OTONABEE
CONSERVATION

ENVIRONMENTAL STUDY REPORT

CLASS ENVIRONMENTAL ASSESSMENT

REMEDIAL FLOOD CONTROL WORKS MILLBROOK DAM

OCTOBER 2013

Prepared for: Otonabee Region Conservation Authority and the Township of Cavan Monaghan

Prepared by: MMM Group

MMM GROUP GENIVAR PAST RECOVERY ARCHAEOLOGICAL SERVICES

OTONABEE CONSERVATION

OTONABEE REGION CONSERVATION AUTHORITY

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September 28, 2013

Otonabee Region Conservation Authority
250 Milroy Drive
Peterborough, Ontario
ON K9H 7M9

Attention: Mr Allan Seabrooke B.Sc., M.Sc., A.M.C.T.
Chief Administrative Officer/ Secretary Treasurer

Dear Sir,

RE: Millbrook Dam Environmental Assessment

Attached for your review is the Final Environmental Study Report for the Millbrook Dam. The study conforms to the Terms of Reference issued by the ORCA and not only fulfills but proceeds beyond the requirements of Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works.

The study process has included collection and review of environmental and engineering background data, site reconnaissance for engineering, biological, geomorphological and planning components, and detailed discussions with ORCA staff. Public consultation has received considerable effort. The preferred solution to potential dam failure, involves widening the spillway to reduce public health and property and environmental safety risks, construction of a new weir to retain the Millbrook headpond, lowering of the headpond elevation, and measures to increase stability. In doing so, the preferred solution satisfies both engineering and social needs of the community. The new structure would comply with MNR's Dam Safety Guidelines. Long-term adverse ecological or social effects are not anticipated by implementation of the proposed solution.

MMM Group Limited thanks the Otonabee Region Conservation Authority and the Township of Cavan Monaghan for the opportunity to assist on this important project and looks forward to further assisting with project implementation.

Yours Truly,
MMM Group Limited

J.A. Bertulli, MES, MCIP, RPP
Senior Environmental Planner/ Senior Project Manager

EXECUTIVE SUMMARY
ENVIRONMENTAL STUDY REPORT
REMEDIAL FLOOD CONTROL WORKS
MILLBROOK DAM

The Millbrook Dam is located on an upstream reach of Baxter Creek in the Village of Millbrook (Millbrook Ward, Township of Cavan Monaghan) approximately 20 kilometers southwest of the City of Peterborough.

The nearly 200 year-old dam, owned by the Otonabee Region Conservation Authority (ORCA), is composed of a 120 metre-long earth embankment. Flow through the earth embankment dam is controlled by a U-shaped overflow weir and concrete spillway structure.

Owing to its commitment to protective flood control, the ORCA commissioned a series of engineering studies to review and evaluate all aspects of design, construction, maintenance and operation affecting the safety of the Millbrook Dam. Collectively, these studies demonstrated that the Millbrook Dam did not meet the Ministry of Natural Resources' (MNR), Lakes and River Improvement Act (LRIA) Ontario Dam Safety Guidelines. In particular, it was determined that the dam had structural stability, seepage and hydraulic capacity deficiencies that were likely to lead to dam failure. Further, owing to downstream residential and commercial development (i.e., Village of Millbrook commercial core), it was demonstrated that failure of the dam could lead to incremental loss of life, property damage, social and economic disruption, and environmental harm. Hence, safety analysis of the Millbrook dam demonstrated that the appropriate Hazard Potential Classification (HPC) category for the dam was "High". In addition, the current overflow weir and spillway were shown to be incapable of discharging the required Inflow Design Flood (IDF).

It is the "incremental flooding hazard" and associated risks to public health, property and environmental safety that could result from failure of the Millbrook Dam that the ORCA seeks to avoid. Hence, the issue of "how best" to control this incremental flood hazard was the subject of this Class Environmental Assessment (Class E.A.). The purpose was, therefore, to identify and evaluate a range of options directed toward solving the problem and ultimately, recommending a preferred solution.

Studies supporting the Class E.A. have included a thorough review of previous engineering studies, as well as completion of ecological and geomorphological field investigations and an archaeological assessment. Also, considerable engagement of the public occurred prior to as well as throughout the Class EA process. Prior to commencement of the Class E.A., an independent consultant was retained to engage the public, the results of which were considered during this Class E.A. Throughout the Class E.A., opportunities for public input included direct mailings, publication and door-to-door delivery of notices, formation of and several meetings with a Community Liaison Committee, First Nations consultation, agency consultation, and organization/facilitation of a Public Information Centre.

Although many approaches to possibly solving the problem of incremental flooding due to dam failure were conceived and considered, many failed the test of actually being effective in addressing the project objectives. In the end, however, three remedial concepts were devised and offered for public review with each presenting an effective solution to the dam safety concern. Concept "A" provided for removal of the existing overflow weir / spillway and a large portion of the adjoining earth embankment with restoration of Baxter Creek and creation of parkland in place of the lost millpond. Concept "B" also removed the existing weir / spillway, construction of a larger, naturalized opening in the earth embankment and restoration of Baxter Creek, but also proposed retaining approximately one half of the existing millpond. Concept "C" focused on replacement of the existing overflow weir / spillway with a new weir / spillway capable of passing the required Inflow Design Flood, stabilizing the earth embankment, controlling seepage through the earth embankment and removal of sediment from the headpond.

Engineering studies concluded that all concepts would control, to within acceptable limits, the incremental flood hazard caused by dam failure, and that preliminary estimated construction costs were similar. Ecological conclusions indicated that although important local natural value exists in the study area, each of the proposed concepts could be constructed without long term adverse ecological effects. Geomorphological studies noted that potential stream morphology changes could be remedied by known methods. The preponderance of evidence for selection of a preferred concept, however, was provided through public input. The historical, cultural and social value of the dam and associated Needler's Mill, the immense local aesthetic and natural value of the headpond, the commercial/tourist value to the community's economy and, the importance of the study area to continued community gathering activity, makes this site the functioning heart of the Millbrook community. Consequently, Concept "C" has been selected as the preferred solution in that it preserves the dam, protects Needler's Mill, maintains the headpond and, largely preserves the existing character and values of the study area.

Following approval of the Remedial Flood Control - Millbrook Dam Class E.A., the Otonabee Region Conservation Authority, as requested by the public and recommended by the study team, is committed to completing an independent peer-review of the HPC, IDF, and water level elevation and average water depths of the headpond. Further, the ORCA is committed to giving due consideration, in consultation with the public, to a variety of different weir shapes and layouts with an aim to pass the required IDF over a shorter weir width than that of the straight weir illustrated in the preferred option - Concept C. Subsequently, the ORCA intends to proceed to detailed engineering design and then, to construction. During these next steps of the project, the ORCA is also committed to on-going public consultation through continuance of the current Community Liaison Committee, publication of notices, and organization and facilitation of public information centres.

ENVIRONMENTAL STUDY REPORT

REMEDIAL FLOOD CONTROL WORKS

MILLBROOK DAM

CLASS ENVIRONMENTAL ASSESSMENT

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1.0 INTRODUCTION

1.1 Background

The Millbrook Dam is located on an upstream reach of Baxter Creek in the Village of Millbrook (Millbrook Ward, Township of Cavan Monaghan), approximately 20 kilometres (km) southwest of the City of Peterborough (Figure 1-1).

The dam was constructed 1822-1824 to supply mechanical waterpower for a grist mill operation. The Otonabee Region Conservation Authority (ORCA) purchased the dam along with 0.69 hectares (ha) (1.74 acres) of land in 1967. Lands purchased included the dam proper and adjacent downstream lands adjoining the Baxter Creek channel. The dam is composed of a 120 metre-long earthen embankment with a concrete spillway near its eastern end. Flow through the dam is controlled by a U-shaped overflow weir at the spillway entrance. The weir creates a small headpond of approximately 5.5 ha (13.7 acres) in size which in turn, is surrounded by urban Millbrook on the north and west, the Medd's Mountain Conservation Area on the east and vacant wetlands/forest of the Baxter Creek floodplain on the south (Figure 1-2). The dam, its headpond and Needler's Mill jointly represent what is reportedly the most important social and integrating element of the Millbrook Community.

Recognizing that central Millbrook lies downstream from the dam, and that a flood wave generated by failure of the Millbrook Dam might pose a threat to the downstream residential and commercial district, the ORCA commissioned a number of engineering studies (Acres International, 2004) (Geo-Logic Inc., 2007) (IBI, 2008) directed towards the review and evaluation of all aspects of design, construction, maintenance and operation affecting the safety of the Millbrook Dam. In accordance with Ministry of Natural Resources (MNR), Lakes and River Improvement Act (LRIA) Ontario Dam Safety Guidelines, these studies collectively assigned a "high" Hazard Potential Classification (HPC) to the Millbrook Dam. That is, in the event of failure, the resultant flood wave was projected to cause incremental flooding in the downstream developed area that could lead to incremental loss of life, property damage, social and economic disruption and environmental harm under both dry and wet weather conditions. In addition, IBI (2008) determined the appropriate Inflow Design Flood (IDF) to be 100 cubic metres per second (cms). Further, it was shown that the existing overflow weir and spillway were incapable of discharging the required IDF. As well, IBI (2008) determined that the dam had inadequate factors of safety to prevent toppling and/or sliding.

After identifying the various deficiencies of the Millbrook Dam, as well as determining the appropriate Hazard Potential Classification (HPC) and Inflow Design Flood (IDF), IBI (2008) went on to also define remedial options for the dam. Subsequently, a public consultation study

Legend

- ★ Millbrook
- Major Waterbodies
- Major Roads
- Municipalities

Client: **OTONABEE CONSERVATION**	
Title: **Location Plan**	
Prepared by: MMM GROUP	
14.12216.001.P01	Scale as Shown / Review: JB
Date: August 2013	**Figure: 1**

(Ogilvie, 2009) was conducted to determine public attitudes and opinions on the remedial options proposed in IBI (2008). Those consultation studies ascribed an extremely high social value to the dam and its functionally associated elements being primarily the headpond and Needler's Mill (Figure 1-2). The Environmental Assessment (EA) which follows draws all engineering, social and ecological elements of the study area together to integrate, balance and recommend a preferred option for the issue of "how best" to control incremental flooding due to dam failure, to within acceptable limits.

The ORCA has opted to complete the Remedial Flood Control Works - Millbrook Dam E.A. to provide a preferred remedial concept which would then be taken to final design at a later date.

It is noteworthy that the aforementioned evaluations that determined the HPC and IDF for the Millbrook Dam were based on the current knowledge, practices and standards that existed at the time when the studies were undertaken, and that since then new technical guidelines for determining a dam's HPC and IDF were recently adopted by the MNR. In acknowledgement of this, a report was submitted on May 16, 2013, to the Board of Directors (BoD) of the Otonabee Region Conservation Authority (ORCA) from Allan Seabrooke, Chief Administrative Officer (CAO) / Secretary-Treasurer, that recommended:

- The Community Liaison Committee will be retained to work with the Consultants and Steering Committee during Phase 2
- Phase 2 will include a formal Public Information Meeting to gain input on the proposed design and work, prior to finalization of construction drawings
- The work plan for the Consultants in Phase 2 will include a review and verification of the minimum hydraulic capacity of the new outflow/control structure which is currently stated, based on previous engineering models, at 100 cubic metres per second
- The Phase 2 work plan for Consultants will include the requirement to present reasonable design configuration options for a permanent, fixed level retention structure (i.e., weir) with the goal of minimizing the size of the spillway while achieving the minimum required hydraulic capacity
- The parameters for the proposed pedestrian walkway over the outflow/control structure will include design that is considerate of aesthetics that retain the historical flavour of the area.

This May 16th Board Report (Number CLR13-005) titled "Class EA – Environmental Assessment For Remedial Flood Control Works – Millbrook Dam; Phase 2" was received by the Board. In addition, the above-noted recommendations from the CAO related to Phase 2 and contained in report Number CLR13-005 were endorsed by the Board pending Board approval of the preferred option from the Class EA.

Following approval of this Class E.A., therefore, and before proceeding to the preparation of detailed design of the preferred solution to the incremental flooding hazard, the ORCA is committed to completing an independent peer-review of the HPC and the IDF, and to consider a variety of different weir shapes and layouts during detailed design, as per the ORCA's Board of Directors Report Number CLR 13-005, titled: "Class EA - Environmental Assessment for Remedial Flood Control Works - Millbrook Dam; Phase 2" In addition, the ORCA has also committed to a peer-review of the preferred option's recommended headpond water level elevation and depth.

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 1-2 Study Area.pdf

Client: OTONABEE CONSERVATION		
Title: Study Area		
Prepared by: MMM GROUP		
14.12216.001.P01	Scale as Shown	Review: JB
Date: May 2013	Figure: 1- 2	
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1.2 The Dam Failure Problem

The Ministry of Natural Resources Lakes and Rivers Improvement Act requires that dams meet minimum design standards to protect public health and environmental safety. IBI (2008) technically defines the problem of dam failure resulting in incremental flooding causing loss of life, property damage, social and economic disruption and environmental harm which is the subject of this Class E.A. Figure 1-3 schematically illustrates the hypothetical process leading to dam failure and its consequences.

IBI (2008) identified the most likely modes of dam failure as:

1. Overtopping - High volumes of runoff generated by large precipitation events collect in the Millbrook Dam headpond due to the constriction of Baxter Creek posed by the dam. This causes the water level in the headpond to rise leading to overtopping of the dam with resulting rapid erosion of materials from the spillway area, or, the dam crest and rear face.

2. Toppling or Sliding - Hydraulic pressure on the dam structure coupled with internal structural weakness or, foundation erosion due to seepage beneath the dam causing the dam to topple or slip. This mode of failure can occur with, or without, high volumes of runoff, but is the most likely mode of failure to occur in the absence of a storm (i.e., "Sunny Day" failure mode).

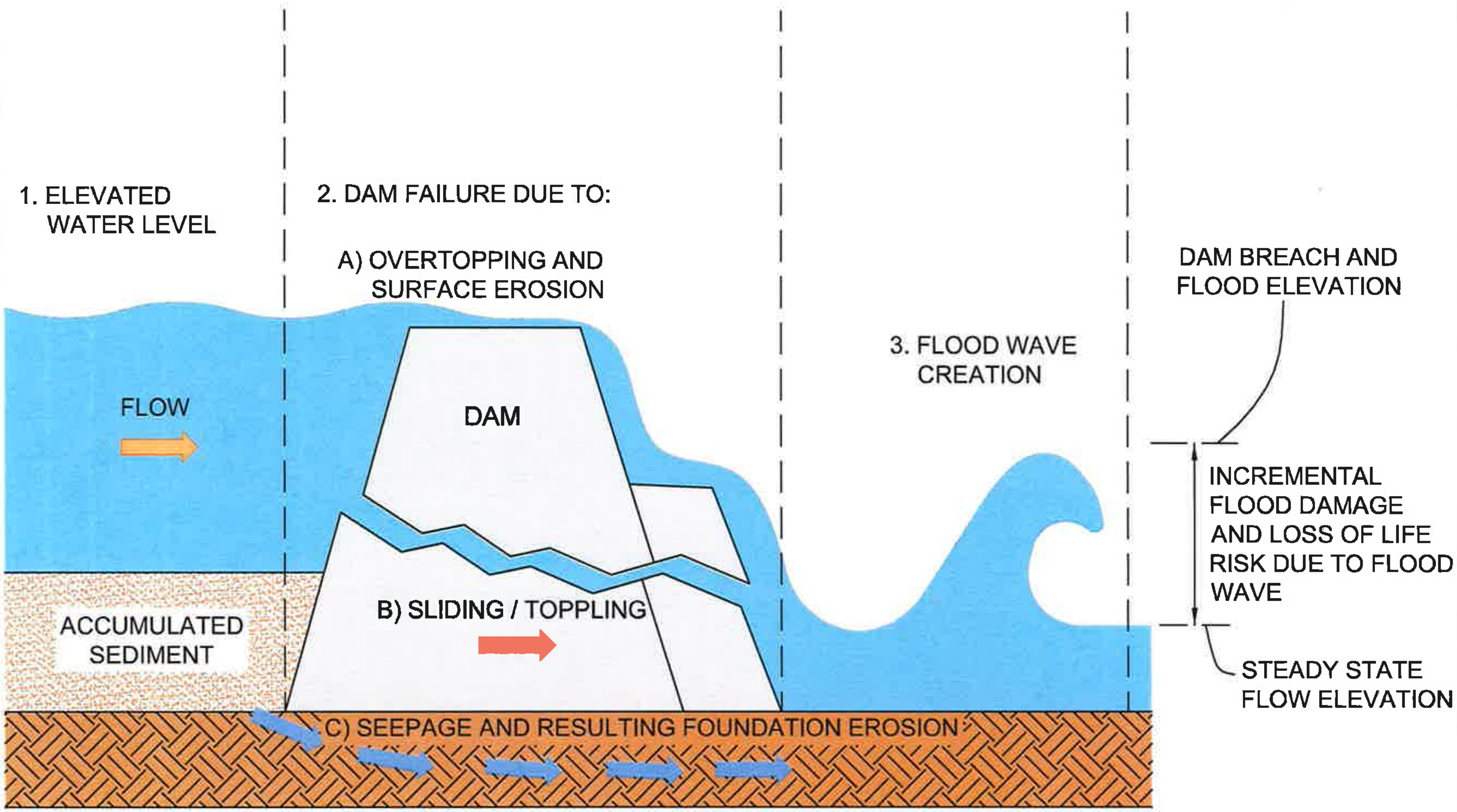
IBI (2008) reported the result of modelling a dam failure/breach and the ensuing flood wave. Figure 1-4 shows an example of dam breach modelling exercise. Typically, two simulations are run **using the same base flow** then, the results (with dam failure) are compared to results (without dam failure) to determine the effect of the dam breach/failure.

For the first simulation, the model routes/conveys the selected flow through the headpond, dam and downstream village to determine the flood water **elevation** at given points (cross sections) along the flow path. A contour is then generated showing the "steady flow flood line". The area between the east and west flood lines represents the area flooded by the selected flow.

For the second simulation, the model is re-run using the same flow but, **simulating a dam failure**. Under this condition, a flood wave is generated as represented by the "dam breach flood line".

Comparison of the "steady flow" and "dam breach" flood lines shows that the flood wave in the dam breach simulation generally produces higher flood elevations than the "steady flow" flood line resulting in **additional** damage.

The increased extent, depth and velocity of flooding between the "steady flow" and "dam breach" flood lines is referred to as "**incremental**" flooding. In the case of the Millbrook Dam, and as worst case scenario, failure of the dam during a storm event would generate a downstream flood wave that would enter the downstream residential and commercial district of Millbrook, worsening the downstream flooding. IBI (2008) identified that this incremental flooding due to dam failure could be responsible for incremental loss of life, property damage, social and economic disruption and environmental harm. IBI (2008) also determined that the worst case scenario during a "Sunny Day" dam failure could also result in incremental loss of life, property damage, social and economic disruption and environmental harm.



Client: OTONABEE CONSERVATION	
Title: The Dam Failure Problem	
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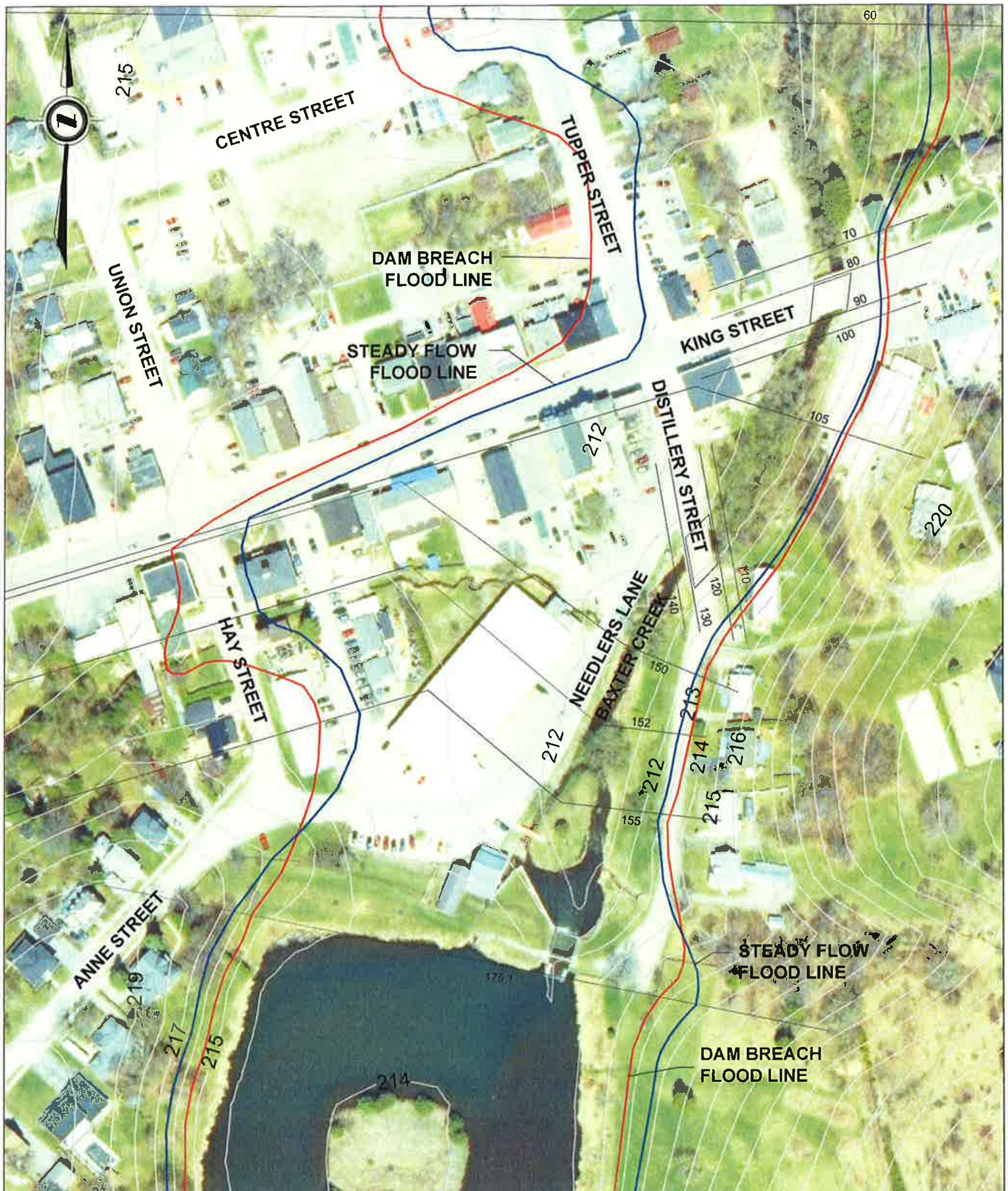
Date: May 2013	Figure: 1-3



Legend

- Steady Flow Floodline
- Dam Breach Floodline
- 175.1 Cross Section
- 214 Contour / Elevation

0 25 50 100

SCALE 1:2000 (m)

Client: OTONABEE CONSERVATION		
Title: Example of Inundation Map / Dam Breach Modelling		
Prepared by: MMM GROUP		
14-12216-001-P01	Scale: 1:2000	Review: JB
Date: May 2013	Figure: 1-4	
Source: Adopted from IBI, 2008		

It is this "incremental flooding hazard", and associated risks to public health, property and environmental safety that the ORCA seeks to avoid. The issue of "how best" to control this incremental flood hazard, to within acceptable limits, is the subject of this E.A.

1.3 Purpose, Scope and Process For The Class EA

1.3.1 Purpose

As stated in Otonabee Conservation's Terms of Reference for the Remedial Flood Control Works - Millbrook Dam project, the purpose of the E.A is to "identify, investigate and evaluate a reasonable range of options to solving the problem, and from this process establish a preferred option to remediate the potential risk to human life, property and the environment that are expected to occur in the event that the dam fails."

