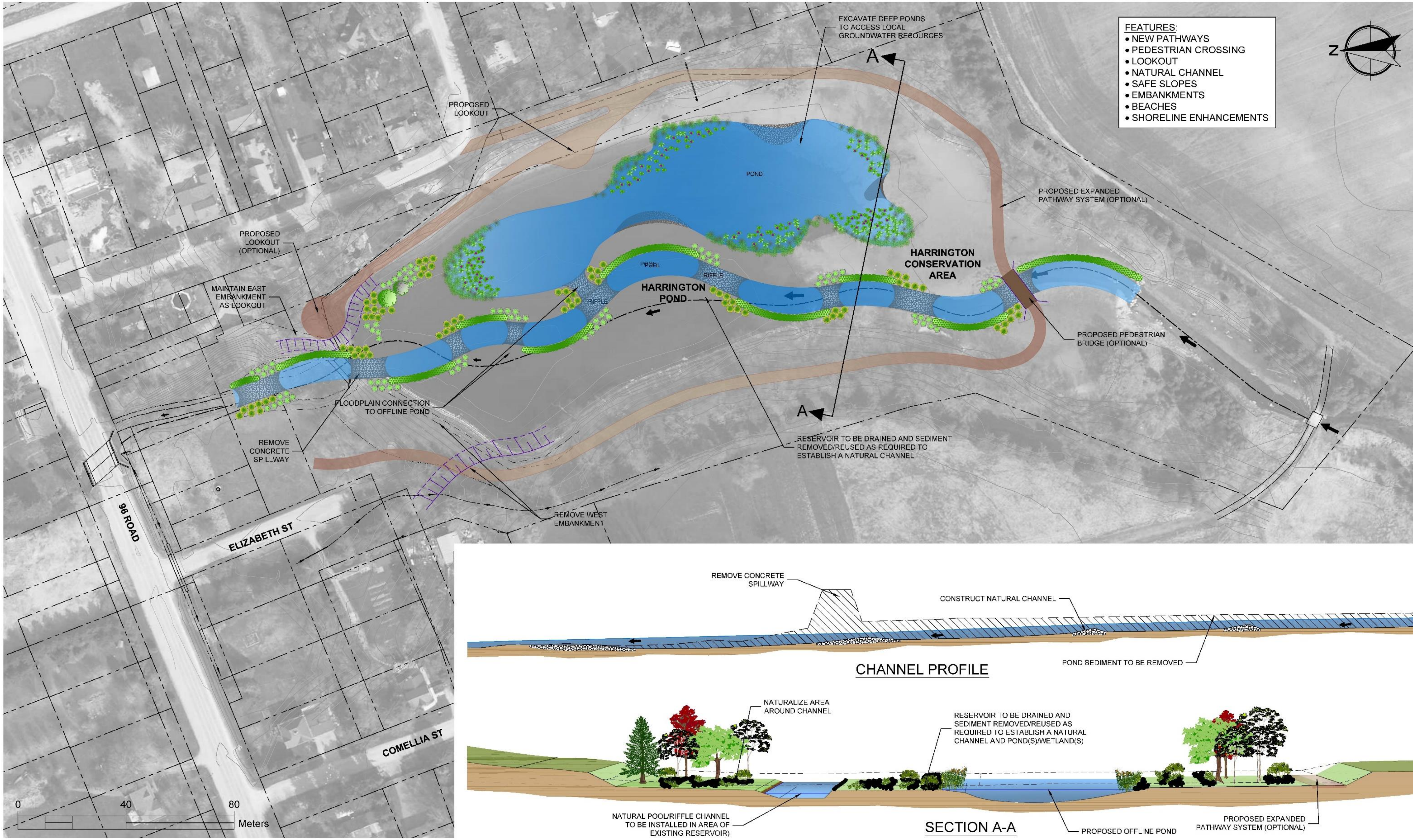


HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 3: REMOVE DAM AND CONSTRUCT NATURAL CHANNEL

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-3

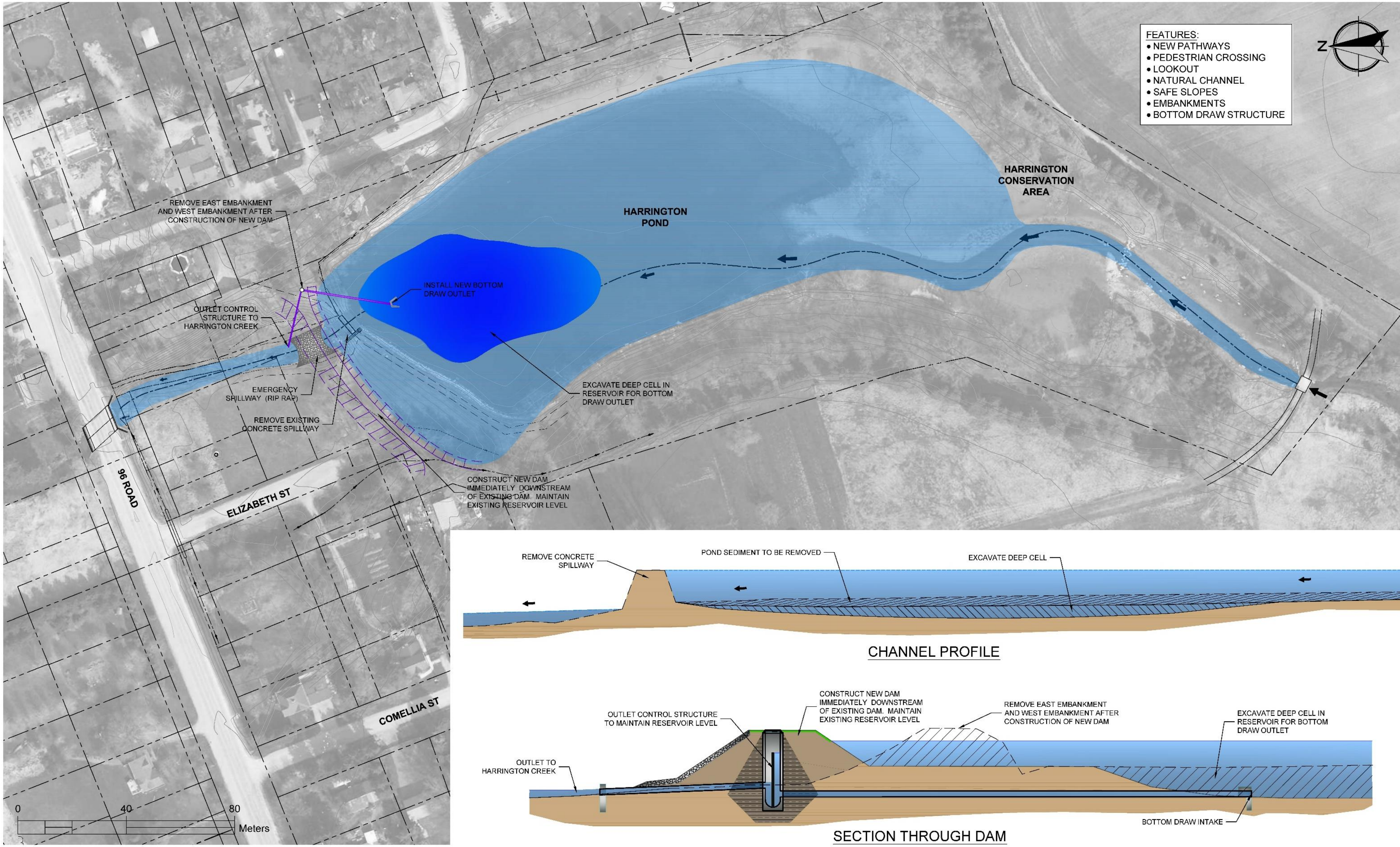


HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 4: REMOVE DAM AND CONSTRUCT ONE OR MORE OFFLINE PONDS/WETLANDS WITH A NATURAL CHANNEL

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-4



HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 5:
REPLACE DAM WITH A NEW STRUCTURE DOWNSTREAM OF THE EXISTING DAM

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

FIGURE 4-5

4.1.6 Alternative 6: Lower Dam Crest with Natural Channel

Reconstruct the existing earthen dam and concrete spillway in its current location with a new, smaller dam structure (approximately 1.0 m head). The reconstruction will require new materials and need to comply with updated engineering standards. Due to the smaller pond footprint, a naturalized channel would be established within the upstream footprint of the existing pond. This alternative reduces the magnitude of potential impacts in the event of a breach/failure.

Culturally, this alternative changes the visual viewscape that is important to the community and the extent to which traditional recreational uses of the pond can be enjoyed (e.g., swimming, fishing, canoeing, and skating). Additional opportunities for recreation, trails, educational signage and viewpoints could be established; some elements may require additional funding. Operation of the Harrington Mill may be constrained compared to the current potential (i.e., due to smaller pond).

The dam would continue to contribute to habitat fragmentation and to poor water quality (e.g., temperature). An option exists to create a fish pass structure that would enable upstream passage of fish from the creek into the pond (note: only a portion of fish species will be able to negotiate the ramp). Although the smaller pond reduces solar heat gain, further mitigation of the thermal effects that are due to the pond could occur through the construction of a bottom draw structure within the new dam. Habitat for waterfowl and amphibians would decrease.

This alternative provides an opportunity to enhance the terrestrial landscape and habitat (e.g., snake, turtle, birds) in the area surrounding the pond, and also reduces risk to nearby shallow groundwater wells. The smaller pond size reduces waterfowl habitat potential and may also affect amphibian habitat. Opportunities for trails are provided.

Construction of a new, lower, dam structure would impose a very high cost in comparison to the other alternatives. Since the existing pond will remain ‘online’, sediment accumulation will continue and require periodic cleanout and continue to limit continuity of sediment transport. The change in pond size alters the aesthetic view of the pond. Water quality downstream of the dam will continue to be impacted by the impounded water. No fish passage will be provided in the proposed scenario; this can be mitigated, in part, through the construction of a fish pass structure. Sediment that is dredged or excavated may be reused on-site, where feasible to create floodplain materials. It is expected that some sediment will require off-site disposal.

4.1.7 Alternative 7: Reconstruct the Existing Dam in its Current Location and Configuration with New Materials

This alternative involves complete reconstruction of the existing dam with new materials and to updated engineering standards, thereby maintaining the current reservoir configuration. The current aesthetic and recreational areas and views are maintained while removing the risk of dam failure. No risk to nearby shallow groundwater wells would occur.

Culturally, this alternative maintains the current open water viewscape that residents from the area currently enjoy and enables a continuation of the traditional recreational uses of the pond (e.g., swimming, fishing, canoeing, skating. If funding opportunities exist, then the potential for incorporating a trail establishment along the east side of the existing pond, a pedestrian bridge, and look-out areas could be considered. Operation of the Harrington Mill may not be impacted by the proposed works. The open water feature will provide a visual reference to the historical operation of Harrington Mill.