1.3.2 Scope

During the early stages of the E.A. it became apparent that the scope of the E.A. was not well understood. Necessarily, the first task of the study team became to define the scope of the Class E.A., as follows:

i) *Millbrook Dam Not A Flood Control Structure*

The Millbrook Dam was constructed for one purpose only. That is, the Millbrook Dam was built to impound water that could then be directed to provide water power to a grist and lumber mill (i.e., what is known today as Needler's Mill). Owing to the relatively small size of the impoundment, it has no flood water attenuation capability, and therefore, does not prevent the entry of flood waters into the downstream developed area. To give a measure of comparison for storage volume, the mill pond would fill to overtopping in less than ten minutes at the Timmins storm flow rate (181 cms) indicating a very small storage capacity which is not useful in detaining major flows. Not only does the Millbrook Dam not prevent entry of flood waters into the downstream developed area, the water that is held behind the Millbrook Dam increases the downstream flood hazard in the event of dam failure. Hence, the scope of this Class EA is to determine a preferred solution to controlling the incremental extent, depth and velocity of flooding caused in the event that the Millbrook Dam fails.

ii) E.A not intended to Reduce Regulatory Flooding Hazard Limit

It is well known that much of the downtown core of Millbrook is, during high volume runoff events, the subject of flooding from the main channel of Baxter Creek, as well as Tributary 1 and Tributary 2. Hence, much of the downtown core of Millbrook is a defined floodway.

The flood hazard limit is defined as the flood resulting from the rainfall actually experienced during the Timmins storm (1961) transposed over the Baxter Creek watershed and combined with local conditions. As per, Ontario Ministry of Natural Resources Technical Guide - River and Stream Systems: Flooding Hazard Limit (2002) this is the minimum acceptable flood hazard limit for the area, and therefore, there is no option for lowering of this flood standard. Hence, the purpose and scope of this Class EA is not to reduce the regulatory flooding hazard limit.

iii) Needler's Mill Outside Scope of Class EA

The purpose of this Class EA is to determine a preferred solution to resolving the problem of incremental flooding in the downtown core of Millbrook. Deciding the future of Needler's Mill is an undertaking that falls outside the types of undertakings that are subject to Conservation Ontario's Class EA (2009). Consistent with good E.A. practice, however, the function of the Mill has been carefully considered since the mill is an integral and critical part of Millbrook's social and cultural fabric. The preferred concept proposed in the Class EA report would not only provide protection of the Mill from flood flow rates up to 100 cubic metres per second (100 cms) but, would also eliminate ongoing foundation deterioration by preventing seepage beneath the building.

iv) Waterpower Potential of Dam Not Part of EA and Not Financially Feasible

Consideration of hydroelectric power generation falls outside the types of undertakings covered by Conservation Ontario's "*Class Environmental Assessment for Remedial Flood and Erosion Control Projects*" dated January 2002, as amended in September 2009. Even if it were part of this Class EA, however, high capital investment needed for purchase and installation of generating equipment and low generating capacity indicates that the Millbrook Dam site is not commercially viable as an electric power supply.

Millbrook at Baxter Creek is currently included in the "List of Waterpower Sites" for the Province of Ontario. The Millbrook site is described as;

- Site reference: 2HJ 19
- Head: 3.7 metres
- Watershed Area: 34 square kilometres
- Power 50% of the time: 4 kilowatt
- Power 95% of time - nil. (i.e. for more than 5% there is not enough flow to generate electricity)

To compare this to modern energy applications, a generating station at Millbrook Dam would produce about $4,000 of energy per year, or 25,000 to 30,000 kWh. It is very interesting to note that what used to be a major source of energy for an industry (i.e. Needler's Mill) would now only supply enough energy for a few houses. In reality, the amount of head available at Millbrook may be considerably less than of that in the "waterpower sites" listing. Under this condition, generating capacity would be reduced proportionately.

1.3.3 Process

The Class E.A. for Remedial Flood Control Works at Millbrook Dam has been completed in accordance with regulatory procedures set out in Conservation Ontario's "*Class Environmental Assessment for Remedial Flood and Erosion Control Projects*" dated January 2002, as amended in September 2009 (Conservation Ontario, 2009). Enabling legislation for the E.A. Regulation as stated in the Conservation Authorities Act, R.SO, 1990 provides the ORCA with the responsibility:

> "to study and investigate the watershed and to determine a program whereby the natural resources of the watershed may be conserved, restored, developed and

managed"…"taking into account the natural unity of the watershed and the interdependence between land and water systems".

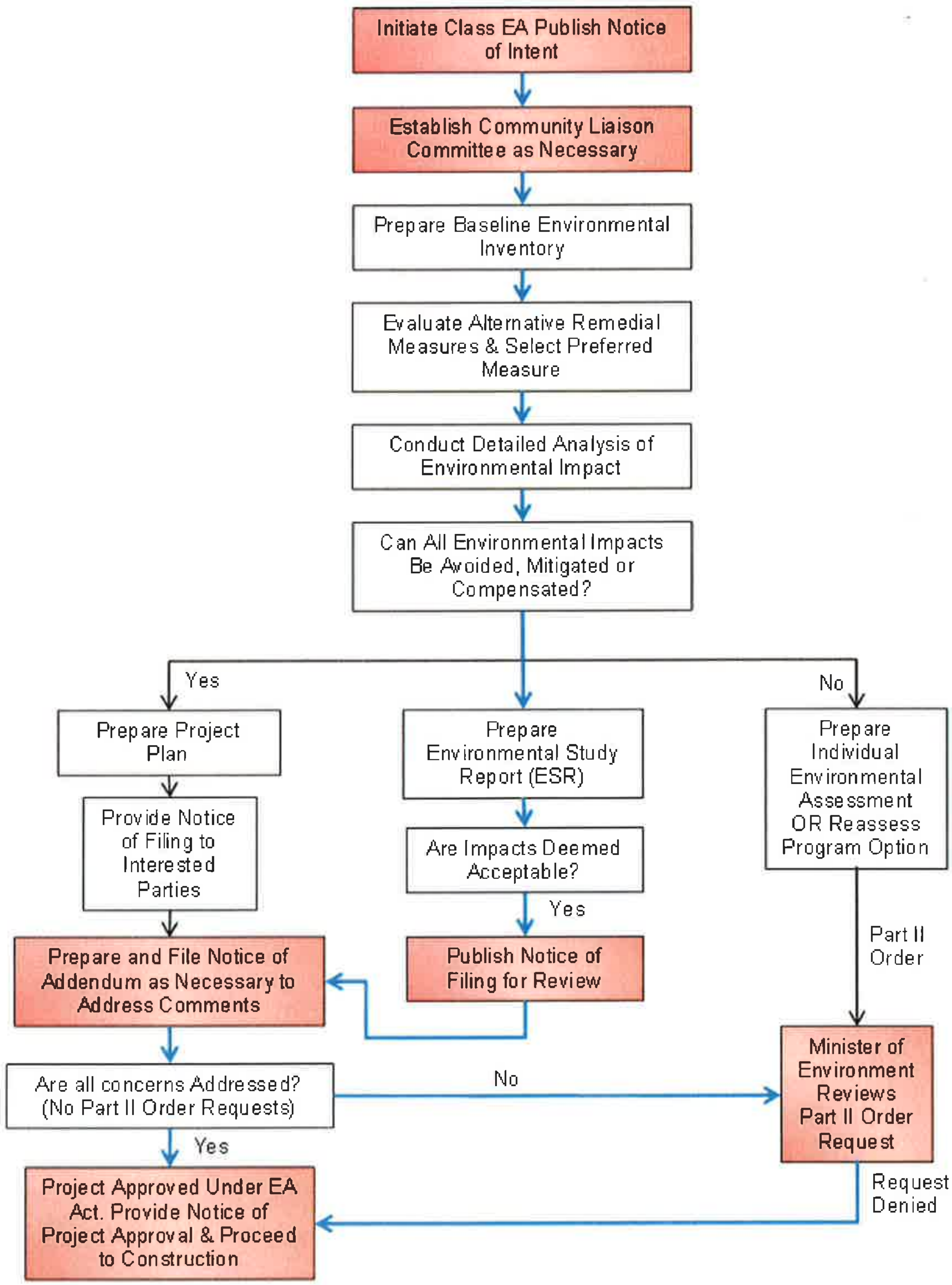
Conservation Ontario (2009) defines remedial flood and erosion control works as "those projects undertaken by Conservation Authorities, which are required to protect human life and property, in previously developed areas, from an impending flood or erosion problem" and, further requires that "remedial flood and erosion control projects are subject to the Class E.A. planning document".

The Millbrook Dam E.A. falls under Conservation Ontario's protective Flood Control Program and is further classified as a "Riverine Flooding" undertaking since it considers increased capacity of a waterway, increased upstream storage, diversion of water and prevention of entry of flood water.

Figure 1-5 shows the Conservation Ontario E.A. process. Following establishment of a Community Liaison Committee (CLC), baseline data containing engineering, social and natural environment components would be assembled and analyzed. Remedial alternatives are then prepared and a preferred measure is selected and, relegated to more detailed environmental evaluation. In the case of the Millbrook Dam E.A., an Environmental Study Report (ESR) is required since "negative impacts will occur, and trade-offs must be made, in choosing among optional methods of carrying out the prepared remedial work". The final ESR documents the process, the study findings and the proposed remedial solution.

Public consultation is a cornerstone of the E.A. process and has proven both important and invaluable to the Millbrook Dam E.A. In brief, the E.A. Regulation requires publishing two mandatory notifications and requires that the public be allowed the opportunity to comment on the draft ESR. Should individuals disagree with the content of the ESR or the study process, persons may request a Part II Order. A Part II Order comprises of a written submission to the Ministry of the Environment stating valid planning objections and, requesting a review of those objections. Although EAs are typically approved by a Conservation Authority's Board of Directors, a Part II Order request transfers the approval responsibility to the Minister of the Environment who renders a final decision on acceptance, rejection or modification of the EA.

The ORCA intends to complete the current E.A then, complete a peer-review of the HPC, IDF, and headpond water level elevation and depth, and subsequently, proceed to detailed engineering design.



Legend

Public Contact Point

Millbrook Dam E.A. Procedure

Source: Conservation Ontario (2009)

Client: OTONABEE CONSERVATION

Title: Environmental Assessment Process

Prepared by: MMM GROUP

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Date: May 2013	Figure: 1- 5	
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M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 1-5 Environmental Assessment Process.pdf

2.0 STUDY METHODS

The E.A. was completed in accordance with methods and procedures prescribed by Conservation Ontario (2009) and comprehensively addresses all relevant disciplinary areas. The study focused on preparation of alternative concepts and selection of a preferred concept which would then form the basis for final engineering design. Since several previous engineering studies had been completed and approved by the ORCA, these studies adequately fulfilled the background engineering needs for designs of concepts. Accordingly, past engineering studies were reviewed and used to advantage. New engineering work was not undertaken. All remaining disciplinary studies consisted of field work supported by literature research. Ecology studies addressed both terrestrial and aquatic habitat and involved five field visits during the summer 2012. Field work for geomorphological studies was conducted on June 28, 2012 and considered the headpond as well as the creek reaches above and below the dam. Archaeological field work took place on July 25 and September 6, 2012. General E.A. work and public consultation efforts spanned the duration of study process. Public Consultation played a vital part of the study process and procedures were modified as necessary to address public information needs.

Disciplinary studies were undertaken by the following:

- MMM Group – environmental assessment, environmental planning and public consultation
- ORCA – additional public consultation efforts, First Nations Consultation
- Genivar – engineering review and ecology
- Past Recovery Archaeological Services – archaeology

3.0 SITE DESCRIPTION

3.1 Geology, Physiography and Soils

Bedrock in the study area lies at depth and consists of Ordovician-aged limestone of the Trenton-Black River Group. Calcareous moraine materials having moderate amounts of rock rubble and occasional Precambrian-aged boulders overlay bedrock. In terms of physiography, the site is located on the Peterborough Drumlin Field which is noted for its drumlins and eskers and, lends a rolling or gently undulating aspect to topography. Surficial materials consist of glaciofluvial and glaciolacustrine deposits relating to the Schomberg Ponding era during the Wisconsinan period of glaciation. Surface soils within the study area are dominantly shallow Brighton sands.

3.2 Study Area Features

Figures 1-2 and 3-1 show the study area. The presence of Baxter Creek has been the main determinant of natural and social function in this setting and, flows in a south to north direction, passing through a deteriorating concrete spillway near the Millbrook Dam's east end. The earthen, 190 year-old Millbrook dam crosses the creek valley creating a small roughly-circular headpond. The island in the headpond was built of sediment dredged from the headpond bottom in 1988. Current depth of the headpond is relatively shallow due to continued sediment accumulation and averages an estimated 0.5 m. A cattail-dominated wetland occurs at the upstream end of the headpond. Urban Millbrook occupies the north and west sides of the headpond. Existing development to the north consists mostly of Millbrook's Central Business District along King Street; a large area occupies the community arena and an attendant parking lot. Distillery Street, to the east of Baxter Creek, serves several private residences and terminates at the entrance to the Medd's Mountain Conservation Area which is owned and operated by the ORCA. The Conservation Area contains manicured grassland adjoining the headpond with forested areas to the south. Anne and Prince Streets to the west of the headpond front on private residences, many of which are described as "century homes" and back onto the millpond.

The historic Needler's Mill is located near the centre of the dam and is connected to the headpond by a penstock through which waterpower was obtained for grist and lumber milling operations. The penstock is fed through a concrete intake structure in the upstream face of the dam. Neither the mill nor the penstock is operational.

A walking path crosses the dam crest and is carried over the spillway by a steel pedestrian bridge connecting Anne Street, Distillery Street and the Medd's Mountain Conservation Area. A wooden stairway, adjacent to west side of Needler's Mill connects the walking path to the arena parking lot.

Medd's Mountain Conservation Area (Looking South)

Headpond (Looking South)

Sediment Accumulation (Upper Headpond) (Looking South)

Needler's Mill (East side)

Upstream Wetland

Plunge Pool and Island Below Spillway (Looking North)

Client:	**OTONABEE CONSERVATION**
Title:	**Study Area Features**
Prepared by:	MMM GROUP

14.12216.001.P01	Scale as Shown	Review: JB
Date: May 2013	**Figure: 3 - 1**	

A small island is located in Baxter Creek immediately below the spillway and is connected to the west bank by a wooden pedestrian bridge.

3.3 Dam Features

3.3.1 The Dam Structure

Figures 3-2 and 3-3 present a schematic drawing and selected photos of the Millbrook Dam. The dam has been constructed across Baxter Creek which flows northward from the headpond through the eastern end of the dam. Needler's Mill is partially built into the downstream face of the dam near its centre point. A parking lot and the community arena adjoin the north side of the dam. The dam structures consist of:

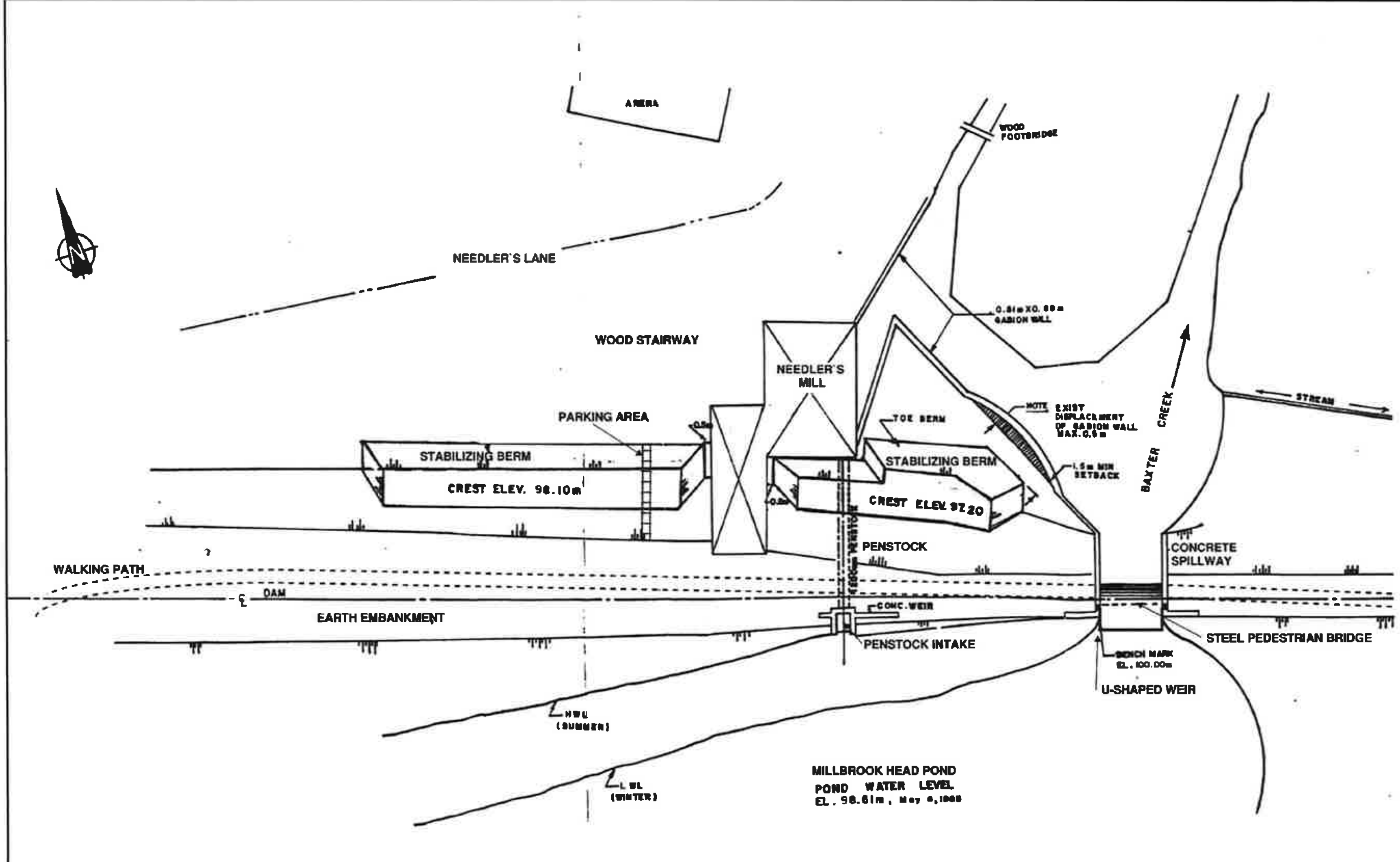
- A primary 120 m long earthen embankment
- A deteriorating 7 m wide concrete spillway near the eastern end of the embankment
- A U-shaped, overflow weir constructed of timber and steel sheet pile and, connected to the upstream side of the spillway. Total weir length is 15.8m (4.4 +7.0 +4.4). The weir is inoperable, controls outflow from the headpond and, stands approximately 1.5m in height
- A concrete penstock intake which formerly directed and conveyed headpond water to a 1.2m diameter penstock serving the historic operations of Needler's Mill
- A steel pedestrian bridge spanning the concrete spillway
- Two earth stabilizing berms along the rear face of the dam on either side of Needler's Mill.

3.3.2 History of the Dam

The following historical narrative has been largely derived from ORCA (2011).

The Millbrook Dam was originally constructed in 1822-24 for the sole purpose of providing waterpower to an adjacent mill. Its internal construction was of timber cribbing filled with locally-derived earth materials. Surficial materials for the side slopes and crest also consisted of local earth. The dam contains a concrete intake structure feeding the mill penstock and turbine. The east end of the dam once contained a cedar plank outlet structure which was washed out in the Spring of 1948. Mid-summer of that year saw the construction of the concrete spillway in its current location. Flow control at that time was provided by stop logs. Operating capability allowed the headpond surface to be held at approximately 1.3m and 2.8 m below the dam crest summer and winter respectively.

The Millbrook Dam is known to have over-topped to a depth of approximately 0.25 metres in 1936 and again in a 1980 flood event. The last overtopping event, demonstrated that it was not possible to manually operate stop logs or gates in a timely manner given the rapid rise in flows that sometimes accompany rain events. Subsequent to this last over-topping event it was recommended that the dam outlet be modified to eliminate stop log operations in order to increase conveyance of flow for the purpose of minimizing spill and risk of dam breach.



Source: Adapted From Acres (2004)

Client:	**OTONABEE CONSERVATION**
Title:	**Millbrook Dam Site Plan**
Prepared by:	MMM GROUP
14.12216.001.P01	Not To Scale / Review: JB
Date: May 2013	**Figure: 3 - 2**
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M:\Jobs\2012\14.12216.001.P01 – Millbrook Dam EA\GIS\Documents\Figure 3-2 Millbrook Dam (Schematic).pdf

U-Shaped (Overflow) Weir (Looking East)

Spillway (Looking Southwest)

Steel Pedestrian Bridge (Looking East)

Penstock Intake (To Needler's Mill) (Looking East)

Upstream Dam Face (Looking Northwest)

Stabilizing Berm (Looking East)

M:\Jobs\2012\14.12216.001.P01 – Millbrook Dam EA\GIS\Documents\Figure 3-3 Dam Features

Client:	**OTONABEE CONSERVATION**
Title:	**Dam Features**
Prepared by:	MMM GROUP
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	**Figure: 3 - 3**
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Stabilizing berms (Figure 3-2) were added to reinforce the embankment in 1989 and a U-shaped, 15.8 m-long overflow weir was built, thereby eliminating the need for stop logs (Acres, 2004).

4.0 PREVIOUS STUDIES

Background information and recommendations in previous engineering and public consultation studies specifically oriented toward the Millbrook dam, contain a wealth of good quality information. Selected parts of these materials have been used during the decision-making process for this E.A. The four studies discussed below address major issues.

i) **Millbrook Dam Classification, Safety Inspection and Review, (Acres International, April 2004)**

This study was commissioned by the ORCA to determine the structural condition of the existing dam by;

- A structural inspection of concrete elements of the spillway, and,
- Investigating earthen parts of the dam for piping, seepage, heaving, settlement and, slope movement

In addition, a preliminary hazard classification for Millbrook Dam was completed to address the consequences of dam failure.

The following conclusions were stated:

Previous Investigations— indicate that - "the embankment had been constructed of silty clay and organic silt fill, underlain by the layers of peat and granular soils over varved clay". The fact that the peat had not been removed prior to construction raises concern for stability due to decomposition and settlement of organics. Similarly, the presence of granular soils may suggest a seepage pathway beneath the dam.

Rock Foundation Properties— The "dam seems not to be founded on underlying limestone bedrock"

Concrete Structures (wingwalls, spillways, apron, etc) - the following were noted:

- Abutments - signs of concrete deterioration on the east and west abutments
- Spillway - erosion and deterioration of the base slab, movement of the east downstream portion of the concrete wall and concrete recessed weir

Seepage and Uplift— "seepage or settlement were not observed"... "displacement was noted and previous observations and studies indicate that seepage is occurring at the concrete wall/embankment fill interface". Snow and ice covered conditions existed at the time of the site inspection potentially affecting ground surface visibility.

Preliminary Dam Classification Studies indicated that: - "In the past, a 25 year flood event overtopped the embankment. It is, therefore, expected that under higher magnitude floods the dam would be overtopped as well. This could lead to erosion of the crest and failure of the embankment. The impounded water released from the dam could cause incremental damages to the bridges and properties downstream and loss of life could be expected".

Hydrotechnical Aspects— "It is expected that a flood of a greater magnitude than the 25-yr flood will flood the downtown core of Millbrook, and the failure of the embankment dam could exacerbate the extent of the damage."

Acres (2004) concluded that on the basis of preliminary study, the dam should be classified as a **high hazard** structure since in the event of failure:

- Loss of life may be expected, as well as
- "Flood damages to downstream Millbrook
- Damage to downstream bridges
- Release of sediment
- Impact on cold water fisheries"

Acres (2004) further recommended:

- Concrete repairs to the spillway
- Additional seepage investigations
- A dam stability assessment
- Confirmation of the preliminary hazard classification by hydrologic and hydraulic studies, dam breach modelling and a full dam safety assessment
- Provision of warning signage and placement of an upstream safety boom

ii) Consolidated Geotechnical Investigation Report, Millbrook Dam, Millbrook Ontario (Geologic Inc, March, 2007)

This "consolidated" report sought to draw together three previous geotechnical studies undertaken during the 2000 and 2007 period, and to provide new information generated by a 2006 investigation. The purpose of the report was; "to define the subsurface soil and groundwater conditions at the Dam, provide geotechnical engineering conclusions relevant to the subsurface conditions, provide an opinion as to the present and future stability of the Dam, and provide recommendations regarding rehabilitation and monitoring of the Dam."

The new 2006 work involved advancing two new exploratory boreholes, groundwater level recording and dye testing for seepage at the spillway structure.

Geologic (2007) provides the following observations and conclusions:

Surface Conditions - "Zones of water seepage have been observed for some time near the base of the Dam's walls, most noticeably on the east side at the bottom of the Dam (beneath existing armour stone steps)".

The Geologic (2006) investigations indicate that:

- "Seepage is occurring on either side of the concrete weir structure;"
- Signs of past seepage were observed on both walls of the weir " (spillway) "structure"
- Displacement has occurred between the sheet piling wall and the (overflow) "weir"
- Water is flowing under the top concrete slab forming the base of the spillway

Subsurface Conditions - groundwater was encountered at boreholes advanced in the immediate vicinity of the spillway

Groundwater Levels - groundwater levels were reported to be within the internal mass of the **embankment section**, suggesting zones of potential weakness. Groundwater levels adjacent to the spillway section were reported to be at approximately the elevation of the bottom of the abutments and, above the elevation of the sloped part of the spillway. At the foot of the spillway, seepage was noted at approximately 0.9m above the level of the downstream Baxter Creek water surface.

Dye testing - was completed during the October 30 to December 21 period in 2006.

> "Dye tests conducted under normal/existing conditions indicated that water leakage occurs both through cracks/fissures in the concrete, and around the Dam [spillway] itself. The leaking water then reappears in various locations: either back into the spillway area through openings in the walls and base of the Dam, or at the toe of the Dam (most evident as observed turbulence at the base of the east armour stone steps)".

On December 31, 2006, distinct evidence of seepage at the south east side of the overflow weir was observed in the form of "vortex that extended from the pond's surface down approximately 0.3 to 0.4m to the bottom of the pond at this location"

> "While monitoring the outflow leakage (ie., turbulent area) in the lower pond at the base of the armour stone steps, green dye was distinctly observed exiting this outflow"... "dye was observed entering the spillway via the apron (including some upwelling)". Seepage beneath the spillway was clearly occurring.

The consolidated geotechnical report concludes that:

> " Past monitoring activities have identified seepage zones on either side of the spillway, with strong seepage flows observed at the toe of the embankment on the eastern side of the spillway."
> " Based on the conditions observed to date, this leakage zone may be in the form of 'piping' around/below the Dam's concrete components, and through its earthen embankment below the existing armour stone steps".

Geologic (2007) recommended:

- Continued monitoring of groundwater and, headpond and tail-water levels by the ORCA
- Consideration of more formal monitoring and,
- The completion of a dam safety review in order to target and prioritize critical areas for remedial action

iii) Millbrook Dam, Hydrotechnical, Dam Classification Study, Dam Safety Review, Feasibility Assessment (IBI Group, November 6, 2008)

The purpose of this engineering study was basically to build on Acres (2004) and finalize the hazard classification of the Millbrook Dam using modelling techniques required by the 1999 Draft Ontario Dam Safety Guidelines as stipulated by MNR's Lakes and Rivers Improvement Act (LRIA).

The study included a site inspection, confirmation of elevations by survey methods and, dam breach modelling. Field observation noted continued seepage from the spillway and, elevation surveys showed that the dam crest had settled by approximately 0.5 m. The most likely mode of failure was noted as overtopping of the east embankment adjacent to spillway and, spillway failure, followed by rapid erosion of the adjacent embankments.

The hydrotechnical analysis concluded that;

- The flow to be used for design purposes (Inflow Design Flow or "IDF") is 100 cms. In order to safely pass this flow, an increase in spillway capacity of more than three times is required.
- Conveyance capacity of the existing spillway is 27cms. The dam will overtop at flows exceeding this rate and with sufficient volume to fill the headpond.

IBI (2008) confirmed that the "high hazard" classification was warranted for the Millbrook Dam and recommended increasing the hydraulic capacity of the spillway to convey the 100 cms flow.

Further analysis of the subject report indicates that in order to provide the required 100 cms capacity for dam safety, the crest of a replacement dam cannot exceed an approximate elevation 214.6m, which is approximately 0.5m lower than the existing headpond elevations. As well, sediment removal from the headpond bottom is needed to provide acceptable headpond depth. Four remedial options were proposed by IBI; one involving dam removal and three involving dam replacement. The dam replacement options are not considered separate options, but, simply different methods of increasing spillway capacity and achieving the same result. Appendix A illustrates the four IBI options and shows the headpond levels used in each option. All options would satisfy dam safety requirements.

iv) Independent Public Facilitator's Final Report- Ogilvie, Ogilvie and Company (Ogilvie, 2009)

This study was commissioned "to begin community engagement in advance of the E.A process".

The general purposes of the subject engagement were to:

- "provide an opportunity[ies] for the community to understand the current state of the Millbrook Dam structure (and Needler's Mill), including the deficiencies identified.
- Provide an opportunity[ies] for the community to review the four improvement options recommended for the Millbrook Dam" (ie.- the IBI (2008) options) "and the future of Needler's Mill"

Relevant information regarding the Millbrook Dam follows while details regarding Needler's Mill are discussed in later sections of this report.

The comprehensive engagement process involved the following:

- Drop-in Center and Outreach- September 14-18, 2009
- Soundings Report-September 29, 2009
- Repositories for Consultant's Reports- October 2, 2009
- Recruitment of Community Working Group (CWG)-October 2-8, 2009
- Special Website Went "On line"- October 10, 2009
- Three Community Working Group (CWG) sessions – October 13 and 27, and November 24, 2009
- Community Charrette on Options- November 7, 2009
- Final Report- December, 2009

- Presentations to the Council of the Township of Cavan Monaghan and the Board of Directors of the ORCA

An important part of the consultation process involved discussion of remedial options previously set out by IBI (2008). Recognizing again that these options consisted basically of dam removal and, three variations of dam replacement, dam replacement was preferred (IBI Option C) as the most desirable course of action by the Community Working Group (CWG) for the facilitation project.

IBI Option C as presented during the consultation process involved:

- Replacement of the dam with a much larger weir (37m) in comparison to the 7.2m existing spillway opening
- Maintenance of the headpond. Note that the headpond level cannot be maintained at existing level of 215.1m (IBI, 2008).
- Provision of "pedestrian access... with a bridge downstream"
- The new weir would be lined with armour stone.

Additional design suggestions included:

- Reducing the length of the new weir by as much as possible for example by, utilizing a serpentine weir to maximize overflow capability or, by utilizing a curved weir.
- The continued siltation of headpond must be addressed
- "Naturalize" the dam by landscaping means
- Consider placing a new pedestrian bridge over the new weir

Other opinions of participants in the Ogilvie (2009) study suggested that:

- The dam is directly linked to the history of the village and should be considered "in tandem with the environment"
- No IBI options are acceptable
- Waterpower potential of the site should be considered

Ogilvie (2009) concludes that:

> "the residents were very clear and with the exception of a small few, were united in their opinions that:
>
> - the dam and the pond is significant to them
> - the dam and pond is an integral part of the village
> - the dam should remain where it is and be repaired
> - Needler's Mill is equally significant to the residents
> - the mill and the dam are inextricably intertwined
> - the mill should remain where it is
> - the mill should be used for a variety of purposes, whichever is most feasible

The results of the Soundings meant that the IBI Option of "removing the dam" should be taken off the table".

The E.A. study team concludes that although Option C (dam replacement) appeared to be selected by the CWG, equally strong feelings appear to have been expressed for repairing the existing spillway. It is not clear from the study if a conclusive preference was expressed.

Ogilvie (2009) recommendations directly pertinent to the Millbrook Dam are summarized as follows:

- "ORCA and the Township should make a public commitment to solving the problems of the dam and restoring the mill in a manner that protects and enhances the heritage aspects for future generations
- Continue this open, transparent and engaging approach to involving the community in all subsequent discussions and decisions in the dam and the mill before they are made
- The Conservation Authority should proceed immediately with an Environmental Assessment of the options for improving the safety and operation of the dam"
- Keep the CWG operating and recognize the CWG as one of the primary reference organizations that should be involved in all future discussions and actions regarding the Millbrook Dam and Needler's Mill
- The residents of the community (i.e. - the CWG) should explore the possibility of establishing a community trust entity as a vehicle for the long-term visions for the dam and the mill."

v) Sediment Studies by ORCA Staff

In the event that retention of the headpond is selected as part of the preferred solution, excavation and removal of headpond sediments will be required. Previous dredging of sediments took place in 1988, at which time excavated sediments were used to create the island in the headpond. Sediment quantity and quality have been studied by the ORCA. Headpond depth and sediment volume studies are described in an ORCA Engineering Memo dated November 14, 2009. Based on field investigation at 12 stations in the headpond, ORCA staff report that:

> "Records indicate that rapid sediment material accumulation in the headpond has been experienced. Based on the data obtained during the field investigation survey, calculated results indicate that there is approximately 11,000 m^3 of material currently settled within the Millbrook pond basin. Depths of measured sediment accumulations ranged from 0.7-1.65 metres. Water depths in some locations were found to be less than 0.3 metres."

Mean sediment depth was calculated at 0.91m.

The "natural pond bottom" elevation was found to be variable, ranging from approximate elevation of 212.8m to 213.9m, a variation of 1.1m. Headpond water depth at the time of the survey varied from 1.4 to 0.3m.

During November, 2009, ORCA staff collected one core sample of reservoir sediment which was then subjected to laboratory analysis. Results were compared to the MOE's Soil, Groundwater and Sediment Standards dated March 9, 2004. Findings indicated that "all parameters tested met the above-referenced MOE criteria".

4.1 Dam Deficiencies Summarized

Previous assessments, investigations and inspections of the dam have revealed various problems with the structure including, but not limited to, the following:

- movement of the left-side face of the recessed overflow weir wall
- seepage through the construction joints of the concrete base pad of the recessed weir and concrete chute spillway
- seepage at the base of the earth embankments, at the interface of the earth embankment and the sidewalls of the concrete chute spillway
- movement of water through the embankment leading to development of a sinkhole along the crest of the dam
- inadequate factors of safety to prevent the embankment from sliding and failing
- inadequate spillway capacity to prevent the dam from overtopping
- lack of public and boater safety features (e.g. warning signs, restrictive barriers, etc.)

Clearly, the concrete spillway is well beyond its useful life and, repair or replacement is warranted. Given its age, the earthen embankment would not conform to current (legislated) dam safety requirements. The presence of peat and granular materials potentially allowing settlement and seepage beneath the structure requires attention.

5.0 COMMUNITY ATTITUDES

5.1 Social Significance of the Study Area

The varied and colourful history of the Village of Millbrook, as demonstrated by the many remaining architectural examples of that history, is a most cherished possession of Millbrook residents. Village history is the basis for extremely strong feelings of "place" and "community".

While community "inspiration" may be the result of its long history, the Millbrook Dam, its headpond and the Medd's Mountain Conservation Area provide the physical setting for community activities that are vital to the social life of today's village residents. The study area (and nearby King Street) has been the social and commercial focus of the village since construction of the dam and mill some 200 years ago. It is from the dam site that the village draws its name. The historic architecture of the village as documented in "*Significant Architecture of Millbrook*" (published by the Millbrook and Cavan Historical Society, 2007) demonstrates a strong bond between village residents and local history, as well as community pride.

5.2 Needler's Mill

Although not formally designated as a "Historic Building" by the Ministry of Tourism, Culture and Sport, Needler's Mill is a vital part of community identity.

Community thoughts on Needler's Mill were documented by Ogilvie (2009) as follows:

- the dam and millpond are inextricably linked
- four options for future use of the mill were discussed namely,
    - preservation and renewal of the building
    - use as a "passive" museum
    - use as a "working" museum and,
    - integration into contemporary life as a restaurant or retail store

The "preserve and renew" option was selected as the most desirable so that "the mill is not lost or relocated from its current site next to the Dam".

Although Ogilvie (2009) recommendations involving the dam were presented earlier, those pertaining primarily to the mill were as follows:

- "Conduct both a formal Heritage Assessment (already being organized by Historical Society) and a Restoration Engineering Assessment during the first half of 2010. The details of proceeding will be subject to the success of securing funding from various sources such as the Cultural Heritage Program, the Rural Economic Development Program and other provincial and federal granting programs "

- At present, Needler's Mill is not open for public viewing and is reported to be in an unsafe condition. The Mill is not operational.

5.3 Social Functions Of The Study Area

The current social functions enabled jointly by the dam, the millpond, Needler's Mill and Medd's Mountain Conservation Area (Figure 5 -1) are extremely important to Millbrook residents both inherently and functionally, within the context of the nearby surroundings.

- Recreational use- there are two major forms of **organized recreation** available in the study area. The Medd's Mountain Conservation Area adjoining the east side of the headpond is owned by the ORCA. It contains grassed and forest areas easily accessible and available to the public on a year-round basis. It also, provides or has access to five walking and hiking trails which extend more than 3000m southwards and collectively have a total length of 8 km. The trail system is managed and maintained by the Township with assistance from the Millbrook Valley Trails Association. The ORCA reports that the trail system is generally well used. **Passive recreation** within the study area is a very important activity and is facilitated by a walking path along the dam crest, and pedestrian access to the headpond shoreline. The headpond is used for canoeing and fishing during summer and, skating/hockey in winter. Private picnicking is a frequent occurrence in the Conservation Area and at the island below the dam. The aesthetics of the area are inherently appealing, containing views of open water, forest, wetland and historic structures. Bird and wildlife viewing is a constant benefit to users. Residents report that aesthetics lend a general feeling of well-being to the viewers and are a valued characteristic of the study area. Residents along Prince, Anne and Distillery Streets consider the headpond viewscape an important visual asset.

- Community Gathering Function- easy pedestrian and vehicular access to the dam, the headpond, the mill and the Conservation Area make the study area a favourite location for community gatherings. The area hosts a number of social events including an annual fish derby organized by the local Lions Club, as well as concerts, festivals and private gatherings.

- Commercial Use – the mill, dam and headpond lie immediately adjacent to Millbrook's Central Business District (CBD) along King Street. Ongoing planning for the CBD involves a need to increase visitation by tourists as a necessary input to the village economy. The historic appeal, aesthetics and recreational opportunities offered by the dam/mill/headpond complex are viewed as a valuable part of tourist attraction and are consequently a valuable contribution to the local economy. The CLC committee reports that plans to return the headpond to a condition suitable for events such as Canada Day Celebrations are being contemplated. The Millbrook Historical Society has released marketing materials highlighting a walking tour of historic Millbrook with the dam and mill as two major points of interest. It is very

Medd's Mountain Conservation Area

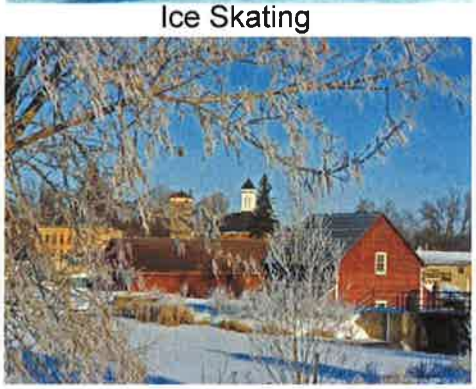
Annual Fishing Derby

Hiking/Walking Trail System

Wildlife Viewing

Ice Skating

Walking Path on Damcrest



History/Aesthetics - Needler's Mill

Community Gatherings

Client: **OTONABEE CONSERVATION**		
Title: **Social Values**		
Prepared by: MMM GROUP		
14.12216.001.P01	Scale as Shown	Review: JB
Date: May 2013	**Figure: 5-1**	
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M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 5-1 Social Values. pdf important to note that rehabilitation and revitalization of the dam and its associated structures are viewed as central to the future commercial viability of the village.

- Various sources indicate significant and long term input of effort by private individuals to build pavilions, repair Needler's Mill, organize boat races, and conduct tours of the Mill. Consequently, the strong bond and kinship of village residents to the study area has been earned in part by "sweat equity" and is entirely understandable.

5.4 Contributions of the Community Liaison Committee

At the first CLC meeting, all committee members were asked to voice their interests in the study area. Interests stated were on behalf of the organizations that each member represented and often included personal thoughts. The following is drawn from minutes of the subject meeting and confirms the strongly interconnected organizational and personal views of CLC members.

Peterborough Field Naturalists

- Interests in the flora and fauna

Lion's club

- Each year, the Lion's Club introduces 300 fish into the millpond in support of the Lion's Club fishing derby – headpond retention would preserve this annual activity
- Lion's Club also has interest in preserving the historical aspects of the community, including the Needler's Mill building, and therefore, are willing to fundraise toward doing this

Kawartha Heritage Conservancy (KHC)

- KHC is involved in establishing land trusts and in obtaining conservation easements
- KHC has broad interests in both the natural and historical landscapes
- KHC has encouraged local people to do something with the Mill building

Adjoining Property Owner (several property owners were CLC members)

- An owner of property adjoining the pond for many years, considers himself fortunate to live next to the millpond
- Interest is to see the pond preserved, and if possible recreate pond to its original size and configuration using historical photos as a guide
- Home overlooks pond – pond and associated aesthetic beauty was major attractor to him and his family moving to Millbrook.
- The pond and adjoining Medd's Mountain CA were the reason that he and his family bought their home where they did

Millbrook Valley Trails and Old Millbrook School Family Centre

- Pond provides premium educational opportunity for children (species identification, etc.)
- Exposure to nature seen as important to children's development
- Uniqueness of trails, pond, etc. has a positive economic impact on the community as it is an attractor that brings new families to the community

Business Improvement Association (BIA)

- The cultural mapping project identified both the mill and the pond as cultural assets
- Needler's Mill and the millpond are together a "monumental piece of who we are" -the identity, the "brand". The mill, pond and a dam date from 1820: "It's obvious it's part of our heritage".
- The pond, the dam and the mill attract a level of tourism which supports local businesses.
- A downtown revitalization plan is currently underway which includes the mill and the pond as assets and destinations.
- Consideration is being given to creating a Heritage District encompassing the downtown and including Needler's Mill and the millpond
- The BIA supports the vision of developing the pond for recreational pursuits that would increase tourism
- The BIA expects the dam to adequately protect the downtown

Cavan and Millbrook Historical Society

- Interest is in seeing Needler's Mill preserved and sawmill restored
- There has been a mill on this site since 1820, and at one time there were 9 mills in the area - now, Needler's Mill is the only one remaining
- Dam and millpond are an integral part of the Needler's Mill, and therefore, need to preserve the dam and millpond along with the Needler's Mill
- Maintain reservoir size and levels to keep open possibility of one day again operating mill

Millbrook Valley Trails

- Pond is Millbrook Valley Trails trailhead
- Values the natural setting and sound of flowing water that the pond and dam provide

Needler's Mill Committee

- Mill building, dam structure and reservoir / pond are at one with each other
- Provides educational opportunities - as SSFC instructor, took SSFC students to the site of the dam and pond

Millbrook Community Resident

- Suggested the possibility of hydro power generation
- Suggested removal of the island as part of pond rehabilitation

Municipality of Cavan Monaghan

- Alternatives must consider the pond as well as the dam
- Concerned about costs and "affordability" of some options
- Siltation of the headpond is an issue - have to deal with this as it relates to fish, fish habitat and recreation
- Dam is a barrier to fish movement

The contribution of the CLC is perhaps best summarized in correspondence of February 13, 2013 from the BIA to the ORCA which states that:

- "the BIA supports an option that best maintains the current status of the pond, as well as pond elevation where possible
- the BIA supports an option that maintains Needlers Mill and current historical value of the area in addition to any benefit to viewscape created
- the BIA supports an option that maintains current ecological values. Green space and fishing opportunities drive visitors to the region therefore, ecology and habitat of the region must not be impacted"

6.0 ENGINEERING REVIEW

6.1 Watershed Description

The Millbrook Dam is located in the Baxter Creek sub-watershed, which is one of 12 sub-watersheds of the Otonabee River Watershed. Baxter Creek is a cold water stream that rises in the Oak Ridges Moraine and flows through Millbrook Village. The Baxter Creek sub-watershed lies in what was once the location of glacial Lake Peterborough. This physiographic history has resulted in an area that is flat, and contains the clays once deposited on the lake bottom. The Millbrook area is composed of a variety of land covers, including forests, wetlands, meadows, and surface water. The forests in the area include spruce, cedar and red pine. The Baxter Creek sub-watershed also contains wetlands, some of which are provincially significant.

6.2 Hydrology and Hydraulics

The Millbrook Dam is located on Baxter Creek which drains an area of 34 square kilometres of generally rolling terrain with a combination of forest and farmlands. The headpond area is approximately 3 hectares. Previous studies of the site have established preliminary design criteria which were used for evaluation of the existing dam and design of new improvements.

The existing discharge capacity through the spillway is 27 cubic metres per second which is much less than criteria normally used for design of structures along a water course. The Ministry of Natural Resources *Lakes and Rivers Improvement Act* (LRIA) typically requires a design flow of the 1:100-year (52cms) to the Regional Flow (181cms) for a water control structure. Table 6-1 provides design storm flows for the Millbrook site . The Millbrook Dam outflow capacity of 27 cms, which is between the 1:25 and 1:50 return period flow rate, is clearly deficient.

Floodplain mapping of Baxter Creek was prepared for ORCA in 1987. This mapping shows that the large area of central Millbrook is within the regulatory "floodplain". According to ORCA records, the limits of the regulatory floodplain are based on the Regional storm flow. That is, the regulatory floodplain is based on the limit of flooding expected if the Timmins storm were to occur over Baxter Creek. To give a measure of comparison for storage volume, the millpond would fill to overtopping in less than ten minutes at the Regional flow (181cms) indicating a very small storage capacity which is not useful in detaining major flows.

Improvements in flow capacity can be achieved by constructing a wider and deeper spillway, or by the installation of gates. For the Millbrook Dam, the installation of gates is viewed as impractical since rainfall events occur very quickly and there is no time to operate the gates. MNR guidelines for floodplain delineation preclude the use of gates for small watersheds.

The key hydraulic issues for this E.A. are:

- The developed area downstream of the dam is in the floodplain, so residents would continue to be exposed to breach flows released from the dam.

Table 6-1 Instantaneous Peak Flows

Baxter Creek – Downstream at Millbrook Pond

Design Storm (yr)	Flow (cms)
1:5	9
1:10	15
1.25	22
1:50	38
1:100	52
Regional	181

- The dam discharge capacity of 27cms is too low, and may result in dam failure which would worsen flood effects.