The dam would continue to contribute to habitat fragmentation and to poor water quality (e.g., temperature). An option exists to create a fish pass structure that would enable upstream passage of fish from the creek into the pond (note: only a portion of fish species will be able to negotiate the ramp, which may include invasive species). Mitigation of the thermal effects that are due to the pond could occur through the construction of a bottom draw structure within the new dam. Habitat conditions for carp will persist. Habitat for waterfowl and amphibians would remain similar to existing conditions. The pond will require periodic cleanout and continue to limit continuity of sediment transport

The costs for reconstructing the existing dam are very high, in comparison to the other alternatives. Due to the impounded water, sediment will continue to accumulate in the pond and will require periodic clean-out. The dam will continue to limit the continuity of sediment transport If funding opportunities exist, then the potential for incorporating a trail establishment along the east side of the existing pond, a pedestrian bridge, and look-out areas could be considered.

4.1.8 Additional Alternative Option Presented by Public

Through the public consultation process (i.e., after PIC 3), the Harrington and Area Community Association (HACA) took the initiative to further explore alternative options for the Harrington Dam that would maintain the pond and, potentially, result in a lower cost. In brief, the alternative is summarized by HACA as follows:

> *"Leaving the existing concrete structure in place, replacing the earthen dyke while leaving portions of the old one in place and, incorporating a spillway to accommodate increased flows and bring the flow capacity to within current guidelines…."*

Detailed description of this alternative is provided by G. Houston in "Harrington Millpond water quality and habitat improvement plan" (see **Appendix J**).

This alternative is intended to maintain the existing pond so that the existing open water viewscape is unaffected, and to maintain potential water support for mill operations. The alternative also identified opportunities to enhance the pond for aquatic and amphibian habitat. In the alternative, the existing dam (embankment/dyke) would be partially reconstructed. The suggested spillway is intended to function as a bypass channel during specific flows so that the existing capacity meets Dam Safety Requirements. The proposed alternative is considered a variation of Alternative 7.

The key variation from Alternative 7 (Section 4.1.8) is the partial replacement, rather than full replacement, of the earth embankment (i.e., referred to as dyke in public communication). This includes excavation of pond side dyke materials and the placement of new materials (Clay core) to create an impermeable barrier and a wider dyke. Rip-rap is identified for placement along the dyke, within the pond. A small retaining wall has also been identified as a measure that could be considered to reduce the footprint of the downstream side of the dyke. A geotechnical engineer will need to determine whether the identified repairs could compromise the integrity of the unaltered portion of the dyke, and whether the improvements would meet Dam Safety Requirements and requirements outlined under the Lakes and Rivers Improvement Act. The repairs as suggested by the community may not be a stable long term option but may, instead, be a temporary measure that will require periodic maintenance until full replacement occurs (i.e., within a Dam replacement/reconstruction alternative).

Another variation from Alternative 7 is the spillway. This spillway is proposed to be a rock lined channel that connects the upstream portion of the pond to the creek that is downstream of the dam. This requires a drop in elevation of approximately 3.5m over a grade of ~ 0.8 %; the spillway will require a sufficiently wide channel corridor (locally up to ~ 20m) to accommodate the channel and stable (e.g., 3 (hor):1(vert) side slopes); the corridor will need to be set sufficiently west from the pond, to maintain stability of the west pond embankment (i.e., the embankment is unreinforced and results from excavation of the spillway. The spillway is anticipated to intercept and receive groundwater inflow; this may have long term implications for the pond. The spillway could be enhanced as a naturalized channel (i.e., similar to Alternative 4) to improve aesthetic appearance and to enable fish passage during design flows; this would also enable the upstream migration of invasive species.

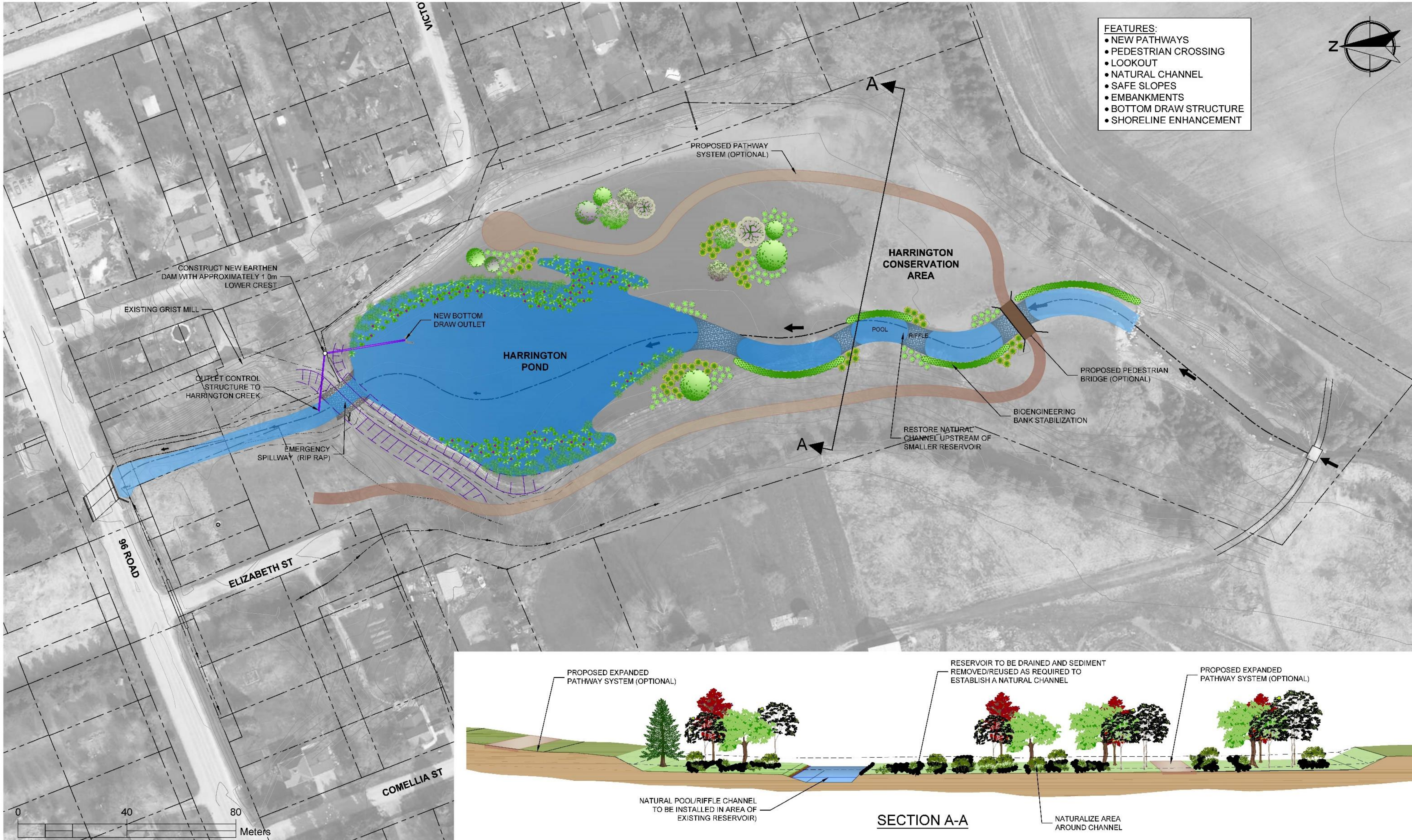
In brief, suggestions to enhance water quality, aquatic habitat, and recreational improvements included:

- Enhance fish and amphibian habitat along the pond edge (e.g., boulders, logs etc.).
- Enhancement of Brook Trout spawning potential (i.e., place gravels at groundwater seepage areas).
- Remove invasive carp.

- Create an island in the southern portion of the pond.
- Provide turtle nesting habitat.
- Consider transfer of Brook Trout from other portions of the creek or watershed.
- Create deeper pockets in the pond to intercept groundwater.
- Install a bottom draw outlet structure that takes water from the pond bottom and directs it into the downstream watercourse.
- Create observation deck.
- Create handicap fishing platform.
- Minor bank improvements to facilitate safe fishing.
- Re-use dredged materials in the pond bottom to maintain native benthic community (i.e., reduce time required to re-establish healthy benthic community).
- Encourage better land use practices along the upstream drainage network to reduce soil and nutrient loading into the creek.

Each of these habitat and recreational enhancement measures are not unique to the alternative proposed by HACA. Indeed, these measures can (and should) be considered to enhance Alternatives 4, 5, 6 and 7 during the detailed design process.

Overall, the alternative put forth by the HACA shows thoughtful consideration, initiative, and determination to maintain the pond, dam, and reduce construction costs. The alternative is considered to be a variation of Alternative 7 and is considered to provide a temporary fix since it does not include full replacement of materials to current design standards . A geotechnical review of the alternative will determine whether the proposed works would meet Dam Safety requirements and thus provide a longer term solution, or remain a temporary measure. The spillway is the key differentiator to the alternative described in **Section 4.1.7**. The alternative is not considered to result in water quality improvements beyond those which could similarly be achieved in **Alternatives 4, 5, 6 and 7**.