6.3 IBI Study Findings

By regulation, a dam is required to meet a minimum capacity for "Dam Safety" which considers the potential downstream damage if the dam fails. Dam Safety procedures are uniquely different from design standards, such as the Building Code. For example, the Building Code prescribes specific loads for snow and rain to protect occupants from collapse of the building. In contrast, Dam Safety Review methods require evaluation of a **range** of loadings resulting in the selection of an Inflow Design Flood (IDF) based on the hazard to downstream occupants. The Millbrook Dam was classified as a High Hazard dam in 2008, using the 1999 LRIA criteria which were applicable at that time and considers the potential loss of life. Present Dam Safety legislation contains similar criteria for assessment and selection of the IDF.

Since the developed area of Millbrook is downstream of the dam, dam failure or "breach" would increase flows and potentially increase flooded area and depth. This **potential** increase in flows and resulting **hazard** to residents, property and infrastructure is used to select an IDF which is in turn used to determine spillway size/capacity.

The conditions for this IDF selection can be understood by considering the nearby Otonabee River. The river rises to "flood" levels routinely during the spring. At some dams, the water level rises both upstream and downstream. The "drop" at the dam during a flood event may be only half what it is in summer. If a dam was to fail when the area was already flooded there is not as much damage as there might be if a dam failed in dry conditions when people are using the waterway.

Two dam breach scenarios are normally considered in dam safety modelling – a "Flood" breach and a "Sunny Day" breach. The "Sunny Day" breach is associated with seismic events such as earthquakes during low water periods and as such, does not bear directly on remedial design in that it would not affect the hydraulic capacity of its spillway. Hydraulic capacity and design flow conveyance through the spillway is determined by hydraulics at high flows.

Accordingly, previous studies by IBI Group considered a range of flow conditions from very high flows (snowmelt and/or rain events) to low flows that occur during dry conditions. First, the study estimated breach flows and determined that failure during the most extreme design (the Probable Maximum Flood) was excessively high and did not result in incremental flood damages or potential loss of life. It was concluded that detailed analysis was required, to look at successively smaller flows until the flood due to the breach resulted in significant increase in hazard to people. The study concluded that 100 cubic metres per second (i.e. – the IDF) was required to be passed through the spillway.; approximately **four times the current spillway capacity of 27cms**.

Key study conclusions were:

- the Dam is confirmed as a high hazard structure.
- The existing discharge capacity is not adequate for life safety.

The changes required to meet dam safety criteria included combinations of the following:

- Increasing spillway discharge capacity to the required 100 cms. This can be accomplished with a wider and deeper spillway.
- Reducing the height and volume of water held back by the dam to lower the hazard class.

7.0 ARCHAEOLOGY STUDIES

7.1 Stage 1 Archaeological Assessment

As required by Conservation Ontario (2009) and the Ministry of Culture, Tourism and Sport (MCTS) a Stage 1 archaeological study has been conducted for the Millbrook Dam E.A. Past Recovery Archaeological Services was retained by MMM Group Limited to undertake Stage 1 Archaeological Assessment for that purpose. The purpose of the Stage 1 assessment was to determine whether or not the study area, or portions thereof, exhibit potential for the presence of significant archaeological resources and to make recommendations to address archaeological concerns either prior to the initiation of or during the planned remediation work. Stage 1 studies consisted of a careful review of previous research and field studies conducted on July 25 and September 6, 2012 to obtain first-hand knowledge of the topographic and current property conditions. Weather conditions were excellent during the site inspections, and clear skies provided good visibility of the property. The study area was extensively photographed; a complete catalogue has been produced. Major sections of the following have been taken from "Stage 1 Archaeological Assessment for the Proposed Millbrook Dam Remediation", prepared by Past Recovery Archaeological Services in December, 2012 (Past Recovery, 2012). This information was used to aid in the selection of a preferred alternative for the remediation of the Millbrook Dam.

7.2 Cultural Overview

The earliest human occupation of southern Ontario began approximately 11,000 years ago with the arrival of small groups of hunter-gatherers called Palaeo-Indians. These groups gradually moved northward as the glaciers retreated. Very little is known about their lifestyle.

During the succeeding Archaic period (ca. 7000 to 1000 B.C.), populations continued to follow a mobile hunter-gatherer subsistence strategy with a greater reliance on gathered food (e.g. plants and nuts). The tool kit also became increasingly diversified, including the presence of adzes, gouges, end scrapers and other ground stone tools for heavy woodworking activities such as the construction of dug-out canoes. The middle and late portions of the Archaic period saw the development of trading networks spanning the Great Lakes and by 6,000 years ago copper was being mined in the Upper Great Lakes and traded into Southern Ontario. There is increasing evidence of ceremonialism and elaborate burial practices and a wide variety of non-utilitarian items such as gorgets, pipes and 'birdstones' were being manufactured. By the end of the Archaic period populations had increased substantially as seen in the more frequent discovery of Archaic period archaeological sites.

More extensive First Nations settlement of eastern Ontario began during this period, between 5,500 and 4,500 B.C. Artifacts from Archaic sites in eastern Ontario suggest a close relationship to the peoples of New York State. The mid-Archaic period is known for its broad bladed, stone slate projectile points, and heavy ground stone tools as well as extensive use of cold-hammered copper tools.

The introduction of ceramics marked the beginning of the Woodland period (ca. 1000 B.C. to A.D. 1550). Woodland populations continued to participate in an extensive trade network that by A.D. 200, spanned much of North America and included the movement of conch shell, fossilized shark teeth, mica, copper and silver. Social structure appears to have become increasingly complex, with some status differentiation evident in burials. The Middle Woodland period (ca. 300 B.C. to A.D. 900) saw distinctive trends or 'traditions' evolve in different parts of Ontario for the first time, noted through variations in artifacts. The Middle Woodland tradition has become known as 'Point Peninsula'. Through the late fall and winter, small groups would occupy an inland 'family' hunting area. In the spring, these dispersed families would congregate at specific lakeshore sites to fish and hunt in the surrounding forest and socialize. Gatherings would last through to the late summer when large quantities of food would be stored for the approaching winter.

Towards the end of the Woodland period (ca. A.D. 800), domesticated plants were introduced. Initially only a minor addition to the diet, the cultivation of corn, beans, squash, sunflowers and tobacco gained economic importance for Late Woodland peoples. Settlements located adjacent to the corn fields began to take on greater permanency and eventually semi-permanent and permanent villages were established in these areas. The appearance of these villages along the western end of the north shore of Lake Ontario heralded the beginning of the Ontario Iroquois Tradition ca. A.D. 900.

The first Europeans to occupy the area, predominantly French explorers, arrived in the early seventeenth century. This period saw several changes in settlement patterns for aboriginal populations.

The end of the French regime in 1760 brought little change to the area. The Mississauga, who had been allied with the French, established a new alliance with the British which lasted through the American War of Independence. British presence remained sporadic until 1783 when Fort Frontenac was officially re-occupied. The need for land on which to settle refugees of the American Revolution led the British government into hasty negotiations with their Mississauga military allies.

The rapid influx of settlers and the need for more land for the Loyalists led to further negotiations and surrenders of Native land.

In 1788, four administrative districts for Upper Canada and associated land boards were created to facilitate settlement. The first three concessions of Cavan Township were surveyed in 1817, with the remaining concessions completed either later that year or soon thereafter. Cavan Township was described as well settled by 1878, mostly by Irish settlers. In 1850 the population was 4,198, in 1861 4,901, and in 1871 4,761, indicating that by that date many individuals were leaving for newer land.

The Village of Millbrook evolved around a grist and sawmill complex established by John and James Deyell on Lot 12, Concession 4, between 1822 to 1824. In 1846 Millbrook had a population of approximately 250, and included two physicians, the Deyell grist mill and sawmill, a distillery, a tannery, four shops, two taverns, two wagon makers and four blacksmiths. By 1851 the population had risen to about 300. A fire destroyed much of the core of the village in 1875. A description in 1887 notes that the population was approximately 1,300, with prominent buildings being the town hall, two public schools, two banks, a weekly newspaper, Methodist, Episcopal and Presbyterian churches, a flour mill, a sawmill, an oatmeal mill, a woollen mill and a tannery.

7.3 Property History

The patent for the east half of Lot 12, Concession 4, consisting of 100 acres, was granted to James Deyell in 1824. John and James Deyell erected a dam and grist mill between 1822 and 1824 so that grain could be milled locally rather than be sent to Port Hope. The addition of the sawmill was confirmed in the 1827 census and assessment roll.

The 1850 census indicates that by that date the grist mill had been expanded to include two runs of millstones and was producing 1,848 barrels of flour, while the sawmill had cut 50,000 board feet of lumber. The increase in the size of the grist mill may have corresponded to the reconstruction of the original wooden dam, which was renewed in 1850 using local clay and materials from the previous dam. Both the grist mill and the saw mill were destroyed by fire in 1857.

Shortly after, James Deyell sold the mill property to Walker Needler who constructed a large, three storey flour mill at the dam in Millbrook. By 1861 the Tremaine map of Durham County shows that the core of Millbrook was well established. A school or church is illustrated next to the eastern edge of the Lot 12. There was also a cemetery in this location. Thomas Medd purchased 97 acres on the east side of the millpond including a farm.

The flour mill was described in the 1871 census as being worth $10,000, operating for twelve months of the year and employing three men, using waterpower (approximately 40 horse power) to convert wheat and coarse grains to flour, chop and offal. It does not appear that the saw mill had been reconstructed after the 1857 fire. In 1878, most of the property to the east and south of the millpond in Lot 12 was still owned by Thomas Medd. Mapping shows the dam, flour mill and millpond, as well as the Deyell Subdivision lots and the house owned and presumably occupied by Thomas Medd.

An 1878 illustration of the mill, at the time known as 'Needler's Flour Mills,' shows a three-and-one-half storey wooden structure with a peaked roof and six windows. A two storey addition was attached to the western side of the mill and a three bay drive shed stood further to the west. The mill was clearly powered by water, with a flume leading to a turbine attached to the eastern side and the dam and millpond to the south. The one-and-one-half storey Needler residence is shown behind the western edge of the millpond.

Flour production continued through the late nineteenth century and into the twentieth century; until the mill was again destroyed by fire in 1909.

Instead of rebuilding the mill new, Needler decided to remove part of his existing mill at Cedar Valley, and re-erect it at the Millbrook site. This was a much smaller building than the former flour mill, consisting of only two storeys with two windows to the east of an entrance door on the south side. A tubular steel penstock was constructed into the dam to bring water to a single internal turbine. The new mill stones were intended to be used solely for grist. The mill was purchased by Henry Attwooll in 1917. In 1922, Attwooll and his partner Sheppard added a small sawmill to the west side of the Millbrook building. This had a large door to the second floor on the millpond side for drawing in logs to the main saw. Cut timber would have been discharged through the ground floor door on the north side of the structure. The grist mill was later adapted to allow a return to the production of flour, and the business expanded to include the sale of building supplies.

The wooden spillway in the dam was destroyed by a flood in the spring of 1948 and was immediately rebuilt in concrete. Two sheds were added to the site in the 1950s to the west of the mill at the foot of the dam so that coal could be weighed and sold. The sheds remained until 1992, when they were demolished.

Following the death of Attwooll in 1959, the saw mill closed. Sheppard sold the mill to the Otonabee Region Conservation Authority (ORCA) in 1967, but was retained to operate it until his death in 1972. The mill officially closed in 1974, and was leased to a building supply salesman until 1978 when it became vacant. Threatened with demolition, a community group was formed to restore and preserve the building. This work was undertaken over the early 1980s but it unfortunately reduced both the archaeological and historical significance of the mill given both the extent of the reconstruction and the use of modern construction methods and hardware. The spillway was also repaired at this time, necessitating the construction of a large coffer dam. The millpond also appears to have been dredged during this period, creating the 'island' currently visible within it.

The Village of Millbrook purchased the 95 acre former Medd farm property at the south end of Distillery Street. The ORCA bought 71 acres of this property from Millbrook in 1981 to create a public park, which has become Medd's Mountain Conservation Area.

7.4 Archaeological Potential

Archaeological assessment standards established by MTCS (Standards and Guidelines for Consultant Archaeologists, 2011) establish minimum distances to be tested from features indicating archaeological potential. In areas that are considered to have pre-contact site potential and require testing include lands within 300 metres of water sources, wetlands or elevated features in the landscape including former river scarps. Areas of historic archaeological site potential requiring testing include locations within 300 metres of sites of early Euro-Canadian settlement and 100 metres from historic transportation corridors. Further, areas within 300 metres of registered archaeological sites, designated heritage buildings or structures/locations of local historical significance are considered to have archaeological potential and require testing.

The study area is located within close proximity to several features indicative of potential for the presence of archaeological sites related to pre-contact Native settlement and other land uses (Figure 7-1). These landscape features consist of a prominent rise of land located in close proximity to Baxter Creek and its two subsidiary streams, as well as an abundance of sandy, well-drained soils.

Though within the area of immediate concern (ie - the dam, spillway and Needler's Mill) the construction of historic period features would likely have removed pre-contact deposits, the more gently sloped areas surrounding the millpond retain the potential for Native sites, particularly given that there would originally have been a small waterfall or rapids along this part of Baxter Creek, making it attractive as a mill location.

The restoration of Needler's Mill and the dam spillway in the 1980s has reduced the heritage and archaeological value of both structures. The reconstruction of the penstock would also have disturbed the dam in this area, perhaps also the location of the flumes for the earlier mills. It is likely that archaeological remains from the original Deyell mills have been removed by the construction of the later mills; however there is potential that evidence from the late nineteenth century flour mill, constructed after 1857 and destroyed by fire in 1909, remains within the original part of the dam and below the added stabilizing berm and present parking lot, given its much larger size than the current Needler's Mill. Remains from the drive shed dating to this period may also survive. It is also likely that traces of the coal sheds constructed in the 1950s remain below the current parking area to the west of the current Needler's Mill; however given their twentieth century use and demolition in 1992 these are considered to be of low archaeological significance. The dam itself may also contain remains of the original 1820s cribwork below the current earth berm; if so these would be considered archaeologically significant.

The millpond, having been dredged does not retain archaeological potential. Further, the section of Baxter Creek downstream of the dam has been altered with the creation of the 'park' island in 1982 and other likely associated landscaping as well as having its shoreline stabilized more recently with deliberately placed landscaping rocks, thus reducing its archaeological potential. There appears to be at least one level terrace further upstream which may be more natural and thus retains archaeological potential.

Apart from the foot-prints of constructed residences or related infrastructure, or the steeply sloped area at the foot of Prince Street, the private properties along the east side of Distillery Street and in the block of land framed by Anne and Prince Streets should be considered to retain archaeological potential. This would in particular apply to the residences at Nos. 7 and 13 Anne Street and Nos. 6 and 10 Prince Street which have been declared nineteenth century heritage buildings. Several other buildings in the vicinity not on the heritage list were also constructed in the nineteenth century. As noted above, remedial works would not affect these buildings.

LEGEND

- Archaeological potential: Stage 2 shovel testing required
- Deeply buried archaeological potential: Archaeological monitoring required
- No archaeological potential: permanently wet
- No archaeological potential: dredged
- No archaeological potential: steeply sloped
- No archaeological potential: disturbed by construction

Source: Past Recovery Archaeological Services (2012)

Client: **OTONABEE CONSERVATION**		
Title: **Archaeological Potential**		
Prepared by: MMM GROUP		
14.12216.001.P01	Scale as Shown	Review: JB
Date: May 2013	**Figure: 7-1**	
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As stated above, the sections of Medd's Mountain Conservation Area that are not steeply sloped or permanently wet are considered to retain pre-contact archaeological potential. As well, a nineteenth century farmstead was constructed in this area, which may have housed James Deyell and his family. The open areas on the property would have been cleared during this period to create pasture for livestock. Though the farmhouse and main barn survived until at least 1980, when the ORCA purchased the property, and were probably demolished about this time, there is still potential for archaeological deposits related to the nineteenth century occupation of the farmstead to be found on the property, particularly features or artifacts relating to the Deyell or Medd families. The shoreline of the millpond in the immediate vicinity of the dam, however, has been disturbed by the construction of coffer dams during the 1950 and 1980 repairs to the dam spillway.

7.5 Cultural Heritage Sites

A request for a search of all archaeological sites registered with the Provincial Archaeological Site Database maintained in Ontario by the MTCS revealed that there were two identified sites within a one kilometer range of the study area; the Patterson Site (BaGo-15), an indeterminate stone axe found on Lot 14, Concession 4, and the Draper Site (BaGo-19), an indeterminate point found in a garden at No. 6 Anne Street.

Currently there are 45 designated historic buildings located in Millbrook, of which 29 lie in the vicinity of the study area. Only four – 7 Anne Street, 13 Anne Street, 6 Prince Street and 10 Prince Street – actually lie within the study area (Figure 7-2). Needler's Mill is not listed, having been rebuilt with modern materials during early 1980s renovations, though the building has significance to the Millbrook community.

There is also an abandoned cemetery within the study area, which though registered with the Cemeteries Regulation Unit of the Ontario Ministry of Consumer Services is currently unnamed and is marked by a single monument to the Deyell family.

A separate cultural/built heritage study has not been completed in concert with the Millbrook Dam E.A. since:

- Needler's Mill would not be adversely affected by remedial works. In actual fact, the current seepage that damages the mill's foundation will be corrected and, the mill will be protected from flood damage due to dam failure,
- Although designated historic buildings on Anne and Prince Streets are not currently subject to flooding, proposed remedial measures will act to further reduce flood elevations, affording additional protection to their homes.

7.6 Stage 1 Recommendations

Figure 7-1 shows areas of archaeological potential and is to be read in conjunction with the following Stage 1 assessment recommendations

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 7- 2 Built Heritage Features.pdf

LEGEND

18 — Locally Designated Heritage Building

Cemetery

Source: Past Recovery Archaeological Services (2012)

Client: **OTONABEE CONSERVATION**		
Title: **Built Heritage Features**		
Prepared by: MMM GROUP		
14.12216.001.P01	Scale as Shown	Review: JB
Date: May 2013	**Figure: 7-2**	
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i) All areas shown in yellow on Figure 7-1 retain archaeological potential and should be the subject of a Stage 2 archaeological assessment if they are to be impacted in any way during proposed construction activities, for example through excavation, stockpiling and/or use as a staging area. As none of these areas can be ploughed, the Stage 2 assessment should be completed through shovel test pits excavated at five metre intervals.

ii) All areas shown in brown retain potential for deeply buried archaeological resources and should be the subject of archaeological monitoring during construction activities. Provision should be made with the contractor to allow time for the recording of any features of archaeological significance before they are removed.

iii) All areas shown in red, blue, green or magenta do not have archaeological potential. No further archaeological work is required in these areas.

iv) Though not a designated heritage building, the current Needler's Mill has significance to the Millbrook community and care should be taken to avoid damaging this building during construction activities.

v) The numerous designated heritage buildings and the unnamed cemetery within the study area should be avoided during construction activities. The cemetery is remote from the study area. These structures may require further assessment should they be impacted in any way.

vi) The recommended Stage 2 and monitoring work should be undertaken by a licensed archaeologist in accordance with the *Ontario Heritage Act* and in compliance with the Ministry of Tourism, Culture, and Sport's *Standards and Guidelines for Consultant Archaeologists* (2011).

8.0 ECOLOGICAL STUDIES

8.1 Background Information Review

The Millbrook Dam and Baxter Creek Natural Environment Literature Review (Otonabee Region Conservation Authority, 2008) was supplied to GENIVAR as a compilation of relevant background information for this EA. Relevant points with regard to the immediate terrestrial and aquatic environment surrounding the Millbrook Dam from numerous documents listed in this review are summarized below.

Baxter Creek occurs within the Otonabee River watershed, and outlets into the Otonabee River. Baxter Creek is known to possess suitable habitat and spawning locations for a variety of cool-water fish, including Brook Trout (Salvelinus fontinalis) and Brown Trout (Salmo trutta). Brook Trout, the only native Trout in eastern North America, typically inhabit small, coldwater streams. Brown Trout , a European species, were introduced to North America in the 1800's and it has been thought that this species is slowly outcompeting Brook Trout. Brown Trout tend to be more resilient to the results of anthropogenic stress, i.e. change of water temperature. (ORCA 2004 & ORCA 2009).

In 2004 and 2009, ORCA assessed various water courses throughout the watershed to determine their thermal regime and locations impacted by anthropogenic stressors. Overall, Baxter Creek was classified as a cool-water system, supporting Brook Trout. Two reaches of the several sampled suggested warm-water temperatures possibly due to the shallow water depths or from anthropogenic activities (i.e. removal of riparian vegetation). To ensure long-term sustainability of the Baxter Creek fishery, it has been recommended that riparian cover be maintained by way of new plantings.

Using a nomogram to assess the relationship of maximum air and water temperatures at eight (8) locations along Baxter Creek, ORCA was able to determine that the system is able to support both cool and coldwater fish communities. Shade provided by riparian cover contributed strongly to this thermal regime (ORCA 2009).

As part of an effort to protect environmentally sensitive areas within the ORCA watershed, in 1979, ORCA mapped all Environmentally Sensitive Areas within the watershed. Environmentally Sensitive Areas were defined as those areas possessing natural biological features which would be adversely affected from an environmental standpoint through alteration in land use.

The site, Baxter Creek and Millbrook Dam, occur within a sensitive area designated as Open Water, Emergent, and flooded Coniferous and deciduous forest types. It was suggested at the time, that this area supported both Brown and Brook Trout. Also noted was minimal stream bank cover in this area to provide riparian shade and that the ponded area provided suitable waterfowl habitat (Chamberlain 1979).

A stream flow quality and habitat assessment was carried out along Baxter Creek in 1982 in order to assess physical, chemical and biological conditions of habitat. Following this, physical improvements were carried out along Baxter Creek (i.e. removal of natural barriers, etc). It was determined that downstream of Cedar Valley (approximately 3 km downstream of the Millbrook Dam), water temperatures are too warm to support Trout populations (McGrath et al. 1986).

A trout spawning survey of Baxter Creek, conducted by counting the number of redds, was carried out in 1984. Heavy siltation and many debris dams were observed upstream of the Millbrook Dam. There was no evidence of trout spawning upstream or downstream of The Dam; however, it was noted that the surveys may have been completed too early (Rochetta 1986b).

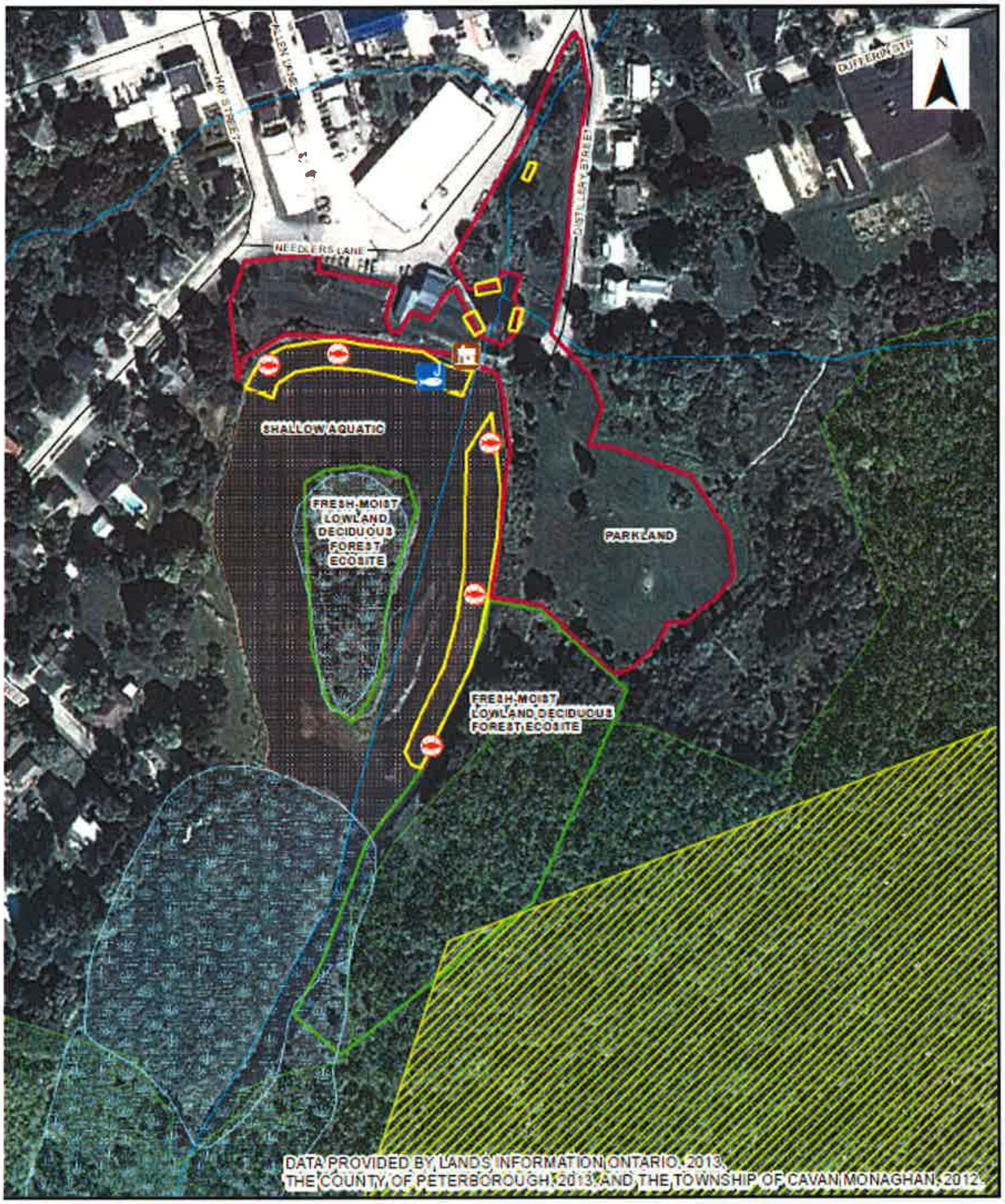
In September of 1986, several reaches of Baxter Creek were assessed as possessing quality or optimal trout habitat conditions, and areas in need of rehabilitation were noted along with recommended improvements. At this time, several habitat quality problems were noted within the reach containing the Village of Millbrook, such as the presence of a large/beaver/debris dam, large wood platforms and a large conifer located in-stream. It was suggested that this particular reach possessed excellent spawning habitat (Rochetta, 1986a).

As part of the Village of Millbrook's Master Drainage Plan, an assessment of existing conditions, including surveys of aquatic habitat and fish populations was carried out in December of 1993, on a tributary to the main branch of Baxter Creek, downstream of the Millbrook Dam. Using a battery-powered electrofisher, three (3) fish species were captured, namely, Brown trout, Blacknose Dace (Rhinichthys obtusus), and Creek Chub (Semotilus atromaculatus). At this location, water quality parameters indicated suitable conditions for Trout with a low temperature (2.5°C) and high dissolved oxygen (11.8 mg/L) level. Additionally, approximately 70% of the reach possessed 70% riffle cover, indicating suitable spawning sites. It was determined through these investigations, development could affect the quality of Baxter Creek, and therefore, it was considered crucial to implement appropriate mitigation measures to lessen runoff into the Creek and enhance or create additional infiltration opportunities (Totten Sims Hubicki, 1995).

As for water quality, a 1986 study found that overall Baxter Creek was considered a relatively clean system showing a general decline in lead and phosphorus concentrations. In comparison, nitrate concentrations were high, but significantly lower than the Ontario Drinking Water Standard and were on a decreasing trend. It was thought nitrate levels were impacted by agricultural influences, such as fertilizer runoff (ORCA 1986).

8.2 Ecological Site Reconnaissance

Five (5) visits were conducted in 2012, including: March 9th (reconnaissance visit for bid preparation), July 10th (terrestrial, aquatic and Species at Risk (SAR) assessment), August 23rd (additional SAR and avian surveys) and September 6th and 7th (fish sampling) (Figure 8-1). The purpose of the visits was to document the existing conditions of the site, investigate the presence of any rare or endangered species or their habitats, and define the presence and extent of any Natural Heritage Features on the site. Specifically, and as per ORCA's



M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 8-1 Existing Ecological Conditions.pdf

LEGEND

Natural Heritage Features
- Permanent Watercourse
- Non-evaluated Wetland
- Approximate significant woodland
- Observed Barn Swallow foraging area
- Approximate regional area of natural and scientific interest

Fish and Fish Habitat Assessment
- Minnow trap location
- Angler Report
- Visual Inspection
- Needler's Mill

Client: **OTONABEE CONSERVATION**		
Title: **Existing Ecological Conditions**		
Prepared by: MMM GROUP		
14.12216.001.P01	1:2000	Review: JB
Date: June 2013	**Figure: 8-1**	
Source: Adapted from Genivar (2013)		

instructions, the Baseline Environmental Inventory Checklist for Class Environmental Assessment for Remedial Flood and Erosion Control Projects (Conservation Ontario 2009) was followed.

Prior to the site visits, satellite imagery of the property, land use and topographical maps were reviewed to identify the potential for Natural Heritage or Hydrologic Features on the site. The Natural Heritage Information Centre (NHIC) database (MNR 2012a) was searched for records of Species at Risk, Significant Plant Communities, Wildlife Concentration Areas and Areas of Natural and Scientific Interest (ANSI) on or near the Site.

8.3 Terrestrial Methodology and ELC Classification

Terrestrial investigations were conducted on foot in order to ground-truth available mapping, document existing flora and Ecological Land Classification (ELC) communities and note incidental fauna observations. A multi-visit assessment, over the spring and summer months allowed documentation of birds within the core nesting period (i.e. May 1st to July 31st) and identification of various flora species during display of inflorescence. Avian surveys were conducted concurrent with flora and ELC investigations and confirmed the presence of numerous avian species within or adjacent to the study area. Species were confirmed through visual and auditory identification.

The site is composed of three (3) main vegetation types, two (2) of which are defined by the Ecological Land Classification (ELC) (1998), including: Fresh – Moist Lowland Deciduous Forest Ecosite (FOD7), and Shallow Water (SA) and one (1) non-ELC vegetation type – parkland. The majority of the study area is composed of parkland, consisting of maintained lawnspace and scattered with naturally occurring and planted trees. A Fresh-Moist Lowland Deciduous Forest occurs southeast of the pond, which is identified as a significant woodland within the draft Official Plan. The Shallow Aquatic feature consists of the pond, an online feature of Baxter Creek.

8.4 Natural Heritage Feature Assessment

Generic requirements for an Environmental Impact Statement are detailed under Section 3.7 of the Township of Cavan Monaghan Draft Official Plan (May 2010). Generally, the EIS must "describe the natural heritage features and ecological functions, identify their significance and sensitivities and describe how they could be affected by a proposed use. The EIS should give consideration to the relevant aspects and inter-relationships of various components of the natural heritage system on and off the site".

In addition to the description of the site, a detailed assessment and characterization of the Natural Heritage Features and functions present on the site are expected. An evaluation of the Natural Heritage Features as defined in the Provincial Policy Statement (PPS, 2005) will also provide additional information with regard to the biophysical context of the site.

8.4.1 Fish Habitat

Fish habitat as defined by the Fisheries Act, c. F-14 (June 2012) includes the spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. The Act also includes a broader definition of fish as shellfish, crustaceans at all stages of their life cycles.

8.4.2 Fish and Fish Habitat Assessment

Fish and fish habitat assessments were completed for the western and eastern portions of the reservoir shoreline in the summer and fall of 2012. Wading conditions were too unsafe to sample using a backpack electrofisher (soft deep organic fines made walking unstable). Therefore, overnight minnow traps were deployed at five (5) stations around the perimeter of the pond. Minnow traps were baited with dry catfood and set for 24 hours.

During the field visits, observations were documented, including:

- fish or schools of fish observed;
- substrate composition;
- existing vegetation and;
- anecdotal information (from anglers, recreational users).

The east shoreline of the Millbrook Pond was walked from immediately upstream of the dam to the approximate south end of the island and the in-stream habitat was homogeneous throughout. Substrate composition was entirely a thick layer of organic fines, ranging from 30 to 80cm deep. Water depths overtop of the thick sediment layer ranged from 10 to 45cm. In-stream cover was sparse, and limited to isolated downed trees and scant emergent aquatic vegetation, primarily Broad-leaved Arrowhead (*Sagittaria latifolia*). A wide buffer of cattails and native shrubs and trees are present between the water line and the manicured lawn/park area, but provide little in the way of overhead shade or cover.

No fish or schools of fish were observed when walking in the water on any of the aquatic field visits (July 10th, September 6th and 7th, 2012) and only one single Brook Stickleback (*Culaea inconstans*) was captured in three minnow traps set along the east and west shorelines during the 24 hour overnight sampling event (Figure 8-1) (representing 120 trapping hours from September 6th through September 7th, 2012) (Figure 8-1). Brook Stickleback, a common and widespread fish in Ontario, are small native fish found in a variety of habitats, including small, boggy headwater streams, shallow lake margins, ponds, and clear pools and backwaters of creeks and small rivers. They are usually associated with aquatic vegetation and have a preferred water temperature of 21.3°C. They are tolerant of low dissolved oxygen, acidity and alkalinity and are often the only species occurring in marginal habitats (Eakins, R. J., 2012).

The west shoreline of the Millbrook Pond supported in-stream homogenous habitat and was homogeneous throughout. Substrate composition was entirely a thin layer of organic fines, ranging from 10 to 30cm deep. Water depths ranged from 10 to 20cm. In-stream cover was abundant, and was composed of organic debris (leaf litter and small twigs and mats of filamentous algae). An extremely narrow buffer of cattails and native shrubs are present between the water line and back-lots of adjacent residences.

Large schools of unidentified young of the year fish (numbering in the hundreds) were observed during the aquatic field visits on September 6th and 7th, 2012, the majority of which were using the algal mats as cover. One small (5 cm) Snapping Turtle (*Chelydra serpentina*) was found in one of the minnow traps and released unharmed.

No trout were observed or caught on any of the aquatic survey dates, although one angler reported catching a small brook trout upstream of the dam on September 6th, 2012.

8.4.3 Significant Areas of Natural and Scientific Interest

Significant Areas of Natural and Scientific Interest (ANSI) are defined as areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education.

The Natural Heritage Information Centre (NHIC) database was searched for the presence of any ANSI's on or within 120m of the site. No ANSIs occur within 120m of the site; however, the Cavan Supraglacial Till No. 1 occurs southeast of the site, an unique deposit of glacial till of the Oak Ridges Moraine. It is anticipated that all remedial options for Millbrook Dam will not extend into this area, and that no alteration to the form and function of this Earth Science Site will occur.

8.4.4 Significant Habitat of Endangered, Rare or Threatened Species

The PPS (2005) defines the significant habitat of endangered or threatened species as the habitat, as approved by the Ontario Ministry of Natural Resources, that is necessary for the maintenance, survival and/or the recovery of a naturally occurring or reintroduced population of endangered or threatened species, and where those areas of occurrences are occupied or habitually occupied by the species during all or any part(s) of their life cycle. The MNR is directly responsible for identifying, listing and conducting ongoing assessments for significant endangered species and their related habitats.

A survey of the MNR's NHIC database (2012a), the Ontario Breeding Bird Atlas (OBBA, 2005), the Ontario Reptile and Amphibian Atlas and consultation with MNR suggest that nineteen (19) Species at Risk and rare species have been documented within 10km of the site. Based on habitat conditions, some have potential to occur onsite. The site conditions were assessed relative to habitat preferences of individual species. Table 8-1 summarizes this information.

Barn Swallow was observed onsite, displaying courtship and foraging behaviour. As these species are protected under the Endangered Species Act (2007), proposed activities must not adversely affect the species or habitat. As a colonial bird, this species generally nests with other breeding pairs. Nests are typically constructed on flat, vertical surfaces, such as caves, barns, bridges or cut banks. No nests were observed during investigations, indicating that

Table 8-1

Endangered, Rare, or Threatened Occurrence Potential

Species	S-Rank[1]	SARO[2]	SARA[3]	Habitat Description	Database	Habitat Potential
BIRDS						
Barn Swallow *Hirundo rustica*	S4B	THR	No	This species can be found in many habitat types such as: agricultural, urban and coastal. They will nest in agricultural structures, or under bridges.	OBBA	High
Black Tern *Chlidonias niger*	S3B	SC	NAR	The species requires large, shallow, quiet marshes where their floating nests are not subject to disturbance from humans or boat traffic.	OBBA	Low
Bobolink *Dolichonyx oryzivorus*	S4B	THR	No Status	The species build nests on the ground in dense grasses such as unmaintained hayfields.	OBBA, MNR	Low
Canada Warbler *Wilsonia canadensis*	S4B	SC	THR	The species is found in a variety of forest types, but is most abundant in wet, mixed deciduous-coniferous forest with a well-developed shrub layer, preferably near streams. Also found in riparian shrub forest.	OBBA	Moderate
Chimney Swift *Chaetura pelagica*	S4B,S4N	THR	THR	The species feeds in flocks around water bodies due to the large amount of insects present. Nesting occurs in large, hollow trees or in the chimneys of houses in urban and rural areas.	OBBA	Low
Common Nighthawk *Chordeiles minor*	S4B	SC	THR	The species nests in areas with little to no ground vegetation, such as logged or burned-over areas, forest clearing, rock barrens, etc.	OBBA	Moderate
Eastern Meadowlark *Sturnella magna*	S4B	THR	No	This species prefers pastures, open fields and overgrown roadsides.	OBBA, MNR	Low
Golden-winged Warbler *Vermivora chrysoptera*	S4B	SC	THR	The species are known to inhabit areas dominated by early successional vegetation such as those situated along old field edges or openings in deciduous swamp.	OBBA	Moderate
Henslow Sparrow *Ammodramus henslowii*	SHB	END	END	This species prefers open fields possessing tall grasses and herbaceous plants.	NHIC	Low
Least Bittern *Ixobrychus exilis*	S4B	THR	THR	This species breeds in stable marshes with emergent vegetation, such as cattails, and areas with open water. They are typically found in large, quiet marshes.	OBBA	Low
Loggerhead Shrike *Lanius ludovicianus migrans*	S3B	END	END	This species prefers meadows with scattered shrubs.	OBBA	Low

Table 8-1 (Cont'd)

Species	S-Rank[1]	SARO[2]	SARA[3]	Habitat Description	Database	Habitat Potential
Red-headed Woodpecker *Melanerpes erythrocephalus*	S4B	SC	THR	The species lives in open woodlands and woodland edges, especially in oak savannah and riparian forest, where dead trees are used for nesting and perching.	OBBA	Low
Short-eared Owl *Asio flammeus*	S2N,S4B	SC	SC (Schedule 3)	This species prefers prairie, savannah, and maintained farmland.	OBBA	Low
Whip-poor-will *Caprimulgus vociferus*	S4B	THR	THR	This species breeds in patchy forests with clearings, and generally avoids exposed, open areas, or closed-canopy forest.	OBBA, MNR	Low
HERPETOFAUNA						
Blanding's Turtle *Emydoidea blandingii*	S3	THR	THR	This species inhabits lakes, slow-moving streams and wetlands, preferring shallow wetland areas with abundant aquatic vegetation.	ORAA, MNR	Moderate
Eastern Milksnake *Lampropeltis triangulum*	S3	SC	SC	This species is typically found in rural areas, especially around old buildings and fields within close proximity to water.	NHIC, ORAA	Moderate
Fived-lined Skink *Plestiodon fasciatus pop. 2*	S3	SC	SC	This species is typically located in wooded areas, moist habitats. They typically find refuge under fallen debris, and are known to bask in the sun.	ORAA	Moderate
Northern Map Turtle *Graptemys geographica*	S3	SC	SC	This species prefers large bodies of water with rock and log basking areas along the shoreline.	ORAA	Low
Northern Ribbon Snake *Thamnophis sauritis*	S3	SC	SC	These species are typically found in meadows or forested edges within close proximity to a water feature. They typically predate in water.	ORAA	Moderate
Snapping Turtle *Chelydra serpentina*	S3	SC	SC	This species prefers large bodies to water to small ponds containing dense vegetation.	ORAA, MNR	Moderate
Western Chorus Frog *Pseudacris triseriata pop. 2*	S3	NAR	THR	This species can be found in moist cultivated, meadow or forested lands. Tadpoles develop within intermittent wet pockets.	ORAA	Moderate
FLORA						
Butternut *Juglans cinerea*	S3	END	END	This species prefers well drained soils, adjacent to streams, with direct sunlight.	MNR	Moderate

Notes:
[1] Protection priority Provincial Rank (NHIC 2012); 1 - Critically Imperiled, 2 - Imperiled, 3 - Vulnerable, 4 - Apparently Secure, 5 – Secure; SX-Presume Extirpated, SH – Possibly Extirpated, SNR – Unranked, SU-Unrankable, SNA – Not Applicable, S#S# -Rank Range, S#B – Breeding migrants and S#N – Non-breeding migrants;
[2] Species protected under the provincial Endangered Species Act; END – Endangered, THR – Threatened, SC – Special concern;
[3] Species protected under the federal Species at Risk Act (2007); and
Species not at Risk – NAR.
[4]Habitat Potential – N-None, L-Low, M-Medium or H-High

nesting activities may take place offsite. The site habitat types that are present, pond and lawn-space, provide ideal conditions for foraging and courtship practices.

The site possesses moderate potential for Canada Warbler and Golden-winged Warbler foraging and courting practices; however, the nesting preference of these species; ground nester in deciduous swamps and ground nesters in tall grasses and/or shrubs, respectively, are not anticipated to be directly affected by the proposed works. The Lowland Deciduous Forest, east of the pond, may provide nesting opportunities for Canada Warbler. If water levels increase beyond the exiting Millbrook Valley Trail system, which parallels the east side of the pond, further assessment should be taken to ensure no nest will be impacted. Since no areas with tall, upland grasses were noted, low potential for Golden-winged Warbler nesting is ascribed to the study area.

Snapping Turtle (Special Concern) was identified during the aquatic assessment. The slow moving water, wetland habitat at the south of the pond and suitable basking locations provide optimal habitat for this species. Since the individual captured was a juvenile, the sandy nature of the area is providing breeding and nesting habitat within the immediate area of the pond.

8.4.5 Wetlands

Wetlands are defined in the PPS (2005) as lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. There are four major wetland types; which are classified as swamps, marshes, bogs, and fens. A significant wetland is defined as an area identified as provincially significant by the Ministry of Natural Resources using evaluation procedures established by the province, as amended from time to time (PPS 2005).

The NHIC database and municipal mapping shows no provincially or locally significant wetlands occurring within 120m of the site. A non-evaluated wetland occurs south of the headpond.

8.4.6 Significant Wildlife Habitat

Wildlife habitat is defined as areas where plants, animals, and other organisms live and find adequate amounts of food, water, shelter, and space needed to sustain their populations. Specific wildlife habitats of concern may include areas where species concentrate at a vulnerable point in their annual life cycle; and areas which are important to migratory or non-migratory species (PPS 2005).

Wildlife habitat is considered significant if it is ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or Natural Heritage System (PPS 2005).

Guidelines and criteria for the identification of significant wildlife are detailed in the Significant Wildlife Habitat Technical Guide (October 2000), the Natural Heritage Reference Manual (June 1999), and the Significant Wildlife Decision Support System (OMNR 2000). Significant wildlife habitat is described under four main categories:

- Seasonal concentrations of animals,
- Rare vegetation communities or specialized habitats for wildlife,
- Wildlife movement corridors, and
- Habitats of species of conservation concern.

8.4.7 Birds

Several avian species were documented through either sight or auditory identification. All birds were determined to be common, expect for one exception (i.e., Barn Swallow). Canada Geese (Branta canadensis), Great Blue Heron (Ardea herodias), Mallards (Anas platyrhynchos), Ring-billed Gulls (Larus delawarensis) and Barn Swallow were observed directly using the millpond for foraging and courtship and/or feeding.

The pond and lawn-space were inhabited by several geese during mid and late summer site visits. It is anticipated that the pond and marsh, south of the pond, may provide suitable habitat for staging and therefore the pond feature is considered a significant wildlife habitat as determined through use of the Significant Wildlife Decision Support System (OMNR 2000).

A Great Blue Heron was heard calling within low vegetation of the pond's island and as the individual was not observed, behaviour (e.g. nesting or stalking/foraging) could not be documented.

8.4.8 Herpetofauna

Both Green Frog (*Rana clamitans*) and Leopard Frog (*Rana pipiens*) were observed onsite, within the identified Cattail and Reed Canary Grass pockets. It is anticipated that this area may provide a suitable area for deposit of Green Frog egg masses. This area also provides favourable habitat for turtles and snakes as terrestrial and aquatic habitat types occur in close proximity.

8.4.9 Mammals

No mammals were observed during the 2012 field investigations; however, a local resident of the area provided images of a River Otter (*Lutra canadensis*) in the pond. It is anticipated that River Otters may utilize the pond for foraging activities and possibly denning within the base of trees and roots, which extend into the pond and water course upstream. The pond doubtlessly provides some form of linkage for mammals.

8.4.10 Significant Woodlands & Wooded Areas

Significant Woodlands are defined as treed areas that provide environmental and economic benefits such as erosion prevention, water retention, and provision of habitat, recreation and the sustainable harvest of woodland products (PPS 2005). Under the Greenbelt Plan, a significant woodland is defined as 'an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history'. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance. The identification and assessment of significant woodlands is the responsibility of the local planning body. Woodland significance is typically determined by evaluating key criteria which relate to woodland size, ecological function, uncommon woodland species, and economic and social value.

The Township of Cavan Monaghan's draft Official Plan (Schedule B-1) indicates the presence of significant woodland southeast of the pond. Potential treatment options do not propose alteration to the pond whereby the form and function of the significant woodland is alerted. Figure 8-1 shows the approximate location of the Significant Woodland.

8.4.11 Significant Valleylands

The PPS (2005) refers to significant valleylands as "a natural area that occurs in a valley or other landform depression that has water flowing through or standing for some period of the year". The local planning authority is responsible for identifying and evaluating significant valleylands.

Valleylands were not identified either in literature or in field investigations.

8.4.12 Significant Feature Assessment Summary

The results of the assessment of Natural Heritage Features identified on or adjacent to the site are provided in Table 8-2.

Table 8-2

Key Natural Heritage Feature Summary

Feature	Present	Comment
Fish Habitat	Yes	Present.
Significant ANSI	No	Not present.
Rare, Threatened or Endangered Species Habitat	Yes	Barn Swallow (Threatened) was identified.
Significant Wetland	No	Not present.
Significant Wildlife Habitat	Yes	The pond provides migratory staging habitat for waterfowl.
Significant Woodland	Yes	Significant Woodland occurs southeast of the pond. No development should occur within 30 m of this feature.
Significant Valleyland	No	Not present.

9.0 GEOMORPHOLOGY

Millbrook Dam was constructed in the 1820's from local clay soil and timber. Upgrades were completed in 1950 when the concrete portion of the dam was constructed and in the 1990's when the existing sheet piling and overflow weir structure were constructed.

Millbrook Dam is an earthfill embankment approximately 120m long with U-shaped concrete overflow weir structure (7m across) and is aligned east to west. At its base, the spillway discharges into a broad pool that is defined by armour stone walls that follow the toe of the dam.

The dam's hazard classification is based on only the additional damage that would result from dam failure. The dam spans the width of the valley defined by the Regional flood flow and areas upstream and downstream would be flooded under such conditions. The dam has little influence on flows or water levels at the Regional flow or above since the dam would be inundated under this condition.

Millbrook Dam is located in the Sand Plains physiographic region and surficial geology consists of modern alluvial deposits. It is located on Baxter Creek which is a tributary of the Otonabee River (Chapman and Putnam, 2007; Ontario Geological Survey, 2010).