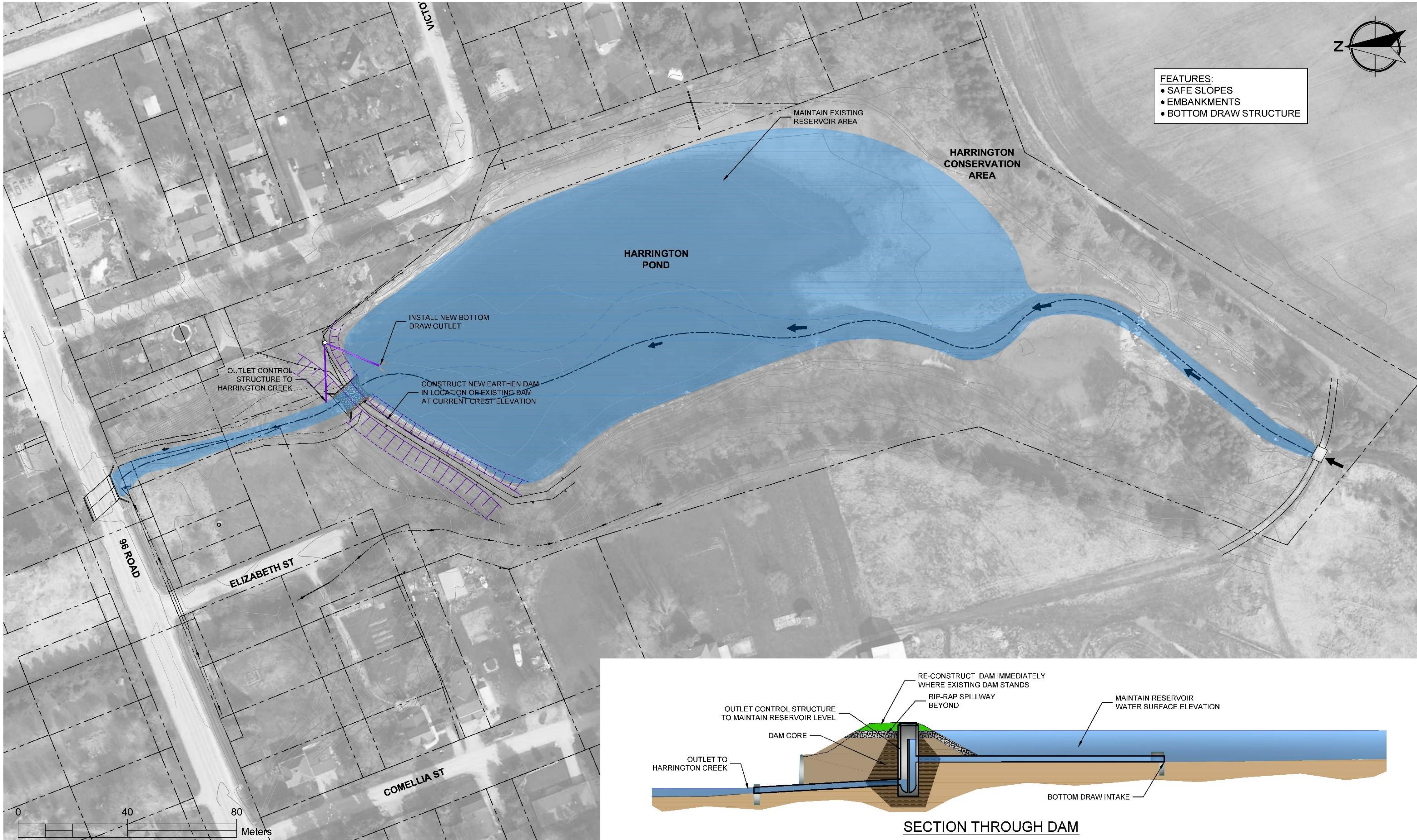


HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 6: LOWER DAM CREST WITH NATURAL CHANNEL

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-6



HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 7:
RECONSTRUCT THE EXISTING DAM IN CURRENT LOCATION WITH NEW MATERIALS

ecosystem recovery inc. PROFESSIONAL ENGINEERS

FIGURE 4-7

4.2 Alternative Cost Estimates and Funding Opportunities

As part of the economic evaluation of the alternatives, construction and maintenance costs, and the potential availability for funding is considered (**Section 5.1**). This section provides an overview of cost estimates and funding opportunities.

4.2.1 Construction and Maintenance

A preliminary estimate of the potential costs for each alternative, from a construction and maintenance perspective was developed. These estimates were intended to inform the evaluation process, to inform the UTRCA regarding potential funding estimates, and to inform the public.

The cost estimates were based on unit costs for similar projects undertaken by Ecosystem Recovery, UTRCA, and others. In this regard, the key components of the work necessary to construct the alternative were identified and typical costs applied (e.g., site mobilization, pond dredging, sediment disposal, embankment improvements, spillway construction, dam removal, site restoration etc.). The costs include estimates for mitigating impacts to nearby shallows wells (i.e., drill deeper wells). All costs are based on 2016 price estimates (**Table 4-1**). The costs are similar to those estimated by Burnside (2010): removal - $247,750; replacement - $1,414,750.

Table 4-1. Cost estimates of alternatives.

Alternative 1 **Do Nothing**	Repairs to concrete structures, site restoration in the event of failure (assumed)	$20,000 to $500,000	$5,000 – 20,000 per year
Alternative 2 **Remove Dam, Construct Rocky Ramp**	Dam removal, construction of grade control 'Rocky Ramp' , some sediment removal and site stabilization	$300,000 to $360,000	$1,500 to $3,000 per year
Alternative 3 **Remove Dam, Construct Natural Channel**	Dam removal, channel construction, sediment removal, site restoration	$600,000 to $800,000	$1,500 to $3,000 per year
Alternative 4 **Remove Dam, Construct Offline Pond and Channel**	Dam removal, channel construction, sediment removal, offline pond construction, site restoration	$800,000,to $1,000,000	$1,500 to $5,000 per year
Alternative 5 **Replace Dam with New Earth Dam Downstream of Existing**	Dam Removal, Excavation and installation of new core, bottom draw structure, sediment removal	$1,200,000 to $1,600,000	$5,000 to $35,000 per year. Dam retirement (75 yrs) costs $120,000[1]
Alternative 6 **Replace Dam with New Earth Dam, lower crest**	Dam Removal, Excavation and installation of new core, bottom draw structure, sediment removal	$1,100,000 to $1,500,000	$5,000 to $35,000 per year. Dam retirement (75 yrs) costs $120,000[1]
Alternative 7 **Reconstruct Dam in Current Location** **Alternative 7b** **Include spillway channel**	Dam Removal, Excavation and installation of new core, concrete dam, sediment removal	$1,800,000 to $2,100,000	$5,000 to $35,000 per year. Dam retirement (75 yrs) costs $120,000[1]

Components of operation and maintenance activities are not required annually; some maintenance activity (e.g., dredging) may occur once every 10 years. Costs for maintenance activities were provided by UTRCA. The estimated costs were reduced to an annual rate, to enable better comparison between alternatives. This data can also be used for budget planning purposes by the UTRCA.

4.2.2 Potential Funding Sources

Implementation of any alternative, except Alternative 1, will require funding in excess of that collected to date for routine maintenance and operations. Potential funding sources that may be available, depending on the alternative are summarized in **Table 4-2**. The actual funding sources that may be accessible to the project, once implementation is planned should be reviewed; that is, some funding sources may no longer be available and/or new funding opportunities may exist.

Table 4-2. Potential funding sources.

Upper Thames River Conservation	Project Management at cost.
Municipal Contributions	Zorra Township provides $10,000 annually for operation and maintenance, and required studiesand repairs.
2014 New Building Canada Fund: Provincial-Territorial Infrastructure Component, Small Communities Fund Program	
Recreational Fisheries Conservation Partnerships Program	http://www.dfo-mpo.gc.ca/pnw-ppe/rfcpp-ppcpr/index-eng.html
Water and Erosion Control Infrastructure Funding (WECI)	
Fundraising	Financial donations from residents and/or organizations could also be obtained to support implementation, or enhancement of an alternative.
In Kind Donations	

5. Evaluation of Alternatives

The process of evaluating alternatives is clearly outline in the MOE (2014) Code of Practise: Preparing, Reviewing and Using Class Environmental Assessments in Ontario and in the Class Environment Assessment for Remedial Flood and Erosion Control Projects (Conservation Ontario (January 2002, amended June 2013). Evaluation of each of the alternatives is accomplished systematically by identifying evaluation criteria and completing a comparative evaluation process. This chapter provides an overview of the evaluation process that was used to determine the preferred alternative. As part of the environmental assessment process, the technical steering committee and public provided input into the final evaluation process used in this study.

5.1 Evaluation Criteria

To identify the alternative that best addresses study objectives, each alternative outlined in **Section 4** was rated against evaluation criteria that are broadly set out by MOE (2014) and includes consideration for technical, economic, environmental, and social factors relevant to the study area. MOE (2014) recommends specific criteria within each factor that should be evaluated; the final selection of criteria is informed by the study area characteristics, findings, and concerns of the public. The evaluation criteria are listed in **Table 5-1** below.

Table 5-2 shows the rating scale used to assess each alternative against the evaluation criteria and in comparison to the other alternatives. The rating provides a numerical basis for evaluation in contrast to symbols, which are more difficult to tabulate.

Each of the category scores is adjusted to be out of 25% (i.e., equally weighted) since each criteria category is considered to be equally important; this is in keeping with the MOE (2014) Environmental Assessment process. Once each category score is calculated and normalized/weighted, then these are summed to derive an overall category score (i.e., technical, economic, environmental and social). The category scores allow for a comparison between alternatives. Tabulation of all category scores is completed to define an overall score. The top score is ranked as preferred.

The MOE (2014) document allows for the weighting of one or more criteria to be altered, reflecting specific study area interests or findings. Given the high level of social/cultural value that the Harrington Dam and Pond has to local residents, the weighting of the criteria was altered to be 40% for social/cultural, and 20% for each of the Technical/Engineering, Natural Environment, and Economic criteria.

Table 5-1. Alternatives Evaluation Criteria

Criteria	Description
Technical/Engineering (25% of score)	
Dam Safety	Effectiveness of the alternative to address dam safety requirements, reduce risk of failure
Flooding Impacts/ Enhancement	Effectiveness of the alternative to manage or reduce flooding, or not cause negative impacts to flooding
Geomorphology/ Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment impacts
Protection of Infrastructure	Effectiveness of the alternative in mitigating risk to adjacent infrastructure (e.g., roads)
Constructability	Potential to construct the project using conventional, accepted construction and engineering practices
Implementability	Potential to implement the alternative, based on common accepted management practise
Approvability	Potential for regulatory agencies to grant approval for implementation
Natural Environment (25% of score)	
Aquatic (Creek) Habitat Impacts/Enhancement	Effectiveness of the alternative to enhance fisheries resources; fish diversity, food source, and fish passage
Aquatic (Pond) habitat Impacts/Enhancements	Effectiveness of the alternative to enhance pond habitat (fish, fowl, wildlife) resources, diversity, food source
Terrestrial Habitat Impacts/Enhancement	Potential for impact and/or enhancement to connectivity and terrestrial habitat (amphibian, avian, mammal) due to implementation of the alternative
SAR Impacts/Enhancement	Potential for impact and/or enhancement to wildlife habitat and existing SAR in the project area
Geomorphology/Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment impacts
Groundwater Impacts/Enhancement	Potential for impact and/or enhancement to groundwater regimes in the project area (baseflow, recharge, water table, etc.)
Water Quality Impacts/Enhancement	Effectiveness of the alternative to improve water quality, TSS, phosphorous, nutrient uptake
Social/Cultural (25% of score)	
Impact to Private Property	Measure of the impact to adjacent private property (i.e., loss of property, access to property, aesthetic)
Impact to Public Access	Measure of impact to public access (e.g., trails, recreation - picnic, fish, boat)
Impact to Public Safety	Measure of the impact to public safety in the surrounding area resulting from the alternative
Impact to Cultural/Heritage Features	Potential impact to existing cultural and/or heritage features in the project area
Recreational Impacts/Enhancement	Measure of the impact to existing recreation and opportunities to enhance recreational activities in the project area
Economic (25% of score)	
Construction Costs	Relative measure of the initial costs to install/construct the proposed works, including environmental mitigation, sediment management etc.
Maintenance/Future Costs	Relative measure of the ongoing maintenance costs following implementation (or continued maintenance)
Availability of Funding	Estimate of the availability for funding to implement the alternative

Table 5-2. Evaluation Ranking Criteria

1	Least positive, or negative, impact • Most cost • Environmental degradation • Difficult to implement
2	Minor negative impact
3	Neutral impact
4	Positive impact
5	Most positive or beneficial impact • Least cost • Environmental improvement/gain

5.2 Evaluation Matrix

Each of the criteria identified in **Table 5-1** was assigned a rank (**Table 5-2**). The evaluation matrix received input from each of the discipline leads involved in this study based on their knowledge of their study findings; public input received through the public consultation process was also considered through the evaluation process. The completed matrix was subject to further review, input, and adjustment from the technical steering committee. Thus, the evaluation matrix was subject to a rigorous evaluation process. Once completed, the weighting of the criteria was altered as outlined in **Section 5.1.** The equal criteria weighting is presented in **Table 5-3**; the evaluation matrix with the higher social/cultural weighting is presented in **Table 5-4**.