Geo-Logic Inc. provided consolidated geotechnical information (2007) for the area in the vicinity of Millbrook Dam using samples collected between 2000-2006. In the vicinity of the dam there is topsoil or gravel underlain by earth fill (which consists of a mix of soil types with timbers and organics throughout) and, silty clay below the earth fill, which is underlain by a layer of clay. Groundwater was encountered in all boreholes.

According to a 2008 preliminary bathymetric survey there is approximately 11,000m^3 of material currently settled within the Millbrook headpond. The material ranges between 0.7-1.65m in depth. Water depth ranges from 1.2-2.3m (measured from the top of the water to the bottom of the pond) but in some places water depth is less than 0.3m.

Upstream and downstream of the dam the existing channel is well defined and is generally bordered by grasses and trees. It was noted that there are deposits of finer sediment at each bridge but there was minimal evidence of active erosion (IBI Group, 2008). The Millbrook Dam is within the valley defined by the Regional Flood but if the dam were to be breached, channel velocities and depths would reach 'high' hazard conditions at much lower flows.

9.1 Existing Conditions

A site visit was conducted on the 28th of June 2012. A Rapid Geomorphic Assessment was conducted on two reaches downstream of the pond (Figure 9-1). The first reach started at the pond and extended to the bridge at King Street. The second reach extended a further 100m downstream. In addition, spot checks were conducted along the downstream section between Bank Street and Centennial Lane. Upstream of the pond, spot checks were conducted near Main Street and 150m upstream from the pond inlet.

View of dam/spillway

Downstream Creek Channel (Looking South)

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 9-1 Geomorphology study photos. pdf

Client:	OTONABEE CONSERVATION
Title:	Geomorphology Study Photos
Prepared by:	MMM GROUP
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	Figure: 9-1

There are no significant areas of erosion or deposition that would be of concern. The creek appears to have been historically straightened and widened. Banks have been re-profiled and heightened, and as a result, disconnected the channel from its floodplain in places. Baxter Creek along this downstream section consists of a pool-riffle sequence containing well sorted bed materials. Along the riffles, gravels have formed a compacted armour layer that seems very stable. The smaller particle size fractions (i.e. sands, silts and clays) are being transported with deposition occurring in sections that have been over-widened such as under the bridges. Sediment supply has been cut off by the pond, there is, however, localized erosion and deposition within the reach. Downstream of Millbrook Dam, Baxter Creek has adjusted to the presence of the dam which has been in place for approximately 200 years. The profile of the channel bed as well as the cross-sectional shape and size of the channel are in equilibrium with the dam structure.

i) Millpond to King Street (Reach Ba001)

The creek along this reach has semi-continuous floodplain connectivity. Banks are steep and have been re-profiled. Only during high flow events will the floodplain be accessed. Bank top vegetation consists of tall herbs, weedy vegetation and grasses. The riparian corridor is semi-continuous along both banks and extends for less than one river width along the left bank (looking downstream), while it is slightly wider along the right bank. Tree lining is scattered along the left bank with occasional clumps along the right bank.

Bed material consists of cobbles, gravel, sand, silt and clay. There are discreet clay beds along sections of the channel. Riffle sections contain gravel beds that are well compacted and do not appear to be mobile, forming an armour layer along the channel. Bank material consists of sand, silt, clay and earth. This reach appears to have been historically straightened. Water depth ranged from 15-20cm on the day of the survey and the wetted width was 6.7m. Bankfull width, measured at a riffle, is 12m. The gradient along the reach is moderate. This reach is stable with minimal erosion or deposition. Vegetated bars and banks, as well as aquatic vegetation along the bed further attest to a stable system. The Stability Index for this reach is 0.12 indicating that the reach is in “regime”. A Conservation Status of 6 indicates signs of previous alteration but that the reach still retains many natural features and is recovering towards conditions indicative of a higher category.

ii) King Street to 100m downstream (Reach Ba002)

The creek along this reach has been totally disconnected from the floodplain as a result of steep, high banks that have been re-profiled. Only during high flow events will the floodplain be accessed. Bank top vegetation consists of grasses, shrubs and deciduous woodland. The riparian corridor is semi-continuous along the left bank and continuous along the right bank. The corridor is less than one river width wide along the left bank and one to five river widths along the right bank. Tree lining along both banks is semi-continuous.

Bed material consists of cobbles, gravel, sand, silt and clay. There are discreet clay beds along sections of the channel. The riffle sections along this reach are slightly less compacted than the upstream reach but still form an armouring layer. Bank material consists of sand, silt, clay and earth. This reach has been straightened. Water depth ranged from 20-40cm, and the wetted width was 8-10 m on the day of the survey. Bankfull width is approximate 13m. This reach has been historically over-widened. The gradient along the reach is low. The reach is stable. The Stability Index for this reach is 0.04 indicating that the reach is in regime. A Conservation Status of 5 indicates signs of previous alteration but that the reach still retains some natural features and is recovering towards conditions indicative of a higher category. The conservation status is lower on this reach as there are less signs of planform readjustment compared to reach Ba001.

The geomorphological assessment was completed recognizing that dam removal and dam replacement was being considered. Preliminary conclusions suggest that geomorphological effects resulting from such construction can either be assimilated by the creek channel or be mitigated by known structural or bio-engineering methods.

10.0 PUBLIC AND AGENCY CONSULTATION

Consultation for the Millbrook Dam E.A. included the joint efforts of ORCA staff and the consultant study team. Follow-up was largely by ORCA staff. Owing to an intensely interested public, consultation efforts were "ramped up" over those originally planned to accommodate changing public needs. It is important to note that previous public consultation studies were completed in advance of this E.A. by Ogilvie (2009) and noted the community`s general "negative and distrustful feelings towards the Township and the Conservation Authority". These feelings often surfaced during the E.A. and were in part, a determining factor in revising consultation procedures.

10.1 Published Notification

Consistent with procedural requirements of Conservation Ontario (2009), three mandatory notices are required including a Notice of Intent, a Notice of Filing of an ESR and a Notice of Project Approval. One additional voluntary notice was issued to announce the open house.

Notices, in chronological order, consisted of the following:

i) Notice of Intent - to initiate the E.A. process. This notice described the project and its location, provided a general description of E.A. procedures and requested input from the public
ii) Notice of Public Information Centre - this second notice advised the public of the date, location and particulars of an open house which was designed to share study findings, optional concepts and, the preferred solution, while again requesting public input.
iii) Notice of Filing - this notice was published to inform the public that an E.A. report had been prepared and was available for review. The notice described the preferred solution, and noted that pending receipt of comments, the ORCA intended to proceed with the project.
iv) Notice of Approval – following approval of this E.A., the subject notice will announce that planning and design has been completed and, that the project will proceed to continuation

The notices of "Intent", "Public Information Centre" and "Filing" were published in the Millbrook Times and Peterborough Examiner on June 7, 2012, March 14, 2013, and October 3 2013, respectively, by the ORCA. Geographic coverage was sufficient to address the needs of the E.A. The Notice of Approval will be forwarded to all interested parties by mail or e-mail following formal approval of the E.A. Comment response periods were set at the standard 30 calendar days.

Notices are contained in Appendix B.

10.2 Community Liaison Committee

As required by regulation, a Community Liaison Committee (CLC) was organized by the ORCA. Procedures involved a newspaper advertisement stating the purpose of the Committee and requesting interested candidates for CLC membership, review of potential candidates by ORCA staff and selection of committee members (Appendix B). The CLC membership was composed of 13 selected individuals representing a broad cross-section of the community including the Millbrook Dam/Needler's Mill Future Directions Advisory Committee, Peterborough Field Naturalists, Kawartha Heritage Conservancy, the local Historical Society, the District Lion`s Club, the Millbrook Valley Trails Association, the Municipal Heritage Committee, local Business Improvement Association, the MNR, and knowledgeable area residents and neighbouring property owners. Certain members had been involved with previous consultation committees and provided continuity from earlier studies.

Terms of Reference for the CLC were prepared by the ORCA and distributed to all members.

In all, five meetings of the CLC were conducted.

10.2.1 CLC Meeting #1

CLC Meeting #1 - took place on July 10, 2012 and was attended by the selected public members, ORCA and Township staff and, the consultant. The meeting was designed to receive information from public committee members following presentations and discussion of the Class E.A. process, proposed E.A. study plans and previous remedial options.

During a round table discussion, each committee member presented the position and views of the organization that he/she represented. Remedial options described by the consultant were those developed by IBI (2008) and consisted basically of four options involving different forms of:

- Dam removal/decommissioning, and,
- Dam replacement.

Committee members strongly reinforced the integrated nature of the dam, the millpond and Needlers Mill and their relationship to the adjoining Millbrook Central Business District (CBD) initiative. Little time was spent on discussion of previous remedial options.

Various ideas were offered by members including:

- Extending the U-shaped overflow weir further upstream to obtain minimum 100 cm/s capacity requirement
- Combining extension of the U-shaped weir with a serpentine orientation to obtain minimum 100 cm/s flow requirement through outlet structure
- Returning the existing water control structure to active operation (i.e., a stoplog structure)
- Removing the island from the headpond

- Removing the sediment from the reservoir, and possibly including a bottom-draw gate in the outlet structure to flush sediments downstream to prevent accumulation in the headpond.

A summary of comments by issue is as follows:

i) Needler's Mill

- ORCA wishes to divest itself of Needler's Mill and its attendant lands
- The Class EA will only determine the preferred concept for solving the problem of incremental flooding, property and environmental damage that is expected to occur in the event of dam failure
- It is preferred by the CLC to maintain the headpond at, or near, current water levels, to retain the potential for future operation of Needler's Mill
- the CLC requested that the design include sheet piling (or others means) to stop water seepage through the earth embankment dam where it then causes damage to the mill's foundation
- There is no need for the community to wait until the Class EA is completed before exploring the future of the Needler's Mill

ii) Penstock Intake

- The penstock and its concrete intake structure are considered part of the dam
- Treatment of the penstock will be considered in the options to be presented

iii) Dam Decommissioning/Removal

- the Class EA must look at all reasonable alternatives to resolving the problem of incremental flooding possibly resulting in the loss of life, property damage and environmental harm if the dam should fail.

iv) Sediments and Headpond

- The island in the headpond was created when the pond was dredged in 1983
- The island is not thought to be eroding and contributing to the current accumulation of sediment in pond
- Selected CLC members would like to see the island removed and the reservoir dredged to restore its original form and depth

v) Fish & Fish Habitat

- If the dam is currently keeping brown and brook trout populations separate, a barrier to fish passage should be maintained
- Pond/reservoir is not conducive to coldwater fish
- Current shallow water depths in reservoir and the island are contributing to poor water quality by inducing heating of the water and slowing the flow. Trout require a well oxygenated, "cold water" environment for survival
- Construction should not adversely affect Baxter Creek immediately downstream from the dam

vi) Hydro Electric Power

- The feasibility of electricity generation at the dam should be further evaluated

10.2.2 CLC Meeting #2

CLC Meeting #2 was held on December 4, 2012. The purpose of the meeting was to:

- describe and further discuss previous engineering studies
- share new information gained from field studies of archaeology, ecology and geomorphology
- present new remedial concepts for members consideration

Additional attendees at this meeting included the study team's structural engineer and biologist who provided presentations in their respective findings. There new structural concepts were presented to the membership:
Concept A – dam removal, widening of the spillway and construction of new parkland on the west side of the headpond

Concept B – dam removal, widening of the spillway and creation of a groundwater smaller fed off-line pond occupying the west part of the headpond and,

Concept C – dam replacement, with a widened spillway, and retention of the headpond.
Concept C was ultimately offered as the preferred solution.

Topics presented included:

- reviewing of the purpose of the E.A. and, the E.A. process
- the engineering background for the previous IBI options (which would be integrated into new options)
- summarises ongoing field studies
- preliminary new concepts
- items to be considered in the selection of the preferred option.

The ensuing discussion focused on new spillway dimensions, bottom sediment removal, treatment of the penstock intake, consideration of groundwater as a partial source for headpond water (Concept B) and, headpond island removal.

10.2.3 CLC Meeting #3

CLC Meeting #3 was held on February 13, 2013. From discussions at previous committee meetings, it was apparent that engineering information, regulatory methods and their application to the decision making and E.A processes were quite complicated and not easily understood. In order to rectify this situation, ORCA staff organized and conducted a "plain language" meeting with only public committee members, ORCA staff and Township staff attending. Based on ORCA meeting minutes dated February 23, 2013, the overall response of the Committee favoured the reconstruction or rehabilitation of the dam:

"to the minimum standards as required by the MNR and ORCA's insurance agency while taking into account and maintaining the historical aesthetic and ambiance of the surrounding area while maintaining the level of the headpond and completing minimum dredging of 2m. It would also include an ongoing maintenance plan for silt removal."

Specific implementable recommendations are summarised as follows:

- Restore the headpond to its historical water level while considering all the reasonable implications of doing so,
- Dredge the headpond to a minimum of 2 metres and include a reasonable plan to maintain the water depth at no less than 2 metres
- Conducting further inundation modelling to determine exact spillway sizing
- minimize the outlet structure to the smallest size possible while considering all the reasonable implications of doing so
- Design the outlet structure to include a waterfall feature as per the existing structure
- Make operational the intake structure to the penstock leading to Needler's Mill
- maintain a pedestrian pathway along the crest of the dam, including a "period style" pedestrian bridge over the outlet structure
- Naturalize the riparian zone of the reservoir/headpond
- Include works to stabilize the dam, eliminate seepage through the dam, and protect the Needler's Mill from further damage
- Make provision for a fish ladder if possible
- Prepare an emergency management plan for the dam
- During the subsequent final engineering design phase of the dam, include input from the original CLC members, the Millbrook Historical Society and the Millbrook Heritage Committee.
- Any dam replacement and design is to include the historical and future uses of the Needler's Mill building

10.2.4 CLC Meeting #4

CLC Meeting #4 was held on the afternoon March 26, 2013, immediately preceding the Open House which occurred that evening. The purpose of the meeting was to:

- present and discuss all open house display panels to the Committee in advance of the open house,
- describe the final remedial concepts to committee members
- present Concept C as the preferred solution
- receive comments from the membership
- thank Committee members for their participation

The two primary outcomes of that meeting are as follows:

- there appeared to be a "measured" acceptance of Concept "C" (dam replacement and headpond replacement) on the part of many members
- concerns were raised as to possible alterations of Concept "C" during the detailed engineering design following the E.A. The ORCA committed to retaining the CLC Committee during the engineering design process and seeking its advice.

10.2.5 CLC Meeting #5

CLC Meeting #5 was held on the evening of September 17, 2013. The purpose of the meeting was to discuss the draft Environmental Study Report (ESR) which CLC members had received for review and comment approximately three weeks earlier. The ORCA provided written comment to each of the questions / concerns raised by the CLC membership. As a result of this meeting, suggested changes were incorporated into the final ESR. Generally, these were intended to make clear the process followed by the consultant in deriving a preferred option, and clarified for the CLC the next steps pending approval of the Class E.A. Also, along with the minutes of this meeting, the CLC membership was provided the written response prepared by Bryon Keene, P.Eng. Quinte Conservation, to comments / questions submitted earlier by the Save The Dam Mill Pond Committee regarding the work completed by IBI (2008).

10.3 Public Engagement Beyond the E.A. Process

Two influential forms of public contact initiated by others occurred during the E.A. process.

10.3.1 Information Night: Save the Dam Mill Pond Committee

The Save the Dam Mill Pond Committee is an independent residents' organization. The Committee voluntarily organized and conducted an "Information Night" on January 29, 2013 to provide public information and the thoughts of the organizers on the on-going E.A. A presentation was provided followed by a question and answer period and a request for feedback to the CLC. Attendance was approximately 100 persons.

An ORCA memo dated February 22, 2013 summarized the results of the meeting.

- "In general, the public in attendance stress that the dam, millpond, and mill are core components to the identity of the Millbrook community and as such these features should be preserved for the benefit of current and future generations and must not be removed...the dam, pond, mill and adjacent parkland/ nature trails... are a cultural and social anchor, and significant cultural heritage would be lost if the dam, pond, mill and adjacent parkland/ natural trails are not preserved"
- "There was considerable interest expressed in maintaining historical water levels in the millpond, as well as pursuing dredging of the millpond, so that boating, canoeing, fishing, and even swimming could be recreational activities that can thrive, as in previous times"

- "There is little if any support expressed for any of the three options as presented by MMM Group on December 4, 2012. Notably, many individuals commented that the substantial increase in the size/ width of the dam's outlet/ spillway, is not acceptable, but there is interest in a rebuild / replace/ rehabilitate option that preserves the recreational, cultural, historical and social values of the area"
- Conclusions urged finding a "solution to the problem that is in keeping with ... public sentiment for preservation of the dam, mill and millpond, and the recreational, social, cultural and historical values that these features provide, that were articulated in the Independent Public Facilitator's Final Report – Community Engagement Results on the Future of the Millbrook Dam and Needler's Mill "

Regarding the latter two points, the writers of the E.A. re-iterate that reconstruction or repair of spillway to its existing unacceptable flow capacity cannot be considered as a viable solution to the incremental flooding problem.

Subsequently, in May 2013, written comments were received by the study team from the Save The Dam Mill Pond Committee. Generally, these comments challenged the IBI (2008) report findings, noting some seeming incongruencies. As a result, the ORCA requested a review of the IBI report. This was completed by a professional engineer who concluded that "while there were typos in the report or apparent inconsistencies in the information, there is no evidence to suggest incompetence on the part of IBI Group in the engineering calculations and recommendations they have provided." The engineer's response letter was later distributed to the Community Liaison Committee, several members of which were also key members of the Save The Dam Mill Pond Committee.

10.3.2 Newspaper Articles

The involvement of a large number of residents in a project crucial to the village would understandably give rise to articles written in the local press. Appendix B contains several such articles which appeared in the Millbrook Times newspaper and are offered for information, context, and transparency purposes.

10.4 Open House

An open house was convened at the Millbrook Township Offices on the evening of March 26, 2013, during the 7:00 to 9:00pm period. Comment and attendance sheets were provided. Notification for the event consisted of:

- preparation of a newspaper notice announcing the open house (Appendix B)
- mail-out of the notice to approximately 80 individuals, groups, public agencies and First Nations recipients on the updated mailing list
- hand delivery of approximately 535 notices within the Village of Millbrook 10 days in advance of the event
- newspaper advertisement of the notice occurred 12 days in advance of the event

- the notice was posted on the websites of both the ORCA and the Township of Cavan Monaghan.

The purpose of the open house was to:

- present the purpose and procedures of the E.A.
- present the results of background studies (engineering review, ecology, geomorphology, archaeology)
- present the new concepts for dam remediation
- receive comments from those in attendance for input into the E.A. process
- provide additional information on procedures and opportunities for continuing input by the public

The event was designed as an open house displaying 23 information panels, with a short introductory Powerpoint presentation. The session was well attended with an excess of 200 people present. Attendees were respectfully vocal; several held placards offering a "Save Our Dam" sentiment. The high number of attendees made viewing of information panels difficult, and resulted in the evening basically being conducted as a question and answer session as opposed to open house. Regardless, many attendees went to the effort of viewing the information panels and remaining after the 9:00 pm time limit to discuss outstanding issues with the presenters.

Collectively, attendees made it abundantly clear that the character of the study area must be preserved, referring to the inter-related features and functions of the dam, the millpond and Needler's Mill.

Approximately 34 written comments were received by the study team and are summarized as follows.

- Many respondents rejected all remedial options presumably in favour of repairing the existing spillway. As repeated earlier, repair of the spillway cannot be considered as a viable option since risks to property and human life remain unmitigated
- There appeared to be a desire for additional technical data which would typically be presented during the final engineering design process. To address this need, the ORCA offered to continue consultation with the CLC and to conduct an open house during the final design process to present more detailed data.
- General frustration was experienced about the time lapse between the earlier public consultation study and potential construction, the length of the study process, the location for the open house and "bureaucratic" procedures.
- Occasional mention was made of the lack of dam maintenance since its purchase and the continuing need for sediment removal.
- Notably, a submission of 13 letters was received from Grade 3 students at the Millbrook-South Cavan Public School, all expressing a wish to preserve the study area.
- One letter noted that no option would relieve the general flooding of Millbrook. This was also stated verbally at the open house.

- It was suggested that a fish ladder be considered at the spillway
- A request for additional data was received from the Scugog First Nation

Items "standing out" from the Open House session and commentary are as follows:

- Public opinions appear unified in asserting that the features and functions of the dam, millpond, mill complex be retained in a manner that respects the historic and social significance of the site.
- The collective reaction of attendees was more demonstrative of emotion than of recognition of technical facts. One respondent indicated that "Unfortunately, the environmental assessment was "lost" due to concerns that the pond and dam may disappear soon."
- Objections to the preferred option appear to be dominantly aesthetic in that the length of new weir proposed is approximately three times the length of the existing 7.0 m spillway opening.
- The study team feels that, the public only partially understood the engineering principles being applied.
- One First Nation attendee requested that the ORCA consult with the Sacred Water Circle Committee
- One attendee was vocal on economic principles, indicating that the cost did not justify any form of rehabilitation and that dam removal was warranted.
- The aesthetics of the proposed weir (in particular, its length) appeared to be a major concern and additional thought should be given to making the weir "less obvious"
- Reactions of the gathering were mixed providing no clear direction
- Although facets of all concepts were discussed intermittently, no clear preference for any concept was evident.

Open house display panels were posted on the ORCA website following the event, for public ease of viewing and are attached in Appendix D.

10.5 First Nations Consultation

First Nations (F.N.) potentially wishing involvement in the Millbrook Dam E.A. were identified from mapping (by assessing geographic proximity), from discussions with the ORCA and from discussions with Mississaugas of Scugog Island First Nation. The contact list for notification was updated as required throughout the E.A. process and resulted in the following F.N.s, and F.N. affiliates and the Metis Nation being identified:

- Alderville First Nation
- Curve Lake First Nation
- Hiawatha First Nation

- Kawartha Nishnawbe
- Mississaugas of Scugog Island First Nation
- Metis Nation of Ontario
- Oshawa & Durham Region Metis Council
- Peterborough and District Wapiti Metis Council
- Williams Treaty, First Nation Claims

The Metis Nation organizations were included in the contact list owing to their statutory harvesting rights.

Contact with F.N. and Metis groups involved:

- circulation of all project notices
- an introductory telephone discussion with the Scugog Island F.N.
- provision of a project description, project plan and preliminary E.A. results as requested by Curve Lake First Nation

At the Open House, one attendee requested involvement of a F.N. group called the "Sacred Water Circle Committee". Contact was made with this Committee by ORCA staff who offered to distribute all upcoming notification to that group.

With the exception of one information request during F.N. consultation, the ORCA has not received any response from F.N.'s on its project description letter.

10.6 Agency Consultation

The stated purpose of agency consultation is to inform and receive input from all government agencies with jurisdiction or a program interest related to the subject project.

The primary agencies contacted were as follows:

- Provincial Agencies
  - Conservation Ontario
  - Ministry of Aboriginal Affairs
  - Ministry of Energy and Infrastructure
  - Ministry of Municipal Affairs and Housing
  - Ministry of Natural Resources
  - Ministry of Tourism, Culture and Sport
  - Ontario Ministry of Environment
  - Ontario Secretariat for Aboriginal Affairs

- Federal Agencies
  - Aboriginal Affairs and Northern Development Canada
  - Canadian Environmental Assessment Agency

- Environment Canada
- Fisheries and Oceans Canada
- Transport Canada (NWPA Branch)

Municipal Official Plans, Otonabee Region Conservation Authority (ORCA) background documents and Peterborough District Ministry of Natural Resources (MNR) were consulted for relevant background information.

11.0 PRELIMINARY SELECTION OF OPTIONS

The Class Environmental Assessment process requires the identification and evaluation of all reasonable alternatives which would satisfy specific project objectives, based upon biological, physical, social, cultural, engineering and technical, economic, and regulatory determinants.

For the current E.A., the selection process for the most appropriate concept involved four steps; review of previous options, broadly defining all generic options, refining those options based upon site-specific studies and, selecting a preferred solution.

Generic alternatives considered are as follows:

11.1 Do Nothing

This option is self-evident, but it is not considered feasible since dam deficiencies, incremental flooding, risk to human life and property, and ensuing economic costs require attention. Although the ORCA has addressed the dam failure eventuality through several engineering studies, a final decision on remedial actions has not been taken. The serious concern for dam failure must, however, be addressed as soon as possible. The "do nothing" option is included in the EA to provide a background condition or, point of reference for comparison to other options.

11.2 Complete Removal of the Dam (Full Decommissioning)

Complete removal of the dam would eliminate the incremental flood hazard. That is, complete removal of the overflow weir, spillway and the earthen embankment would eliminate the headpond and provide a significant hydraulic advantage (i.e. with no dam or headpond in place there is no concern for incremental flooding due to dam failure). The headpond and dam footprint would be replaced with a flat, open area that could be developed into parkland favourable to terrestrial wildlife. As well, Baxter Creek could be restored to its pre-dam form and function thereby providing more natural aquatic habitat, as well. Thus, from public health and property and environmental safety perspectives, dam removal / decommissioning is acceptable.

Dam removal / decommissioning would, however, remove the historic value of the dam itself which is considered sacrosanct by village residents. As well, loss of the headpond would result in the loss of associated recreational, cultural, social and economic values. In addition, excavation of the larger embankment section of the dam would completely expose Needler's Mill to flood flows while concurrently removing the mill's penstock and intake. Furthermore, dam removal / decommissioning would be unnecessarily costly. Dam removal is, therefore, viewed as unacceptable from historic, recreational, cultural, social, economic and cost perspectives.

11.3 Channel Works

In some situations, flood mitigation may be achieved through channel works aimed at either the prevention of entry of flood water or containing flood flows to control incremental flooding:

- Increasing channel capacity downstream of the dam by construction of berms;
- Diversion of water (e.g. high flows) from the area to an adjacent watershed;

- Diversion of water bypassing flows around flood susceptible areas in and around Millbrook.

Examination of peak flow rates associated with the Timmins storm (181 cms) and the Probable Maximum Flood (350 cms) indicates that these methods do not appear to be technically or economically feasible, since channelization works to either divert the flood flows or convey them downstream would be massive - in the order of the size of the Otonabee River channel. Consequently, these structural methods to control incremental flooding due to dam failure are not available.

11.4 Reduce Probability of Dam Failure

This option would involve applying remedial measures to the existing spillway to re-establish structural integrity or, repairing the earthen embankment and rebuilding the spillway having the same conveyance capacity, all with an aim to keeping the dam in its current configuration while reducing the likelihood of failure due to over-topping and/or toppling or sliding. For example, it would be possible to line the earth embankments with geo-textile and riprap materials to increase the resistance of the earth embankments to erosive forces of water flowing overtop them. The Hazard Potential Classification and Inflow Design Flood resulting from dam failure do not, however, consider the probability / likelihood of dam failure, and instead, only consider that the dam will fail.

Maintaining the existing over-flow weir and spillway in their current configuration is also prevented by regulatory requirements. Owing to their age and state/condition, there is a near future need to address problems of deterioration (e.g., deteriorating concrete outlet/ spillway structure, and deteriorating wooden and sheet-pile weir-type control structure), which will require Ministry of Natural Resources approval under the Lakes and Rivers Improvement Act (LRIA) to rehabilitate, repair and/or replace. LRIA approval will, however, only be granted if it's demonstrated that the proposed works to address deterioration of the Millbrook Dam due to age also make the dam safe to the public by addressing the risk of incremental loss of life and property damage due to dam failure. It is well-documented however, that the current conveyance capacity of the outlet structure is not sufficient to protect downstream properties and /or human life. Hydraulic studies described earlier require approximately a fourfold increase in spillway capacity. Consequently, re-constructing the spillway having the existing capacity could neither be justified, approved or funded, and therefore, is deemed impractical.

11.5 Attenuation

In some cases flood mitigation may be achieved by attenuating flood waters upstream of a developed area to prevent entry of flood waters. That is, increasing upstream storage by:

- construction of upstream dams/impoundments to store flood flows during high volume runoff events, then gradually releasing the detained storage at a lower flow rate, over an extended period of time; and/or
- raising the elevation of an existing dam to increase the volume of storage in the dam's headpond.

Creating storage capacity well upstream of the Millbrook Dam is not a reasonable solution for technical and economic reasons, since flood water volumes are too large. It is estimated, for example, that it would require a minimum storage volume of 3.01 million cubic metres to attenuate the Timmins Regional Storm. This is almost 2 times the volume of the Rogers Centre in Toronto (with the roof closed, the volume of the Rogers Centre is 1.6 million cubic metres). Hence, increasing storage capacity upstream of the existing Millbrook Dam and headpond is not a solution to reducing the incremental flood hazard and associated risks to acceptable levels.

Increasing the magnitude of storage capacity of the Millbrook Dam's headpond itself was also reviewed as a possible remedial measure. Increasing the storage capacity of the reservoir would involve raising the elevation of the existing Millbrook Dam over-flow weir, concrete wingwalls of the spillway and earth embankments to increase the maximum water level that can be contained in the Millbrook Dam's headpond. The minimum volume of storage that would be required would need to be sufficient to attenuate the regulatory flood standard (i.e., Timmins Regional Storm), and is estimated to be 3.01 million cubic meters. This is in the order of 6500 times the current storage capacity of the Millbrook dam reservoir. Clearly, enlarging the Millbrook dam to contain such a large volume of run-off could not be achieved. Further, owing to the regulatory requirements of the Lakes and Rivers Improvement Act, the Ministry of Natural Resources is unlikely to approve a project proposal to increase the height of the dam. Hence, increasing the volume of storage in the Millbrook Dam's headpond is not a reasonable solution.

11.6 Increase Hydraulic Capacity and Lower Reservoir

In 2008, the Otonabee Region Conservation Authority contracted IBI to complete hydrotechnical analysis, dam classification, stability analysis, and dam safety review of the Millbrook Dam. Evidence contained in this report demonstrated that when a spring freshet or storm event causes flows of 100 cubic metres per second (cms), or more, in the main channel of Baxter Creek, the extent, depth and velocity of naturally occurring flooding within the developed area is such that a dam failure would not appreciably add to the pre-failure flooding. As a result, there is no increased potential for loss of life and/or property damage and/or social and economic disruption and/or environmental harm if the dam fails coincidence with spring freshet or storm conditions producing flows of 100 cms, or more.

On the other hand, the occurrence of dam failure at times when a spring freshet or storm produces flows below 100 cms, the wave of water caused by dam failure does flood the downstream residential and commercial area to a greater extent, depth and velocity, thereby causing an incremental flood hazard in the downtown core of Millbrook. Furthermore, even when dam failure occurs when there is no accompanying run-off event (i.e., "Sunny Day Failure"), the result is incremental flooding potentially causing loss of life, property damage, social and economic disruption, and environmental harm.

The solution, IBI (2008) concluded was to increase the capacity of the dam's outflow structure from the current 27 cms to that of 100 cms. The question then became what type and design of outflow / control structure is best suited to increasing the hydraulic capacity of the dam to a minimum of 100 cms while also best preserving the biological, physical, recreational, social, cultural and heritage characteristics and values of the study site.

Further, IBI (2008) determined it necessary to maintain the surface elevation of the headpond at 0.5 meters below the current setting. This was needed to reduce hydrostatic pressure, create the minimum 300 millimeter freeboard required for MNR Lakes and River Improvement Act approvals, and to lessen the extent, depth and velocity of downstream flooding in the event of dam failure during dry weather conditions (i.e., Sunny Day failure). Also, seepage control measures and additional toes berms were deemed necessary to further stabilize the dam and increase the factor of safety to an acceptable level.

Having established through previous engineering studies, and in particular the independent analysis completed by IBI Group (2008), that the solution to relieving the incremental flood hazard and associated risks during storm events lies in **increasing the hydraulic capacity of the outflow / control structure to carry additional flow**, the next step in screening of remedial flood control measures was to explore how best to increase hydraulic capacity.

11.6.1 *Increase Water Level in Headpond*

Public suggestions to raise the crest of the dam by 0.5m to its original height prior to settling have been acknowledged but, would not be to advantage. Raising the elevation of the existing Millbrook Dam weir-type water control structure, concrete wingwalls of the spillway and earth embankments to increase the maximum water level in the Millbrook head pond can effectively increase the flow capacity of the Dam's outflow conveyance structure, but there are several reasons why this is not desirable: 1) high costs required to increase the height of a failing 200 year-old dam are not considered justifiable; 2) raising dam height would increase the upstream hydrostatic pressure on a dam which is currently in danger of failure; and, 3) increased storage capacity in the headpond means that the extent, depth and velocity of downstream flooding caused by the wave resulting from dam failure are also increased. Consequently, there is no hydraulic advantage is provided by raising the dam crest.

11.6.2 *Stoplog or Manual Actuation Water Control Gates*

The size of the watershed above Millbrook is relatively small. As a result, when heavy rainfall occurs, water level and flow conditions in Baxter Creek change relatively quickly. As a highly dynamic watercourse, there is little, or no, time to operate either stoplogs or manual actuation gates, which is what occurred in 1980 when the stoplogs could not be removed before flood waters over-topped the Millbrook Dam. That is, neither stoplogs or manual actuation gates are an effective means of controlling water levels in the Millbrook head pond mainly because these involve manually monitoring meteorological and hydrological conditions and deciding when to increase and decrease outflows and by how much, as well as manually operating the structure.

11.6.3 *Automatic Actuation Water Control Gates*

Fully automatic actuated gates employing computers, data logging, sensory equipment, electric motors and pneumatic systems ("smart gates") in theory do not require a human decision-maker or human operation. In practice, however, operational functionality of automated systems cannot be guaranteed even with regular and on-going intensive maintenance and attention. Provisions for a manual system are, therefore, necessary as back-up. Thereby, automated water control gates do not entirely control for the possibility of human error. An automated water control structure cannot, therefore, be relied on to control the risk of incremental loss of life, property damage, economic and social disruption and/or environmental harm associated with failure of the Millbrook Dam.

11.6.4 *Remove Existing Outlet Structure and Widen Opening*

Removal of the existing over-flow weir and spillway, as well as adjoining earthen embankment, can be considered. Under this condition, the spillway would be removed and the opening in the adjacent embankment widened sufficiently to accommodate the required flows. In doing so, the new spillway would meet all current dam safety standards.

11.6.5 *Rebuild Outlet Structure using Different Configuration*

This alternative would involve reconstruction of the spillway with a new, larger overflow weir, sized to convey the required increased flows. The new structure would be inoperable (i.e.no stop logs, gates, valves or other control mechanisms) and flows would be controlled solely by the elevation of the weir crest. Concurrent with spillway reconstruction, the earthen embankment would be sealed to prevent undermining. Spillway reconstruction in the form of a new weir along with embankment repair represents a viable solution.

12.0 PRELIMINARY SCREENING OF ENVIRONMENTAL EFFECTS

Having discussed generic options above, it is necessary to evaluate the preliminary effects of the selected dam removal and dam replacement initiatives. In compliance with Conservation Ontario (2009) procedures, Table 12-1 has been prepared to address potential adverse effects of each option.

The purpose of the required preliminary screening is two-fold:

i) It provides information to the study team as to which areas of study are most important and allows an opportunity to re-design studies at the early stages of the E.A., to address pertinent concerns.

ii) It provides an overview level of scrutiny to identify potential effects for all project phases being planning, design, construction and operation. All effects are considered; engineering, social and ecological.

When identifying potential effects, the study team recognized that previous remedial concepts had been prepared by IBI (2008). The engineering work for those concepts was used in preparing the subject table.

Table 12-1

Preliminary Environmental Screening

Screening of Potential Effects as negative (-), neutral (NIL) or positive (+) and rating them as relatively high (H), medium (M), low (L) or not applicable (NA)

Screening Criteria	Rating of Potential Effect								Detailed Comments
	- H	- M	- L	NIL	+ L	+ M	+ H	NA	
Physical									
Unique Landforms								X	
Existing Mineral/Aggregate Resources Extraction Industries								X	
Earth Science - Areas of Natural and Scientific Interest								X	
Specialty Crop Areas								X	
Agricultural Lands or Production								X	
Niagara Escarpment								X	
Oak Ridges Moraine								X	
Environmentally Sensitive/Significant Areas (physical)								X	
Air Quality			X						Possible odour from vehicular exhaust during construction. Potential temporary odour from decomposition of sediments when headpond is drained for construction.
Agricultural Tile or Surface Drains								X	
Noise Levels and Vibration			X						Possible noise and vibration from operation of equipment during construction. Possible additional noise and vibration from driving sheet piling to seal the earth embankment.
High/Storm Water Flow Regime		X							Potential project damage / flooding during construction.
Low/Base Water Flow Regime				X					
Existing Surface Drainage and Groundwater Seepage			X						Redirection of drainage & seepage to provide adequate outlet may be required during construction
Groundwater Recharge/Discharge Zones				X					
Littoral Drift								X	
Other Coastal Processes								X	
Water Quality		X							i) Possible sediment run-off/turbidity issues during construction phase that could be harmful to fish & fish habitat, ii) Thermal effects of impoundment.
Soil/Fill Quality				X					Importation of common fill is not anticipated.

Table 12-1

Preliminary Environmental Screening (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments
	- H	- M	- L	NIL	+ L	+ M	+ H	NA	
Contaminated Soils/Sediments/Seeps	x								Although one preliminary sediment analysis shows no contamination, additional sampling is needed.
Existing Transportation Routes			X						Possible disruption to normal flow of traffic during construction.
Constructed Crossings (e.g. bridges, walkway)			X						Possible disruption to normal flow of village traffic during construction.
Geomorphology			X						Potential watercourse and shoreline damage resulting from construction.
Other									
Biological									
Wildlife Habitat			X						Potential changes to nearshore terrestrial habitat for bird, mammals, and amphibians require further ecological study.
Habitat Linkages or Corridors (Terrestrial)			X						Linkages are unknown and require further ecological study.
Significant Vegetation Communities			X						Requires further ecological study.
Environmentally Sensitive/Significant Areas (biological)			X						Requires further ecological study.
Fish Habitat	X								Only rudimentary facts are known- requires further ecological study.
Species of Concern (e.g. species at risk, vulnerable/threatened/ endangered species, conservation priorities - either flora or fauna)	X								Requires further ecological study.
Exotic/Alien and Invasive Species			X						Requires further ecological study.
Wildlife/Bird Migration Patterns (No information)			X						See Habitat Linkages above.
Wildlife Population				X					No significant changes anticipated.
Wetlands	X								Unknown- requires study during E.A. –upstream wetlands are unevaluated, and therefore, potential loss of wetlands associated with removal or lowering of headpond requires further study.
Microclimate								X	
Life Science ANSI's								X	
Unique Habitats			X						Requires further ecological study.
Other: Riparian Habitats			X						Widespread adverse effects on riparian habitat are unlikely. Natural restoration would occur following construction.
Cultural									
Traditional Land Uses			X						No known effects to First Nations rights/use or Metis harvesting rights anticipated. Consultation required.
Aboriginal Reserve or Community								X	

Table 12-1

Preliminary Environmental Screening (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments
	- H	- M	- L	NIL	+ L	+ M	+ H	NA	
Outstanding Native Land Claim			X						Requires further study.
Transboundary Water Management Issues								X	
Riparian Uses				X					No sweeping changes envisaged
Recreational or Tourist Uses of a Water Body and/or Adjacent Lands	X								Potential changes to extensive headpond use for recreation/community gathering/fishing/viewing (critical importance)
Recreational or Tourist Uses of Existing Shoreline Access Locations	X								As above (critical importance)
Aesthetic or Scenic Landscapes or Views	X								As above (critical importance)
Archaeological Resources, Built Heritage Resources and Cultural Heritage Landscapes (Needler's Mill)	X								Built Heritage Resources (particularly Needler's Mill) are among the highest valued features of village residents. Archaeology Study required (critical importance)
Historic Canals								X	
Federal Property								X	
Heritage River System								X	
Other									
Socioeconomic									
Surrounding Neighbourhood or Community	X								Study area is the social centre of Millbrook. Residents have strong ties to the area. Downtown business and tourism are partially dependent on the dam and headpond area (critical importance)
Surrounding Land Uses or Growth Pressure	X								Residents backing onto the headpond consider it a important asset to their properties both monetarily and socially.
Existing Infrastructure, Support Services, Facilities				X					
Pedestrian Traffic Routes			X						Potential route alteration by remedial measures.
Property Values or Ownership	X								Perceived potential for property value reduction. Community perceives that neighbouring property values are higher because of adjacent millpond (critical importance).
Existing Tourism Operations								X	No known current tourist operations.
Property/Farm Accessibility			X						See "Existing Transportation Routes" above.
Other: Life Cycle Costs to Dam Owner	X								Costs and liability to dam owner to accelerate with time.
Engineering/Technical									
Rate of Erosion in Ecosystem			X						Potential for erosion to occur during construction phase due to exposure of unconsolidated materials- mitigate with appropriate erosion control measures.

Table 12-1

Preliminary Environmental Screening (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments
	- H	- M	- L	NIL	+ L	+ M	+ H	NA	
Sediment Deposition Zones in Ecosystem	X								Significant volumes of sediment have accumulated in the headpond and must (in part at least) be removed prior to and/or during construction. Sediment releases to downstream Baxter Creek are a serious concern.
Flood Risk in Ecosystem (natural and Regulatory floodplain)								X	
Slope Stability				X					
Existing Structures								X	
Hazardous Lands								X	
Hazardous Sites			X						Potential for soil contamination from previous coal storage. Neither dam removal nor replacement will impinge on former coal shed locations
Producing the desired effect by addressing the problem of incremental loss of life, property damage and environmental harm due to dam failture							X		Dam removal or replacement would eliminate future risks to incremental property damage and loss of life
Legal and Administrative Requirements including approvals under: Navigable Waters Protection Act; Fisheries Act; Permit to Take Water; Lakes & Rivers Improvement Act; Conservation Authorities Act, etc.			X						Approvals can be obtained using standard procedure. Limited risk anticipated.
Safety and Liability Issues	X								Current high level of risk continues if incremental risk of property damage and loss remains unmitigated.

13.0 EVALUATION OF ALTERNATIVES

13.1 General Construction Sequence

A description of construction procedures is required in order to identify the environmental effects of construction and to provide mitigation for these activities. In essence, two general remedial scenarios have been recommended for consideration: spillway removal and spillway replacement (each with variations). The primary construction issues for both concepts are similar in that, a new spillway would be built and that extensive excavation of headpond sediment is required.

i) Sediment Excavation

Discussions with an experienced contractor indicates that removal of headpond sediment may be completed "in the dry" using standard heavy equipment, or by mechanical dredging. Excavation in the dry would require pre-draining of pond and would be dependent on the ability of the headpond bottom (below the sediment) to support heavy construction equipment. Determination of soil strength would require future geotechnical testing.

Alternatively, mechanical excavation using a barge-mounted excavator and off-loading into waiting trucks could be utilized. In this case, pond excavation would begin in deeper water near the dam to facilitate barge floatation and would proceed progressively southward to completion.

In both cases, excavated materials would be removed from the site by truck.

ii) Construction Staging

Relocation of the creek/drainage channel is central to construction procedures whether the spillway is removed or, a new weir is constructed. Basically, the same steps apply to both options, but, in a different sequence. Figure 13-1 shows staging for the new weir concept. Initially, a flow diversion structure (possibly a sheet pile wall) would be constructed between the south end of the island and the mainland to speed drainage of sediments and enable excavation to the west of the island. Concurrently, a diversion channel would be constructed through the dam embankment, west of the existing spillway to carry flows safely into downstream Baxter Creek. The spillway site would then be coffer dammed. Excavation and construction of the new weir would begin. Following drainage and excavation of "west side" sediments, the sheet pile flow diversion structure would be relocated to form a barrier between the island and eastern shoreline. In doing so, Baxter Creek flows would be directed to the west of the island and through the dam's channel diversion to downstream Baxter Creek. Once weir construction is completed the diversion channel would be filled, and the sheet pile flow diversion structure (at the island) and the coffer dam would be removed, allowing the headpond to refill and the weir to become functional.

LEGEND

Stage 1 Excavation

Stage 2 Excavation

0 30 60 120 Meters

Client:	**OTONABEE CONSERVATION**
Title:	**Construction Measures-Sediment Excavation & Water Management**
Prepared by:	MMM GROUP
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	**Figure: 13-1**

13.2 The "Do Nothing" Option

Under a "Do Nothing" condition, no action would be taken; neither structural nor operational, nor social. The necessary remedial construction, though critical to protecting property and human life, would not be completed. Accelerated structural deterioration of the dam would be a likely consequence. Seepage beside and beneath spillway and other parts of the dam would continue, resulting in eventual failure. The spillway section has failed once in the past.

Existing recreational, community and ecological functions would continue in the study area for as long as the dam is able to support a headpond.

Neither mitigation nor regulatory approvals are needed. More formal and detailed monitoring, however, would be required since continuing dam deterioration and increasing risk of failure are expected.

It is the study team's opinion that retaining the "status quo" by doing nothing leaves the dam, Needler's Mill and downstream Millbrook in a vulnerable state and would ensure eventual failure of the dam.