Review of the Alternative 7 scoring was completed with consideration for the variation of this alternative as outlined in **Section 4.1.8,** for both the equal and weighted scoring. While the alternative scoring would lead to a higher rank, this did not cause the alternative variation to move into the highest ranked alternative.

Table 5-3. Evaluation Matrix - Equal Criteria Weighting

Criteria	Description	Alternative 1 Do Nothing	Alternative 2 Remove Dam and Install Rocky Ramp	Alternative 3 Remove Dam and Construct a Natural Channel	Alternative 4 Remove Dam and Construct an Offline Pond and Natural Channel	Alternative 5 Replace Dam with new Structure Downstream of the Existing Dam	Alternative 6 Replace Dam with an Earthen Dam of Lower Crest Elevation and Naturalize Perimeter	Alternative 7 Reconstruct the Existing Dam in Current Location with New Materials
TECHNICAL/ENGINEERING								
Dam Safety	Effectiveness of the alternative to address dam safety requirements, reduce risk of failure	1	4	5	5	3	3	4
Flooding Impacts/Enhancement	Effectiveness of the alternative to manage or reduce flooding, or not cause negative impacts to flooding	1	3	5	4	2	3	2
Geomorphology/Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment	1	4	5	5	1	1	1
Protection of Infrastructure	Effectiveness of the alternative in mitigating risk to adjacent infrastructure (e.g., roads)	1	5	5	5	4	5	4
Constructability	Potential to construct the project using conventional, accepted construction and engineering practices	5	4	4	4	5	5	5
Implementability	Potential to implement the alternative, based on common accepted management practise	3	5	5	4	4	4	4
Approvability	Potential for regulatory agencies to grant approval for implementation	1	4	5	4	3	3	3
	TOTAL CATEGORY SCORE	**13**	**29**	**34**	**31**	**22**	**24**	**23**
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	**9**	**21**	**24**	**22**	**16**	**17**	**16**
	CATEGORY RANKING (1 = most preferred; 7 = least preferred)	**7**	**3**	**1**	**2**	**6**	**4**	**5**
NATURAL ENVIRONMENT								
Aquatic (River) Habitat Impacts/Enhancement	Effectiveness of the alternative to enhance fisheries resources; fish diversity, food source, and fish passage	1	4	4	5	2	2	2
Aquatic (Pond) habitat Impacts/Enhancement	Effectiveness of the alternative to enhance pond habitat (fish, fowl, and wildlife) resources, diversity, food source	3	2	1	3	5	4	5
Terrestrial Habitat Impacts/Enhancement	Potential for impact and/or enhancement to connectivity and terrestrial/wildlife (amphibian, mammal etc.) habitat due to implementation of the alternative	1	4	4	5	1	3	1
SAR Impacts/Enhancements	Potential for impact and/or enhancement to SAR species	1	3	4	4	1	1	1
Groundwater Impacts/Enhancement	Potential for impact and/or enhancement to groundwater regimes in the project area (baseflow, recharge, etc.)	3	3	4	4	3	4	3
Water Quality Impacts/Enhancement	Effectiveness of the alternative to improve water quality, TSS, phosphorous, nutrient uptake	1	3	5	5	1	2	1
	TOTAL CATEGORY SCORE	**10**	**19**	**22**	**26**	**13**	**16**	**13**
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	**8**	**16**	**18**	**22**	**11**	**13**	**11**
	CATEGORY RANKING (1 = most preferred; 7 = least preferred)	**7**	**3**	**2**	**1**	**5**	**4**	**5**
SOCIAL / CULTURAL ENVIRONMENT								
Impact to Private Property	Measure of the impact to adjacent private property (i.e., loss of property, access to property, aesthetic)	3	4	3	3	4	4	4
Impact to Public Access	Measure of impact to public access (e.g., trails, recreation - picnic, fish, boat)	3	4	3	4	4	4	4
Impact to Public Safety	Measure of the impact to public safety in the surrounding area resulting from the alternative	1	3	5	4	4	4	4
Impact to Cultural/Heritage Features	Potential impact to existing cultural and/or heritage features in the project area	3	2	2	4	5	5	5
Recreational Impacts/Enhancement	Measure of the impact to existing recreation and opportunities to enhance recreational activities in the project	3	4	2	4	5	5	5
	TOTAL CATEGORY SCORE	**13**	**17**	**15**	**19**	**22**	**22**	**22**
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	**13**	**17**	**15**	**19**	**22**	**22**	**22**
	CATEGORY RANKING (1 = most preferred; 7 = least preferred)	**7**	**5**	**6**	**4**	**1**	**1**	**1**
ECONOMIC								
Construction Costs	Relative measure of the initial costs to install/construct the proposed works, including environmental mitigation, sediment management, well mitigation etc.)	5	4	3	3	2	2	1
Maintenance/Future Costs	Relative measure of the ongoing maintenance costs following implementation (sedimentation)	1	3	4	4	2	2	2
Availability of Funding	Estimate of the availability for funding to implement the alternative	3	3	5	4	2	1	1
	TOTAL CATEGORY SCORE	**9**	**10**	**12**	**11**	**6**	**5**	**4**
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	**15**	**17**	**20**	**18**	**10**	**8**	**7**
	CATEGORY RANKING (1 = most preferred; 7 = least preferred)	**4**	**3**	**1**	**2**	**5**	**6**	**7**
	OVERALL NORMALIZED CATEGORY SCORE (100% WEIGHTING)	**46**	**70**	**78**	**81**	**59**	**61**	**56**
	PREFERRED OVERALL RANKING (1 = most preferred; 5 = least preferred)	**7**	**3**	**2**	**1**	**5**	**4**	**6**

Table 5-4. Evaluation Matrix - Higher Social/Cultural Weighting.

Criteria	Description	Alternative 1 Do Nothing	Alternative 2 Remove Dam and Install Rocky Ramp	Alternative 3 Remove Dam and Construct a Natural Channel	Alternative 4 Remove Dam and Construct an Offline Pond and Natural Channel	Alternative 5 Replace Dam with new Structure Downstream of the Existing Dam	Alternative 6 Replace Dam with an Earthen Dam of Lower Crest Elevation and Naturalize	Alternative 7 Reconstruct the Existing Dam in Current Location with New Materials
TECHNICAL/ENGINEERING								
Dam Safety	Effectiveness of the alternative to address dam safety requirements, reduce risk of failure	**1**	**4**	**5**	**5**	**3**	**3**	**4**
Flooding Impacts/Enhancement	Effectiveness of the alternative to manage or reduce flooding, or not cause negative impacts to flooding	1	3	5	4	2	3	2
Geomorphology/Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment impacts	1	4	5	5	1	1	1
Protection of Infrastructure	Effectiveness of the alternative in mitigating risk to adjacent infrastructure (e.g., roads)	1	5	5	5	4	5	4
Constructability	Potential to construct the project using conventional, accepted construction and engineering practices	5	4	4	4	5	5	5
Implementability	Potential to implement the alternative, based on common accepted management practise	3	5	5	4	4	4	4
Approvability	Potential for regulatory agencies to grant approval for implementation	1	4	5	4	3	3	3
	TOTAL CATEGORY SCORE	**13**	**29**	**34**	**31**	**22**	**24**	**23**
	NORMALIZED CATEGORY SCORE (20% WEIGHTING)	**7**	**17**	**19**	**18**	**13**	**14**	**13**
	CATEGORY RANKING (1= most preferred; 7 = least preferred)	**7**	**3**	**1**	**2**	**6**	**4**	**5**
NATURAL ENVIRONMENT								
Aquatic (River) Habitat Impacts/Enhancement	Effectiveness of the alternative to enhance fisheries resources; fish diversity, food source, and fish passage	1	4	4	5	2	2	2
Aquatic (Pond) habitat Impacts/Enhancement	Effectiveness of the alternative to enhance pond habitat (fish, fowl, and wildlife) resources, diversity, food source	3	2	1	3	5	4	5
Terrestrial Habitat Impacts/Enhancement	Potential for impact and/or enhancement to connectivity and terrestrial/wildlife (amphibian, mammal etc.) habitat due to implementation of the alternative	1	4	4	5	1	3	1
SAR Impacts/Enhancements	Potential for impact and/or enhancement to SAR species	1	3	4	4	1	1	1
Groundwater Impacts/Enhancement	Potential for impact and/or enhancement to groundwater regimes in the project area (baseflow, recharge, shallow wells, discharge, etc.)	3	4	3	4	3	4	3
Water Quality Impacts/Enhancement	Effectiveness of the alternative to improve water quality, TSS, phosphorous, nutrient uptake	1	3	5	5	1	2	1
	TOTAL CATEGORY SCORE	**10**	**20**	**21**	**26**	**13**	**16**	**13**
	NORMALIZED CATEGORY SCORE (20% WEIGHTING)	**7**	**13**	**14**	**17**	**9**	**11**	**9**
	CATEGORY RANKING (1= most preferred; 7 = least preferred)	**7**	**3**	**2**	**1**	**5**	**4**	**5**
SOCIAL / CULTURAL ENVIRONMENT								
Impact to Private Property	Measure of the impact to adjacent private property (i.e., loss of property, access to property, aesthetic)	3	4	3	3	4	4	4
Impact to Public Access	Measure of impact to public access (e.g., trails, recreation – picnic, fish, boat)	3	4	3	4	4	4	4
Impact to Public Safety	Measure of the impact to public safety in the surrounding area resulting from the alternative	1	3	5	4	4	4	4
Impact to Cultural/Heritage Features	Potential impact to existing cultural and/or heritage features in the project area	3	2	2	3	5	5	5
Recreational Impacts/Enhancement	Measure of the impact to existing recreation and opportunities to enhance recreational activities in the project area	3	4	2	4	5	5	5
	TOTAL CATEGORY SCORE	**13**	**17**	**15**	**18**	**22**	**22**	**22**
	NORMALIZED CATEGORY SCORE (40% WEIGHTING)	**21**	**27**	**24**	**29**	**35**	**35**	**35**
	CATEGORY RANKING (1= most preferred; 7 = least preferred)	**7**	**5**	**6**	**4**	**1**	**1**	**1**
ECONOMIC								
Construction Costs	Relative measure of the initial costs to install/construct the proposed works, including environmental mitigation, sediment management, well mitigation etc.)	5	4	3	3	2	2	1
Maintenance/Future Costs	Relative measure of the ongoing maintenance costs following implementation (sedimentation)	1	3	4	4	2	2	2
Availability of Funding	Estimate of the availability for funding to implement the alternative	3	3	5	4	2	1	1
	TOTAL CATEGORY SCORE	**9**	**10**	**12**	**11**	**6**	**5**	**4**
	NORMALIZED CATEGORY SCORE (20% WEIGHTING)	**12**	**13**	**16**	**15**	**8**	**7**	**5**
	CATEGORY RANKING (1= most preferred; 7 = least preferred)	**4**	**3**	**1**	**2**	**5**	**6**	**7**
	OVERALL NORMALIZED CATEGORY SCORE (100% WEIGHTING)	**47**	**70**	**73**	**79**	**64**	**66**	**62**
	PREFERRED OVERALL RANKING (1 = most preferred; 5 = least preferred)	**7**	**3**	**2**	**1**	**5**	**4**	**6**

6. Public Consultation

Public Information Centres (PICs) are the primary method to consult with members of the public, communicate important project details, and request feedback on the Class EA process and results. The main objectives of the public consultation process include the following:

- Inform the public and stakeholders about the project;
- Fully inform agencies and regulators of the Class EA progress in order to solicit early feedback;
- Develop public support for the preferred project solutions; and
- Meet or exceed the requirements of the Class EA process.

6.1 Notice of Intent

A comprehensive stakeholder contact list has been developed to support the public consultation process, identifying agencies, First Nations, and organizations that may be interested in the project and/or agencies that must be consulted during the Class EA process. This contact list has formed the basis of project mailings (Commencement/Completion Notice, Notice of PIC, etc.).

A Notice of Intent was been prepared to inform the public of the project and provide contact information for Ecosystem Recovery and UTRCA staff for interested members of the public. This notice was mailed to nineteen (19) recipients on the contact list (see distribution list in **Appendix J**). Only two responses were received (see **Appendix J**)

The Township also set-up a project-specific page on their website with a summary of the project and links to the UTRCA website where copies of presentations, draft reports, and notices were available. A notice of commencement was also posted to the project website (http://thamesriver.on.ca/water-management/recreational-dams/classea-harrington-embro-dams/). A copy of the Notice is included in **Appendix J**.

6.2 Public Information Center #1

The first Public Information Center (PIC) was held on June 25, 2015 at the Harrington Hall and Library and was attended by twenty-two (22) members of the public, including councillors and the mayor of Zorra Township. The purpose of this PIC was to outline the Environmental Assessment process, present background information and characterization of existing conditions at the project site.

The PIC consisted of an open house format with presentation boards displaying project information, analysis, and conclusions. Ecosystem Recovery and UTRCA staff hosted the PIC and were available to address questions and concerns from attendees. Twenty-one people recorded their attendance on the PIC sign-in sheet.

A detailed questionnaire was prepared and provided to attendees, providing a guided tool to obtain high quality feedback on the projects. Four questionnaires were completed by attendees and submitted to the project team, with the following input:

- “There are old (Victorian) structures that do not meet current safety guidelines, but their continued existence is essentially “grandfathered” in because of their age.”
- “This pond is integral to the identity and existence of Harrington, historically and recreationally. Harrington will cease to exist without it. Wells (shallow dug, approx. 12) will go dry without the pond.”
- “I suggest the Harrington area community be recruited and involved in the wildlife observations and studies. Wildlife research is my area of expertise and I would also like to be involved.”
- “I have lived across the street from the mill for 15 years and want to comment on the significance of the mill pond and dam to the community. It is very important to me and others that this be protected – it has significant historical value! My property and much of this area has wet areas – springs and artesian wells

– so the wetness is not necessarily a reflection of dam structures. The importance of keeping the mill pond and dam is very important."

All materials pertaining to the PIC announcements, presentations, questionnaires and public feeback can be found in **Appendix J**.

6.3 Public Information Center #2

The second Public Information Center was held on May 12, 2016 at the Harrington Hall and Library and was attended by twenty-one (21) members of the public, including councillors and the mayor. The purpose of this PIC was to presentat of the different alternatives for the dam, and solicitation of public feedback on additional alternatives and the evaluation of alternatives.

The PIC consisted of an open house format with a formal presentation of study findings and a review of the potential alternatives that were presented on display boards. The PIC was hosted by UTRCA and Ecosystem Recovery. UTRCA staff who had been involved with the project were available to address questions and concerns from attendees.

A detailed questionnaire was prepared and provided to attendees to guide the feedback process on the project. Comments were provided by nineteen (21) members of the public; this included responses from former residents who no longer live in the area and two stakeholder groups (Thames River Anglers Association, Stewardship Oxford). A copy of all comments is provided in **Appendix J** and a summary of key themes brought forth by the public and which should be considered in the evaluation of the proposed alternatives is provided below:

- The mill pond is an historical feature that was significant to the establishment of Harrington.
- The pond is part of the cultural heritage for local residents (then and now).
- Preserving the heritage of the pond and dam should be prioritized.
- Preserving the heritage and traditions of Harrington would include restoration of the existing dam so that it becomes a permanent structure.
- A pedestrian walkway over a replacement dam (i.e., rebuild dam) would enhance public access.
- The mill pond and dam are a cherished component within the personal history of several Harrington families.
- Residents and tourists enjoy recreational walking, picnic and fishing opportunities around the pond.
- Current use of the pond for fire-fighting purposes should be considered.
- Reduce potential for stagnant water/mosquito breeding areas.
- Consider maintenance requirements (e.g., bottom draw)
- Consider public safety (e.g., deep water may pose drowning hazard)
- The sound of running water is pleasant.
- Establishing a grist mill by-pass channel would maintain auditory aesthetic (sound of water), visual pond aesthetic and provide walking opportunities.
- Concern over wildlife (birds, fish) should not take precedence over social elements such as history.
- The Harrington Grist Mill is currently being restored (using government funds) and is now in working order. Plans are underway to restore water force to the mill via a sluice way. The intent of the restoration work is to demonstrate the role of water power and the mill in establishing villages in the early history of this area (i.e., tourist and education potential)
- Regardless of which alternative is chosen, the pond should be big enough and provide elements necessary to run the mill via a restored sluice way: without a water source (sufficient head to operate a turbine in order to drive mill equipment), the mill will not be able to run.
- Consideration of using the mill as a micro grid project to generate hydro electrical power should be considered.
- A fish ladder should be part of the plan.

- The pond, dam, and proposed sluiceway (at the mill) are part of the tourist attraction to Harrington. An alternative that would re-establish the sluiceway so that the grist mill could be brought to working order again as a historic site/tourist attraction should be considered.
- Alternatives that perpetuate status quo, deteriorating environmental conditions, or lack of upgrade to contemporary environmental status are not preferred
- Cost-benefit analyses of Alternatives 2 and 4 may be beneficial to better assess these alternatives
- Preference for wetland over pond for alternative 4.
- Dislike for artificial structures
- Management for pond or wetland may be required into the future to ensure no adverse impacts on the watercourse

All respondents were asked which alternative they liked best. Several respondents provided more than one answer and several respondents provided general considerations that were summarized above. Based on the questionnaire, the respondents indicated that they liked Alternative 7 most (see **Table 6-1**); this is reflected in the comments summarized above.

Table 6-1. Summary of PIC 2 questionnaire results.

	Number of individuals who liked this alternative most
1. Do nothing	1
2. Remove dam and install rocky ramp	1
3. Remove dam and construct a natural channel	2
4. Remove dam and construct an offline pond and natural channel	2
5. Replace Dam with new structure downstream of existing dam	1
6. Replace dam with an earthen dam of lower crest elevation	0
7. Reconstruct the existing dam in current location with new materials	14

All materials pertaining to the PIC, including announcements, presentations, minutes, questionnaires,and public feeback can be found in **Appendix J**.

6.4 Public Information Center #3

The third Public Information Center was held on October 20, 2016 at the Harrington Hall and Library and was attended by thirty-three (33) members of the public, including councillors and the mayor. The purpose of this PIC was to present the evaluation of alternatives and confirmation of the preferred alternative for the dam.

The PIC consisted of an open house format with a formal presentation that provided a brief overview of the project, the preliminary alternatives, evaluation process and selection of the preferred alternatives. Presentation boards displaying the evaluation matrix and preferred alternative were provided. Ecosystem Recovery and UTRCA staff hosted the PIC and were available to address questions and concerns from attendees.

A detailed questionnaire was prepared and provided to attendees, providing a guided tool to obtain feedback regarding the preferred alternative. All materials pertaining to the PIC, including announcements, presentations, minutes, questionnaires,and public feeback can be found in **Appendix J**. In addition to the typical 2 week time period for submission of comments, a further 3 week extension was provided (see **Section 6.5**). In total 33 responses were received from members of the public.

Many of the submissions made provided similar accounts of ancestral linkage to Harrington Dam and Pond (i.e., one resident indicated ancestors settling into the area in 1857) and fond memories of recreational activities in the area including fishing, skating, picnics, walking, floating on the pond and the annual fishing derbies (note: recent correspondence from MNRF indicated that a permit for restocking Harrington Pond with Rainbow Trout will no longer be issued). In many of the comments, members of the public expressed a strong desire to maintain the cultural and historical significance of the area and to enable completion of the Grist Mill Restoration project which includes an operational grist mill powered by water from Harrington Pond. Since many comments reiterated study area perspectives already documented in the feedback received for PIC 2, only a summary of specific concerns and considerations relevant to the preferred alternative are provide below.

- The hope and plan is to restore the Harrington Dam and Grist Mill (significantly connected) as an historical and educational resource for future generations to visit and learn from. The next step is to have use of the sluice way to connect water to the mill and that depends on the mill pond. A strong and significant source of water is crucial. An offline pond and mill stream doesn't provide this. Failure to provide a pond of sufficient size to feed a sluice, and power this mill, renders all of the effort futile and reduces the historical and potentially educational Mill to nothing more than a barn with no context and with a bunch of quirky machinery in it.
- Restoration of the Grist Mill is underway and efforts are being made to raise funds to repair the dam. The Mill received a Trillium Grant. Water from the pond is necessary to power a turbine and make the mill function as it did when it was first constructed... Please do not negate all the hard work that has been done to restore the Mill.
- The dam and mill are the focal point of Harrington.
- Concern expressed regarding non-native species from Wildwood Lake that would be given access to native brook trout habitat through removal of dam.
- Concern regarding the fish sampling completed as part of the EA existing conditions characterization. A difference in fish species, numbers, and size was noted between high and low water levels. Has risk to trout habitat from non-natives species been adequately considered (e.g., similar to the branch of Trout Creek that flows from Camp Bimini)
- Limited fishing opportunity occurs with native brook trout and brook trout habitat. Limited opportunity to enhance the native fishery and ability of public to enjoy fishing would be lost if pond removed. Could brook trout from a branch of Trout be used to stock Harrington Pond (i.e., now that rainbow trout stocking will stop); carp could be reduced or eliminated from the pond by non-chemical methods. Local residents could assist with fish transfer, carp removal/elimination, and shoreline habitat enhancements.
- Are there plans of removing dams on private property? If not, what is gained by returning Harrington to a natural state?
- Consider restocking pond with Brook Trout from elsewhere.
- If 2002 Acres report indicated that risk of Harrington Dam failure is very low, what has changed now? What mitigation measures are included in the preferred option for dealing with the toxic sediment that is transported through the system?
- An off-line pond will not be maintenance free. This is not true if you want to provide access to the water and limit views. Design criteria such as steep drops in depth would be a liability issue (i.e., children).
- How can a naturalized setting be relatively maintenance free and not unsightly? Because of maintenance free overgrowth, would the pond even be visible if not standing right by it. Would the pond be accessible to canoe if weeds present?
- Canoeing and boating are not possible with a small pond.
- The number of mosquitos in the current pond, or an improved pond are less than an off-line pond.
- In order to make the off-line pond an attractive and functional alternative for local residents and visitors, liability to UTRCA will always be an issue, during open water and periods of thin ice and would require regular and continual maintenance with mosquito numbers greater than under current conditions.
- How does non-moving water not create more mosquitoes... Will pesticides be required?
- Desire expressed for large open, accessible pond provides diverse habitat for variety of flora and fauna, viewing opportunities, trails, canoeing, fishing, birdwatching, hiking, picnicking and other day use

activities. These would be eliminated or greatly reduced should the big pond be eliminated and creek and off-line pond installed.

- Local residents have made great efforts to enhance trails, and the pond site to encourage greater use of the pond; regular meetings are held to develop ideas for improving day-use of the pond and area, and to fund proposed projects. The preferred alternative will render all efforts by local residents (money and time) superfluous.
- The creek and offline pond are viewed as a maintenance nightmare and a major step in the wrong direction and virtually pulling rug out from under what has been and continues to be a vibrant and caring group of people.
- Every effort will be made (by the community) to acquire funds to not only support the replacement of the dam and improvement of the pond, but also for continual maintenance of the project. It is the hope of the people that if the money is provided to UTRCA to cover the installation costs and future maintenance costs that the will of the people be honoured. We are working toward that goal.
- Please put a hold on proceedings with Harrington Dam until more progress is made on finding funding.
- Preserve the area as a special place for humans, animals and birds
- Don't want to see dam and grist mill destroyed. The pond is needed for full restoration of the mill. Without this attraction, visitors to the area will lessen.
- I am in favour of whatever measures are needed to preserve the pond in its current state, as a lovely place for picnics, walks, fishing, and a habitat for all birds and critters that live in, and near, it.
- Do you seriously think that the residents of Harrington will stand by and support your agenda to decommission the dam/pond? Give your head a shake, it's not happening, stop wasting resources on studies, start generating the funds needed to maintain the structure.
- It would change the dynamic of the community to lose the peaceful, rich setting of the pond. I would be deeply saddened and upset if the proposed changes go through… I want Harrington Pond saved for future generations to enjoy as those before us have. Many species have come to rely on the ecosystem of this pond for years. I don't know what will happen to them if we disturb what they rely on.… they will leave, or die off, leaving us without the opportunity to observe and enjoy them.
- While I can understand the practical side of this issue, I'm saddened and disappointed that heritage, conservation and wildlife habitat could be sacrificed, and I can't think that the sacrifice could possibly be justified
- I strongly feel that efforts to restore a healthy mill pond, protecting the native fish is a top priority. I strongly believe this is possible. To let invasion of non-native fish from Wildwood Lake doesn't seem wise.
- A large healthy body of water seems so much better for all concerned rather than an off-line pond with a mill stream. Benefits include fire safety, water supply to their wells, fishing, canoeing, secures the existing and growing establishment of birds, wildlife and vegetation.
- Harrington's entire existence and identify is connected to this pond.
- Why does habitat for fish seem to take precedence over habitat for birds, water birds, mammals, reptiles? This question has not been sufficiently addressed, in my opinion.
- Concern regarding potential of stagnant and week choked off-line pond; such conditions would not be conducive to many recreational activities that take place on Harrington Pond.
- If the pond was temporarily lowered or drained, extensive repairs could be undertaken to both the concrete structure and the berm with little or no risk. I still believe that sheet piling the length of the berm should be investigated as a viable option.
- Not convinced that dam needs to be replaced… and that all variables were considered in assessing probability of failure.
- The wet area outside the dam is not a leak; my 78 year old neighbour said the area was similar 70 years ago; it could just be a spring as the name of Harrington was Springville (note: another resident referred to it as Springfield). When the dam was constructed, the neighbour noted that the footings were Piled Driven, making the Dam secure
- Concern that the preferred alternative may not be completed as planned.
- We now have an established natural setting with birds and wildlife. .. It would take a long time to re-establish natural habitat.

- Unsettling that while many residents are in favour of replace/restore the dam and keep the millpond, this is not the outcome of the study.
- The off-line pond idea is a poor substitute for the full pond; it threatens to diminish the quality of community life and destroy historical significance and value. I support keeping the existing pond structure.
- I don't believe that the cost of replacing the dam have been properly assessed or all options considered for its efficient replacement, along with upgrades to the pond itself.

All comments provided in the PIC 3 questionnaire responses were reviewed. In response, updates to the environmental study reports were undertaken (i.e., Fish and Benthic (**Appendix C**) and Vegetation and Wildlife (**Appendix D**)); additional clarification regarding the dam condition and legislative context provided within the current EA report; elements considered desirable, or important, to the community, and which should be further considered during detailed design of the preferred alternative were identified and are included in **Section 7.1**; and additional discussion of the implications for the preferred alternative and potential mitigation measures is provided in **Section 7.2** to address concerns raised in the public comments.

6.5 Information Exchange

In response to high public interest regarding the future of Harrington Dam and Pond, UTRCA project staff exchanged information additional consultation with representatives of the community throughout the study process. This consultation included the following:

Dam Restoration Tour

UTRCA organized a field tour of relatively recent dam removal and restoration projects that have been undertaken both within the jurisdiction of UTRCA and the Grand River Conservation Authority (GRCA). Two community members participated in the field tour that was organized by UTRCA, and led by GRCA; both UTRCA and Ecosystem Recovery staff were in attendance. The field tour occurred on June 18, 2016 and included visits to Chiligo Dam, Ward Pond, Brigadoon Pond, Columbia Lake, and Marden Pond.

Harrington and Area Community Association

Upon request from the Harrington and Area Community Association (HACA), UTRCA held a meeting with HACA representatives to further discuss the study process, preferred alternatives, and opportunity for public participation. As a result of this meeting, UTRCA provided a three (3) week extension for the submission of comments in response to PIC 3.

Harrington Mill

Through the EA study process, it became apparent that the community of Harrington has been working towards greater plans for restoring the Harrington Grist Mill with the intent of developing a demonstration or working facility that can be used for educational and tourism purposes. Restoration has, to date, been funded by a Trillium Grant and both private and corporate donations. Upon the request of UTRCA, the Harrington Community & Historical Preservation Club (also called the Harrington and Area Community Association) provided a tour of the mill on December 19, 2016 and was attended by UTRCA, ERI and Zorra Township staff. Information provided during the tour provided additional insight into future intent of the Mill restoration and technical requirements that need to be considered to make the mill operational.

UTRCA completed a scoped level survey and undertook high level calculations to determine water power potential for the Mill with information on the water turbine provided by the Community (UTRCA, 2017). Results of the assessment indicated the power potential would be less than noted in historic paper clippings and the information provided by the Community This may be in part may be if the reservoir has been operated lower since reconstruction or the reservoir was topped up when previously operated . Further design Information was not able to be provided to UTRCA on mill operation pertaining to turbine operation . The reservoir area was enlarged somewhat in 1952 for the recreation benefit.UTRCA engaged in discussions in January 2017 with the community regarding longer term plans which are predicated on retention of the dam only, and not the preferred alternative, or any other option. Although the discussions were initiated through the EA process, they have now been directed to the Lands and Facilities Unit of UTRCA which manages the property and community agreements and are considered separate from the EA process. The discussions are based on general ideas. Any plans will need to be vetted through the UTRCA, require geotechnical review and assessment, and require approval from MNRF; no plans have yet been approved.

7. Selection of Preferred Alternative

The purpose of the Class EA is to evaluate the existing technical, natural, social, and economic conditions related to the identified problem or opportunity, to develop and evaluate potential alternatives to address the problem, and to select a preferred alternative to proceed to implementation. This section describes the results of the alternative evaluation process which included input received from the public, and describes the preferred approach for addressing identified erosion issues in the study area.

7.1 Preferred Alternative

The preferred alternative, determined through the evaluation process is Alternative 4 **(Figure 7-1)**. It is important to note that the evaluation scoring for Alternative 7 was reviewed, in light of the proposed variation of this alternative proposed through the public consultation process as outlined in **Section 4.1.8**. While the scoring values change, Alternative 4 remained the highest ranked and is thus the preferred alternative.

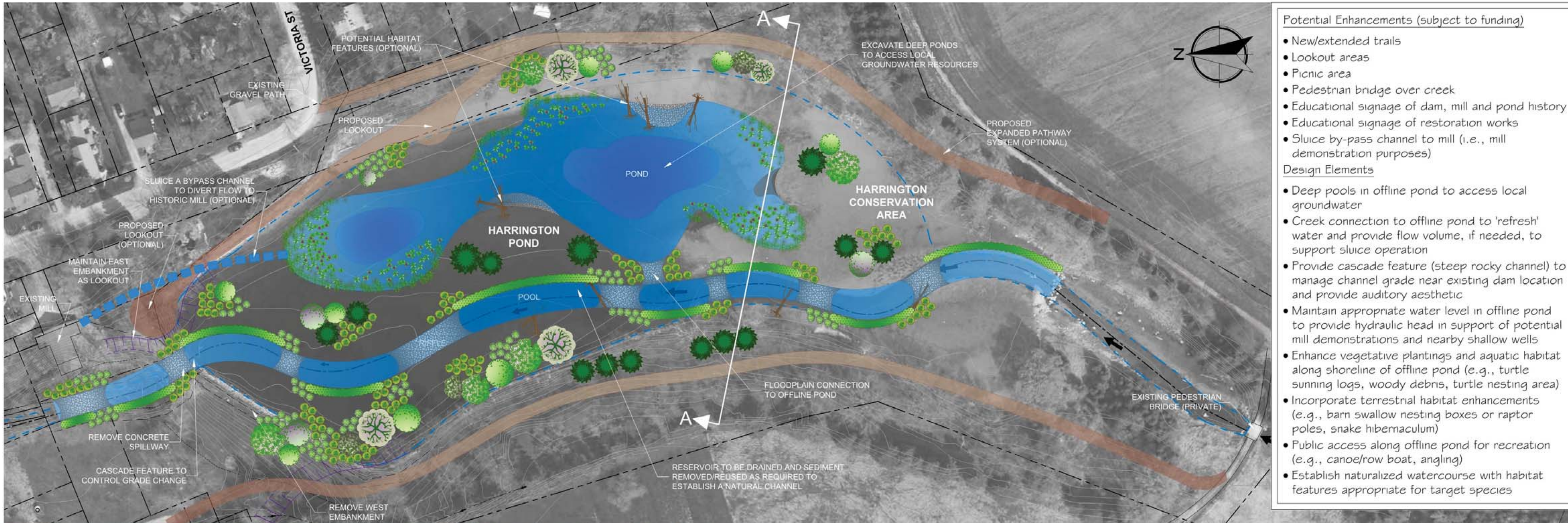
In the preferred alternative (**(Figure 7-1),** the concrete spillway would be removed and thedam embankment would be partially removed. No risk of future failure would occur. A watercourse and associated floodplain would be established and an off-line pond created, including deep pockets of water. While some material that is excavated or dredged may be re-used on-site (e.g., berming pond or floodplain establishment), some material will need to be disposed off-site.

The proposed pond is intended to maintain an open-water viewscape and to enhance pond habitat. Design of the pond could improve habitat conditions including a diversity of water depth and aquatic vegetation along the shoreline and placement of turtle sunning logs. Locally deep pockets would be created to enable interception of the groundwater to assist in cooling the water. Riparian plantings would be placed to provide shade. Public access to the pond would be provided. Recognizing the intent of the Harrington Mill restoration efforts, a sluice bypass channel is proposed to divert flow from the pond to the historic mill.

The naturalized creek would be designed based on principles of fluvial geomorphology and incorporate aquatic habitat elements that are considered beneficial for target aquatic species. The planform and profile (e.g., riffle-pool) configuration of the watercourse should be suitable for the energy and bankfull flow conditions (i.e., recurrence interval of ~ 1.6 yrs) that occur within the study area, provide floodplain connectivity (i.e., for larger than bankfull flows), and consider implication of larger flow events on both the floodplain and the channel.The channel design would promote a naturally sustainable form that is constructed using natural materials. A vegetated floodplain would be established to enable energy dissipation of flooding flows and provide shade to the creek. The creek would gradually decrease in elevation from the upstream to down-stream tie-in locations and thus become lower than the adjacent pond. Connection between pond and channel would be provided for specific flow events (e.g., sub-bankfull), near the upstream limit of the channel restoration design to replenish water in the pond.

The area’s park setting can be maintained and additional recreation opportunities can be incorporated into the design. This could include an established trail along the east side of the pond and a lookout area. Educational signage could be placed throughout the area. Wheelchair access and viewing areas can be integrated into the design.

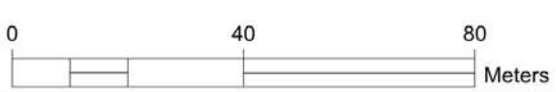
Terrestrial enhancements could include establishment of snake hibernacula, turtle nesting areas, nesting poles etc. Increasing the diversity of terrestrial vegetation would further improve the study area with respect to corridor connectivity to downstream portions of the channel corridor and improve bird viewing opportunities. Establishment of riparian vegetation that contributes organic materials, provides habitat, and provides shade would be incorporated into the design. Landscaping of the area should be designed to balance environmental needs with recreational uses and aesthetically pleasing viewscapes.

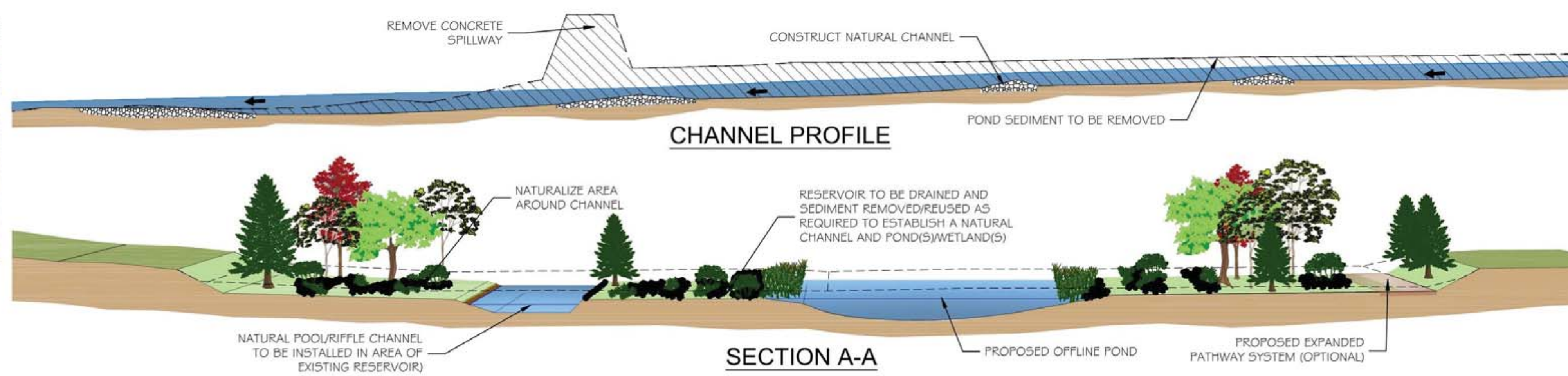


WARD'S POND WITH CREEK (KITCHENER)

CHILIGO POND WITH CREEK (CAMBRIDGE)

CHILIGO POND (CAMBRIDGE)





HARRINGTON DAM CLASS ENVIRONMENTAL ASSESSMENT

EVALUATION OUTCOME
REMOVE DAM - NATURAL CHANNEL WITH OFFLINE POND

UPPER THAMES RIVER CONSERVATION AUTHORITY

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Figure 7-1. Preferred Alternative

7.2 Potential Impacts and Mitigation

Regardless of which alternative is determined to be preferred through the evaluation process, implications of the alternative on one or more of the criteria in the evaluation matrix can be foreseen. A review of key impacts and potential mitigation measures associated with the preferred alternative are summarized below.

Technical: Removal of the dam and placing a pond off-line may interfere with nearby shallow groundwater wells. It is recommended that a shallow well inventory/assessment be completed to identify and further assess potential impacts of dam removal on the operation of these wells. An assessment of potential impacts can also be supplemented by temporarily lowering pond water elevations. If impacts are identified, then new (deeper) wells should be drilled.

Placing the channel off-line will remove the backwater effect that currently extends into the upstream creek which has contributed to the wider channel and accumulation of finer sediment (sands, silts) on the channel bed in this area. Channel restoration works will need to extend sufficiently upstream to ensure a smooth transition that will not adversely affect channel conditions or contribute to channel instability in the existing channel.

Flood flows will be directed into the offline pond to augment flow and refresh water. Flood events (i.e., larger than the bankfull or 2 year flow) will also spill onto a newly established floodplain adjacent to the designed watercourse; this floodplain connectivity will provide for temporary water storage and thus mitigate flood events naturally .

Environmental: From an environmental perspective, the naturalized creek will enable upstream migration of more aquatic species and possibly into the pond Measures could be considered to reduce undesirable species within the existing pond and/or to develop exclusion measures.

Improvements to water quality are anticipated, specifically with respect to water temperature. That is, the removal of the ‘online’ pond will decrease the warming effect on downstream waters that occurs with impounded water. Further, the establishment of vegetation along the channel, and along the off-line pond will provide shade to the area and will contribute to overall cooling.

Through the public consultation process, concern regarding the potential increase in mosquitos within an off-line was identified. Consideration should be given to incorporating measures through the detailed design process to minimize the potential areas for mosquitos.

The open water area of the pond may differ from existing conditions, in the proposed design and may result in a loss of open water habitat for waterfowl and amphibians. Measures should be implemented that will enhance existing condition, including those identified by the public, and summarized in **Section 4.1.8.**

Opportunities exist to enhance terrestrial habitat in the area surrounding the pond, and along the creek. Additional opportunities may exist within the conservation area that can be examined through the detailed design process. These opportunities can focus on specific species and could include snake hibernaculum, nesting poles etc.

During, and in the time that is immediately after construction, a loss of benthic invertebrates occurs within the pond and creek. Where opportunity exists, reuse of excavated material from the pond bottom should be considered, to speed up the recolonization process within the new offline pond.

Social and Cultural: The Harrington Community has clearly conveyed concerns regarding the potential loss of the open water viewscape that is currently enjoyed, and the potential loss of current recreational activities. The proposed design should therefore maximize the footprint of the pond to the extent feasible to replicate the existing viewscape and enable a continuation of existing aquatic recreational activities. This could include consideration to enlarge the footprint of the works by shifting the proposed naturalized watercourse further west so that the width of Harrington Pond can be maximized.

The restored Harrington Mill was intended as a demonstration site. Concern has been expressed by the community that the proposed offline pond will not provide sufficient water power to support Mill demonstration purposes.

As such, the pond should be situated as close as possible to the Mill to mimic the historical relation between Mill and Pond. Similarly, the potential to direct water from the pond to support Mill demonstration should be addressed in the detailed design. Opportunities to implement educational signage should be considered.

The community has expressed concern regarding ease of access for fishing purposes. Landscaping of the area around the pond can be undertaken to provide specific points of access for wheelchairs, and informal viewpoints. The landscape design would integrate elements beneficial for water quality (e.g., shade trees) and aquatic habitat.

Financial Funding to support implementation of the preferred alternative would include funds that may be available from the Upper Thames Conservation Authority, Zorra Township, Provincial and Federal funding sources, and non-government agency initiatives. A summary of currently available funding sources is provided in **Table 4-2**.

8. Project Implementation

8.1 Next Steps

It is recommended that the UTRCA proceed with detailed design of the preferred alternative. In support of the detailed design process, it is recommended that full consideration be given to the input provided by the community during the EA study regarding Harrington Conservation Area. The design process would build upon study findings and recommendations provided in this report and include further collaborative discussions between UTRCA, Zorra Township, and the community, similar to a Master Plan process. This approach would guide the detailed design, phasing, and financial planning (i.e., including external funding applications) for implementation of the preferred alternative.

Implementation of the preferred alternative concept (**Section 7**) is subject to budgetary constraints. Funding for the preferred alternative will define the time frame for implementation. Until sufficient funding is available, continued monitoring of site conditions should be undertaken and maintenance may be required. The Ministry of Natural Resources and Forestry recommends that the maximum time period between Dam Safety Reviews is 10 years; since the last review was completed in 2007 and 2008, another Dam Safety Review should be considered.

Once funding is available, additional study requirements should be initiated, to inform the detailed design process: these include, but are not limited to the following:

Specific studies that should be undertaken include:

- Locate and assess all shallow wells that may be affected by implementation of the preferred alternative and identify what, if any, mitigation measures will need to be incorporated into the detailed design. This may require consideration of additional groundwater treatment for deeper wells (e.g., iron removers, water softener etc.).
- Complete hydrologic study review/update to quantify design flows for Harrington Creek.
- Determine sediment disposal options.
- Complete archaeological assessment of dredged materials, to identify any artefacts, given the history of the area. Extend the archaeological assessment as outlined in **Section 3.8.4** if relevant.

Detailed design and supporting analyses are required to determine the appropriate restoration/mitigation approach and materials given the flow characteristics of Harrington Creek. Engineering drawings for tender and construction will need to be produced. Following the completion of design and acquisition of the required permits and approvals (see **Section 8.2**), eligible contractors should be evaluated on the basis of their previous creek rehabilitation and erosion control experience, with particular emphasis on in-water work experience, to help contribute to the quality and effectiveness of implementation.

If the proposed detailed design includes elements that may impact an area beyond that indicated in the Notice of Intent, then further consultation with First Nations should be undertaken. Communication of any archaeological findings to the First Nations Communities should be undertaken as outlined in the Ministry of Aboriginal Affairs response to the Notice of Intent (See **Appendix J**).

8.2 Design Considerations

The detailed design should incorporate findings from the EA study and be informed by the additional studies as outlined in **Section 8.1;** additional data and information needs may be identified to support the design process. The design should be based on sound engineering practise with due consideration and replication of the social and cultural value (both historical and current) and for enhancement of the natural environment. The selection of restoration materials (substrate gradation, bank treatments) should replicate natural conditions and include diversity that will sustain various ecosystem components and support a functioning and geomorphically stable watercourse.

Through the study process, potential opportunities to enhance the preferred alternative with respect to the social and cultural value and natural environment were identified. A summary of potential design components that should be considered for incorporation into the detailed design, should include the following:

Public Safety, Recreation, and Enjoyment

- Large pond to mimic current open water view from residential homes along Victoria Street.
- Maintain access for fire department.
- Provide wheelchair access for fishing opportunities.
- Maintain unobstructed view of the pond.
- Support recreational opportunities such as fishing, canoeing, boating, and picnicking.
- Develop hiking/walking trails and a viewing stand for bird viewing, similar to that which is located at the south end of the pond.
- Implement measures to reduce mosquito populations.

Environmental

- Provide habitat for snakes (snake hibernacula).
- Provide turtle nesting habitat.
- Provide nesting poles for species known to frequent the area.
- Consider raptor poles.
- Consider measures to keep undesirable species out of the pond and/or creek (e.g., carp).
- Vegetation restoration plan should maintain viewscape of pond and creek.

8.3 Permits and Approvals

The detailed design of the proposed erosion control works, when completed, must be submitted for approval to Upper Thames Region Conservation Authority (UTRCA) along with the completed “Application for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses” form (pursuant to Ontario Regulation 160/06), prior to any construction activities taking place.

An application for approval from the Department of Fisheries and Oceans (DFO) under the *Fisheries Act* may be required, pending results from the self-assessment process. Regardless of whether a permit is required from DFO, the proposed project must avoid serious harm to fish and incorporate best management practices to aovid harm. .

Under Section 16 of the Lakes and Rivers Improvement Act, ‘no person shall alter, improve, or repair any part of a dam… unless the plans and specifications for whatever is to be done have been approved’ by the Ministry of Natural Resources and Forestry. Likewise, under Section 2(1)(b) of Ontario Regulation 454/96, Ministry approval is required to make alternations improvements or repairs to a dam that holds back water in a river, pond, or stream if these may affect the dam’s safety, structural integrity, the waters or natural resources. Further, Section 2(2) of Ontario Regulation 454/96 specifies that LRIA Section 16 approval is required before a person operates a dam in a manner different from that contemplated by previously approved plans and specifications (see: https://www.ontario.ca/page/alterations-improvements-and-repairs-existing-dams for additional information).

8.4 Preliminary Cost Estimate

A preliminary cost estimate was prepared for the preferred alternative (See **Section 4.2.1**). This cost estimate includes all works associated with removal of the dam outlet, embankment, dredgeate disposal, drilling of deeper wells, channel restoration, restoration plantings and trail, based on the concept design description in current dollars and market conditions. The preliminary cost estimate is $800,000 to $1,000,000. The actual total costs will vary depending on when implementation will be executed, findings from the groundwater well assessment, and on materials used as some materials tend to have fluctuating costs such as rock and armourstone.

8.5 Mitigation Measures and Monitoring Program

To ensure the future protection of ecological features within the preferred site, the following mitigation features should be implemented during construction, and illustrated in the detailed design drawings:

- **Erosion and Sediment Control**: Mitigation measures must be used for erosion and sediment control to prohibit sediment from entering the surrounding natural areas. The primary principles associated with sedimentation and erosion protection measures are to: (1) minimize the duration of soil exposure, (2) retain existing vegetation, where feasible, (3) encourage re-vegetation, (4) divert runoff away from exposed soils, (5) keep runoff velocities low, and (6) trap sediment as close to the source as possible. To address these principles, the following mitigation measures are proposed:
  - According to Ontario Provincial Standard Specifications, silt fencing (OPSD 219.110) is required along all construction areas.
  - All surfaces susceptible to erosion should be re-vegetated through the placement of seeding, mulching or sodding immediately upon completion of construction activities.
  - All dewatering required for construction is to be discharged to a sediment trap at least 15m away from the watercourse.
- **Grading Techniques**: Site grading and runoff controls should be developed during final design to mitigate potential stormwater runoff impacts to the surrounding natural areas. This plan should provide for post-construction contours that minimize runoff to the natural areas.
- **Construction Timing**: To mitigate impacts to breeding birds, any tree and site clearing should take place between September and March 31st and avoid the months of April through August. This is to ensure that works do not disturb any potentially nesting birds. This is in accordance with the Migratory Birds Convention Act. Fisheries timing windows should be determined in consultation with the MNR. For fall spawning fish (e.g., Brook Trout), in-water works are typically not permitted between October 1st and May 31st; this should be confirmed.
- **Breeding Bird Surveys**: Should tree clearing be scheduled within the months of April through August, comprehensive breeding bird surveys need to be conducted prior to tree clearing to ensure there is no disturbance of nesting/breeding birds. Surveys should document the location of breeding pairs and potential location of nests. Should nests/breeding pairs be discovered within the clearing area, the location should be clearly marked/flagged and a 10 metre buffer surrounding the nest be implemented. The space within this buffer should be protected until the young are fully fledged. An ecologist with ornithological experience should conduct the surveys and monitor the nests (should nests be discovered) periodically. Clearing can only be undertaken if the ecologist is satisfied there are no breeding/nesting pairs within the affected area.
- **Plantings**: If trees larger than 150mm diameter at breast height (DBH) need to be removed during construction, the goal should be to replace native species at a minimum 2:1 ratio. Where possible, large trees should be planted, to enhance the viewscape of the park and pond area in the post-construction period.

8.5.1 Construction Impacts and Monitoring

The potential negative effects to the natural environment as a result of the proposed work can be reduced with the implementation of standard mitigation measures. The following describes general mitigation measures that are recommended for implementation during the proposed works:

- Extensive sediment and erosion control measures (e.g., silt fencing, trenching) should be established prior to the commencement of any construction activities and remain in place until all disturbed areas are fully stabilized to retain sediment on site and prevent its entry to the creek and wetland communities;
- Clearing of riparian trees and/or shrubs should be minimized such that physical and biological functional attributes of the terrestrial vegetation can be maintained as they relate to aquatic ecological function;

- All exposed areas should be kept to a minimum at all times to minimize the potential for soil erosion and sedimentation within the creek;
- Reinforced sediment control measures, such as double silt fencing, is recommended for select locations in order to provide enhanced containment and erosion protection for adjacent environmentally sensitive areas;
- The proposed timing of construction, e.g., winter and/or summer, does not conflict with fish spawning times (MNR restricted in-water work timing window), which for Brook Trout supporting systems is from October 1st to May 31st ;
- Machinery will arrive on site in a clean, washed condition and is to be maintained free of fluid leaks;
- Wash, refuel and service machinery and store fuel and other materials for the machinery away from water to prevent any deleterious substance from entering the water;
- Re-vegetation of disturbed areas should be completed promptly and through consultation with UTRCA;
- All activities, including maintenance procedures, shall be controlled to prevent the entry of petroleum products, debris, rubble, concrete or other deleterious substances into the creek;
- Re-fuelling and servicing and inspection of all construction equipment should take place no less than 30 metres away from the creek to ensure no leakage of any deleterious substances to the creek or the local environment;
- Construction material, excess fill, construction debris, stockpiling and empty containers should be stored no less than 30 metres away from the water to ensure no run-off of any deleterious substances to the creek occurs;
- Prior to dewatering, all fish should be removed from the area to be isolated and dewatered. Fish should be released downstream of the work area and nets installed to prevent their reintroduction into the work area. Dewatering pump intakes should be screened (*Freshwater Intake End-of-Pipe Fish Screen Guidelines*, DFO) in a manner that prevents fish from becoming impinged and injured. Fish passage must be maintained at all times, see Section 3.2.4 - *Fish Passage.* Silt and debris accumulated around the temporary cofferdams should be removed prior to the removal of all isolation materials to prevent entry of sediments to the watercourse; and
- Use dams made of non-earthen material, such as water inflated portable dams, pea gravel bags, concrete blocks, steel or wood walls, clean rock, sheet pile, or other appropriate designs to separate the dewatered work site from flowing water.

Construction monitoring is undertaken during the implementation of proposed works to ensure that methods for mitigating concerns and for environmental enhancement are performed as planned and approved, and that any problems that may arise during construction are effectively addressed. Construction activities are to be undertaken in accordance with all applicable guidelines, policies, regulations and statutes.

Construction monitoring is to be undertaken by the proponents of the project (e.g., UTRCA) or agents thereof. Responsibilities for construction monitoring include:

- Ensuring adherence to the approved design and monitoring requirements;
- Meetings with project construction staff to ensure the function and correct installation of mitigation measures are understood;
- Providing direction in unplanned situations with the potential for environmental impacts; and
- Addressing noted deficiencies promptly, as required, with construction staff and proponents.

Detailed monitoring and compliance records are to be developed as construction progresses, and submitted to the project proponents for review on request.

8.5.2 Post-Construction Monitoring

Post-construction monitoring of the creek remediation works is to be undertaken to assess the effectiveness and environmental performance of the project. For the preferred alternative, the following components and features are to be monitored following the completion of construction, as required:

- Locations where erosion control works appear to be deficient, if any, through indications of erosion or channel migration;
- Movement of rock or other erosion control works from installed locations;
- Indications of additional/excess sedimentation in the channel;
- Degree of establishment of bioengineering installations;
- Success of site restoration measures and riparian plantings;
- Algae or excessive plant growth in the channel;
- Description and/or photographs of any fish or other wildlife observed; and
- Signs of vandalism or other social-based encroachments onto the creek corridor, outside of established pathways and bridges.

The post-construction monitoring report is to include, as required:

- An assessment of the effectiveness of the undertaking in addressing the identified issues of the EA;
- Documentation of follow-up maintenance;
- A summary of the baseline inventory with respect to any potential impacts that were identified;
- Documentation of any changes in the baseline conditions as a result of the remedial works, including a photographic record;
- Identification of measures that will be undertaken to address any identified impacts; and
- A schedule for ongoing maintenance and monitoring

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