13.3 Concept A: Spillway Removal and Channel Restoration

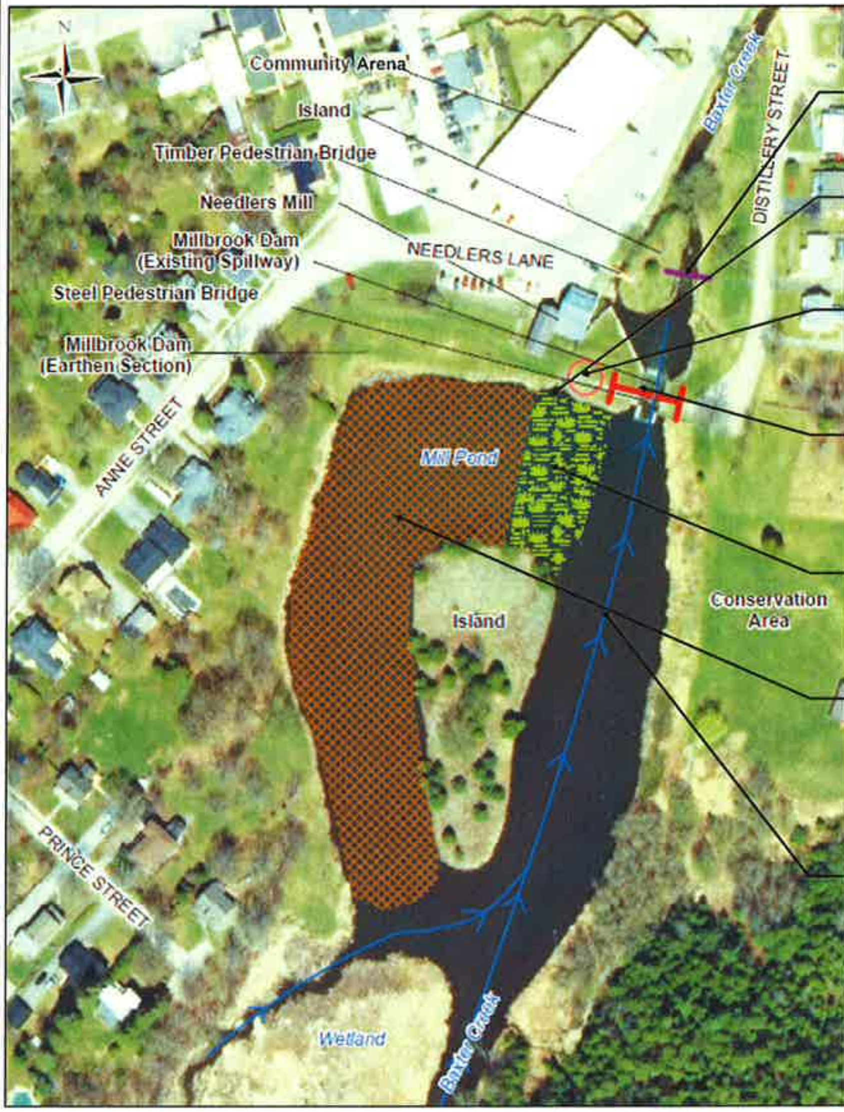
Concept A (Figure 13-2) is predicated on the assumption of:

- removing the existing spillway and constructing a larger opening in its place
- restoring Baxter Creek to its "original" alignment paralleling the eastern headpond shoreline, and,
- creating new parkland on the western part of the headpond by filling with materials excavated from the new channel of Baxter Creek

In this case, the spillway would be deepened by approximately 0.3m and widened from the existing 7.2m to approximately 30m. The new spillway bottom and side slopes would be fitted with a hard surface to prevent erosion. The new Baxter Creek channel would be excavated and fitted with a series of rock weirs, creating a stepped pool system to maintain a steeper stream gradient between the new spillway and the wetland at the headpond inlet. Excavated sediments (if suitable) would be placed to the west of the island and compacted to create new parkland. New lands created on the headpond's western half would be used for passive recreation and could contain a junior-sized soccer field. The penstock intake would be retained as a matter of historic interest. Alterations to Needler's Mill would not be envisaged. Additional amenities may be introduced in the form of a scenic lookout on the high point of the dam (west of the spillway) or a small wetland created between the island and the dam for educational purposes. The existing pedestrian bridge over the spillway would be removed and new access across Baxter Creek would be provided by a new bridge at the island immediately below the dam.

From an engineering perspective, spillway removal and widening would fulfill the requirements of MNR's current Dam Safety Guidelines. This approach would eliminate both the

Concept A Features



- Construct New Pedestrian Bridge at Downstream Location
- Retain Penstock intake (non-functional)
- Landscaped "Lookout"
- Remove Dam and Widen Spillway (Remove Existing Pedestrian Bridge)
- Create Wetland Pocket
- Create Parkland Between Island and West Shoreline
- Excavate New Creek Channel (stepped weir-pool sequence), Place Excavated Sediment on West side of Island

0 25 50 100 Meters

Client: OTONABEE CONSERVATION	
Title: Concept A: Spillway Removal & Channel Restoration	
Prepared by: MMM GROUP	
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	Figure: 13-2

existing spillway and the headpond and, consequently the incremental flood hazard. The enlarged opening would be capable of conveying the required IDF of 100 cms, would eliminate the effect of a flood wave.

In terms of solely dam safety, removing the dam altogether is the ultimate solution. Consequently, there is no longer the risk of failure and consequent damages. In addition, there is no longer the need to address continuous maintenance operations and regulatory requirements. The scope of spillway removal however, requires a significant amount of work to accomplish its ends and includes a broader scope of work than simply upgrading the spillway. The headpond has accumulated sediment which must be controlled as the dam is being removed and ultimately removed from the new water course to allow the channel to return to a more "natural" configuration. Geotechnical testing for both sediment quality and strength are necessary to determine if contamination is present and to determine structural suitability for park construction.

Staging for the work is similar in nature to dam construction with requirements for coffer damming, dewatering, permitting and detailed engineering of structures, channels and slopes surrounding the site. As the dam is removed, it would be necessary to temporarily redirect flows around work areas and consider the possibility of floods during construction. In most areas, the footprint of work would extend well beyond the spillway and channel as the land is recontoured for new uses including stable and attractive shorelines.

After completion of the project, the new channel will require some monitoring and maintenance until a new equilibrium is achieved. Existing infrastructure, walking paths and the pedestrian bridge would be modified to accommodate the new water course. Costs for future sediment dredging are eliminated along with any operations costs and structural maintenance costs are reduced.

Costs for dam removal are shown in Table 13-1 and total approximately $3.1M.

From a social perspective, substantial loss of aesthetics, historic context, recreational utility and community focus, would result from the permanent draining of headpond. Water based activities such as the annual fishing derby, canoeing, ice skating, viewing of aquatic biota and, the general feeling of "well-being" provided by headpond aesthetics would disappear. From a business standpoint, the relationship between commerce with the village and dam, headpond, mill complex may suffer as reflected in reduced sales of local merchants. The historical and functional link among the dam and headpond (as a waterpower source) and Needler's Mill would no longer be obvious. Social benefits would however, accrue due to the removal of incremental flooding and loss of life issues.

From an ecological perspective, anticipated impacts to the aquatic and terrestrial environment are judged to be **high,** relative to the existing conditions. The alteration from a lotic to lentic environment of the east side of mill pond will alter water quality (e.g. increase dissolved oxygen, decrease temperature) and the existing aquatic system. It is anticipated that the presence of migratory birds, amphibians and most of the existing fish species may be altered, as these species are generally dependent on low-flow conditions. Fish habitat will be destroyed by

Table 13-1

Preliminary Construction Cost

Concept A: Spillway Removal & Channel Restoration

1	Mobilization & Demobilization		$250,000
2	Access Road		$25,000
3	Coffer Dam & Dewatering		
	3.1	Coffer Dam West of the Existing Dam	$120,000
	3.2	Coffer Dam South of the Existing Dam	$80,000
	3.3	Coffer Dam Downstream of the Existing Dam	$40,000
	3.4	Bypass Channel Through Earthen Section	$30,000
4	Penstock Sealing		$10,000
5	Remove Existing Pedestrian Bridge		$5,000
6	Remove Dam and Widen Spillway		
	6.1	Removal of Existing Concrete Abutment	$50,000
	6.2	Removal of Existing Weir	$30,000
	6.3	Removal of Existing Sheet pile	$10,000
	6.4	Soil and Rock Excavation	$30,000
7	Excavate New Creek Channel		$480,000
8	Create New Creek Channel		
	8.1	Riffle Structures in New Creek Channel	$90,000
	8.2	Invert Erosion Protection	$280,000
	8.3	Rip-Rap Slopes	$80,000
	8.4	Landscape Side Slope	$30,000
9	Create Overbank West of "Island"		
	9.1	Place Excavated Sediment on West Side of Island	$240,000
	9.2	Create Parkland Between Island and West Shoreline	$200,000
10	Create Wetland Pocket & Lookout (Optional)		$43,750
11	Install Seepage Barrier to Protect Mill Building		$150,000
12	Distillery Street Termination		$20,000
13	Pathway to New Bridge (at Island)		$20,000
14	New Pedestrian Bridge Concrete Foundation (at Island)		$30,000
15	New Pre-Engineered Pedestrian Bridge (at Island)		$70,000
Engineering Fees			$193,000
Contingencies (20%)			$483,000
TOTAL			**$3,090,000**

*Note: Actual costs will only be determined once final design is in place.

infilling approximately half of the pond. It is expected that consultation with the Department of Fisheries and Oceans (DFO) will be required to determine the extent of impact and to design habitat compensation, whereby new fish habitat may need to be created or existing habitat, enhanced. The anticipated level of aquatic alteration warrants a more in-depth study of the fishery, herpetofauna, avian and mammal species to ensure linkages and optimal habitat is not lost. Appropriate mitigation and compensation should be outlined to address the potential loss of significant and Species at Risk habitat.

From a geomorphological perspective, Concept A has the potential to have significant positive impacts on geomorphological function of the system by removing a barrier and re-instating integrity of Baxter Creek as a system. However, there are some technical difficulties associated with realising these benefits. The channel downstream has adjusted to the presence of the dam, removing the dam could lead to instability upstream (through downcutting into the creek bed) and downstream (through scour). This would need further evaluation. Also, there is a layer (depth unknown) of fine silty material that has dropped out upstream of the dam, this is not suitable material for a channel to be situated in and, it would be necessary to import materials to construct the new channel. Depending on the channel slope, it may not be appropriate to create a pool-riffle morphology typically found within Baxter Creek unless channel length can be increased through meandering to compensate for the increased slope. A step-pool design may be more appropriate.

In terms of sediment transport, removal of dam will allow for reinstatement of sediment movement through the system which has been starved of sediment since the installation of the dam. As well as having benefits in terms of geomorphological processes and habitat, Concept A would eliminate the need for headpond dredging.

When considering channel processes and morphology, riffle-pool or step-pool design would improve morphological diversity and provide opportunities for energy dissipation. Temporary impacts from release of fine sediment during construction as well as erosion risk associated with construction would be managed through an erosion and sediment control plan.

Based upon the discussion above, the study team concludes that dam removal does not represent a viable solution. Although having the advantages of providing dam safety and reinstatement of a barrier-free Baxter Creek, this scenario falls short of providing social benefits. In actual fact, existing social benefits are lost if dam removal is implemented. Subsequent concepts are superior in providing community benefits.

13.4 Concept B: Spillway Removal with Off-Line Pond

Concept B (Figure 13-3) is based on similar principles utilized in Concept A as follows

- removal of the existing spillway followed by a construction of a larger spillway (as per Concept A)
- restoration of the Baxter Creek channel alignment and,

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 13-3 Concept B- Spillway Removal with Off-line Pond.pdf

Concept B Features

Construct New Pedestrian Bridge at Downstream Location

Install Seepage Barrier to Protect Mill Building

Remove Penstock intake

Remove Dam and Widen Spillway (Remove Existing Pedestrian Bridge)

Construct Landform "A" Using Excavated Sediment

Excavate New Creek Channel (Natural Channel Design Is Questionable: Stepped Weir System More Likely)

Construct Landform "B" using Excavated Sediment and Install Culvert for Flushing

0 25 50 100 Meters

C - - - - - C - SECTION

Source: © 2012 Cnes/Spot Image, Image © 2012 DigitalGlobe

Client:	OTONABEE CONSERVATION
Title:	Concept B: Spillway Removal with Off-line Pond
Prepared by:	MMM GROUP
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	Figure: 13-3

- creating a new off-line pond in the western part of the existing headpond. Pond depth would be approximately 1.7m after sediment removal.

For Concept B, the spillway would again be deepened and widened as per details provided for Concept A. Similarly, the new Baxter Creek would be excavated and oriented toward the east side of the headpond and fitted with a step-pool channel design (Figure 13-3). In contrast to Concept A, a new pond would be created by excavation to the west of the island. The pond would be contained by two impermeable, earth-fill landscape features (dykes) joining the island to the headpond shoreline as shown in Cross Sections A-A and B-B (Figures 13-4). Pond elevation would be set at same elevation (215.1m) as the existing headpond. The pond would be fed from two sources:

- streamflow from Baxter Creek through a culvert in Landform B, and;
- by groundwater from the adjoining land mass.

Pond elevation would be maintained by an overflow section in Landform A.

Section C-C on Figure 13-4 schematically shows the physical relationship between the new pond elevation and the new Baxter Creek. Excavated material would be removed from the site, following sediment quality analysis (as per disposal requirements) and/or used in landform features A & B if suitable for the purpose.

Since water would rest against the dam as it does at present, an impermeable barrier (likely sheet pile) would be constructed to prevent seepage and continuing erosion of the dam's foundation. Once again, a new pedestrian bridge at the island below the dam would replace the existing spillway bridge.

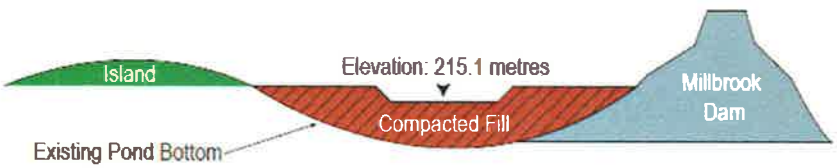
Needler's Mill would remain unaltered.

From an engineering perspective, all dam safety requirements are fulfilled and risks of loss are eliminated by the removal of the high hazard situations. Once again, the absence of the dam and headpond would remove incremental flood risks. The off-line pond is created and maintained by two landforms features which in the opinion of the study team are not considered to be true "dam" and consequently exempt from current dam safety design criteria and approvals. In effect, the new pond proposed would be similar to a large farm pond supplied by groundwater.

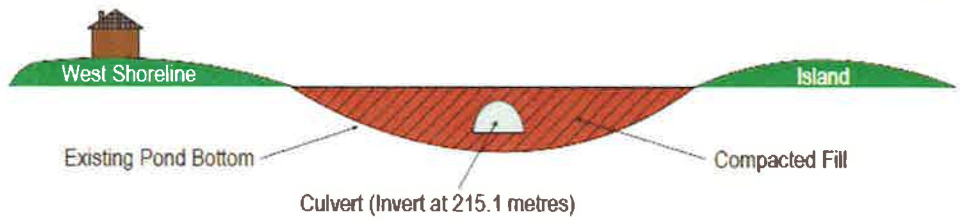
Detailed design of this concept would require a "water balance" analysis to determine the viability of groundwater contribution and the expected fluctuation of headpond water levels. The Millbrook vicinity has a history of "high water table" and artesian conditions and, cold water streams are frequent. In the absence of groundwater research, it is speculated that a reliable supply of groundwater would likely exist.

Staging of construction work and operating costs are similar to that of Concept A. Future maintenance dredging would be eliminated and structural maintenance costs would be reduced. Construction costs for Concept B are presented on Table 13-2 and are approximately \$3.25M.

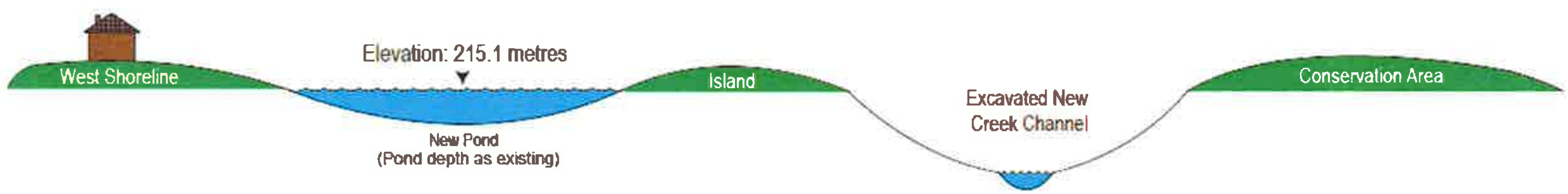
1) LANDFORM "A", SECTION A-A



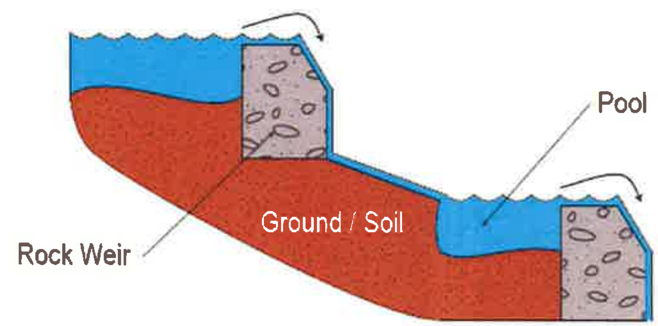
2) LANDFORM "B", SECTION B-B



3) SECTION C-C



4) STEPPED ROCK WEIR / POOL SYSTEM



Client:	**Otonabee Conservation**
Title:	**Concept B: Cross Sections**
Prepared by:	MMM GROUP
14.12216.001.P01	Not To Scale / Review: JB
Date: June 2013	**Figure:13-4**

Table 13-2

Preliminary Construction Cost

Concept B: Spillway Removal with Off-line Pond

1	Mobilization & Demobilization		$250,000
2	Access Road		$25,000
3	Coffer Dam & Dewatering		
	3.1	Coffer Dam West of the Existing Dam	$120,000
	3.2	Coffer Dam South of the Existing Dam	$80,000
	3.3	Coffer Dam Downstream of the Existing Dam	$40,000
	3.4	Bypass Channel Through Earthen Section	$30,000
4	Penstock Sealing		$10,000
5	Remove Existing Pedestrian Bridge		$5,000
6	Remove Dam and Widen Spillway		
	6.1	Removal of Existing Concrete Abutment	$50,000
	6.2	Removal of Existing Weir	$30,000
	6.3	Removal of Existing Sheet piles	$10,000
	6.4	Soil and Rock Excavation	$30,000
7	Excavate New Creek Channel		$480,000
8	Create New Creek Channel		
	8.1	Riffle Structures in New Creek Channel	$90,000
	8.2	Invert Erosion Protection	$280,000
	8.3	Rip-Rap Slopes	$80,000
	8.4	Landscape Side Slope	$30,000
9	Dispose of Excess Excavation		
	9.1	Temporary Storage & Place Excavated Sediment on West Side of Island	$360,000
10	Create Landforms		
	10.1	Construct Landform "A" Using Excavated Sediments	$150,000
	10.2	Construct Landform "B" Using Excavated Sediments and Install Culvert for Flashing	$90,000
	10.3	Landscaping of Landforms	$8,000
11	Install Seepage Barrier to Protect Mill Building		$150,000
12	Distillery Street Termination		$20,000
13	Pathway to New Bridge (at Island)		$20,000
14	New Pedestrian Bridge Concrete Foundation (at Island)		$30,000
15	New Pre-Engineered Pedestrian Bridge (at Island)		$70,000
Engineering Fees			$203,000
Contingencies (20%)			$508,000
TOTAL			**$3,249,000**

*Note: Actual costs will only be determined once final design is in place.

From a social perspective, Concept B represents an improvement over its predecessor in that a water surface is maintained, although half the size of the existing headpond. The retention of partial headpond aesthetics somewhat balances water surface removal in the new Baxter Creek channel. The proposed headpond with its increased depth would be conducive to supporting recreation activities such as fishing, canoeing and possibly swimming, the latter being dependant on water quality bacteriology.

Historic linkages are in part maintained, in that the earthen section of dam would remain intact and Needler's Mill would not be adversely affected, but its penstock intake (though visible) would constitute lesser historic value since it would be masked by Landform A. Provision of a seepage barrier would effectively prevent subsurface erosion and further damage to the Needler's Mill foundation. Use of Needler's Mill and environs for community gatherings would continue without long-term interruption. Passive pursuits such as walking, appreciation of aesthetics and nature viewing could be enhanced by a walkway along the Landform A, the island and, Landform B. Once again, risks to life and property are eliminated.

From an ecological perspective, anticipated adverse impacts to the aquatic and terrestrial environment are anticipated to be **moderate,** relative to the existing conditions. The east side of the existing headpond will alter from a lotic to lentic environment, which would generally displace species from the area; however, the western side of the pond will be maintained as a low-flow system. It is anticipated that the western side of the pond will continue to provide a migratory stopover site and foraging and nesting opportunities for birds although in a reduced capacity. The low-flow environment will also provide suitable habitat to herpetofauna. The combination of habitat types, such as the forested region directly adjacent to the pond, may be necessary for life stages of certain species (e.g. Northern Ribbon Snake). This option intends to alter this combination to a forested region directly adjacent to a quick-flow environment.

Concept B warrants additional study to confirm fauna using the pond and effects related to loss of combination habitat. Potential enhanced opportunities should be considered (e.g. the placement of logs and large debris in the pond for reptile basking). Lastly, a detailed study should be carried out to identify the anticipated alteration to the fishery within the pond and ways in which the new ponded area can be enhancement. This may include the placement of gravel and boulders to provide suitable spawning and cover opportunities and possibly the construction of riffle pool sequences within the riverine portion.

From a geomorphological perspective, previous comments in Concept A apply to Concept B.

In the opinion of the study team, Concept B partially retains social and ecological integrity of the study area. A major question raised by both the study team and the public pertains to pond permanence and the availability of groundwater supply which remains unstudied at this time. Since the reliability concern represents an "unknown", standard E.A. practice would eliminate Concept B as a viable option.

Concept C Features

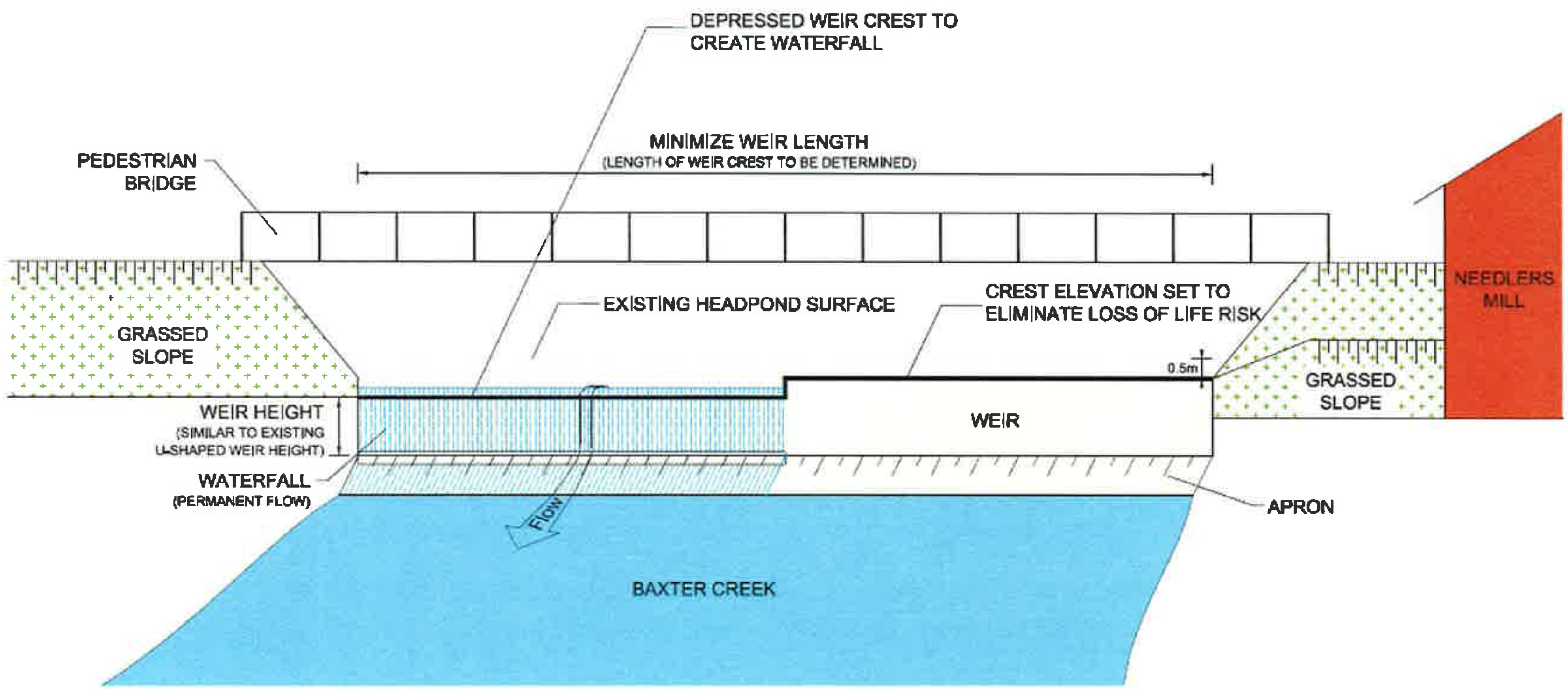
- Place Impermeable Fill to Reinforce West End of Dam
- Install Impermeable Barrier to Prevent Seepage/Erosion of Dam Foundation
- Remove Existing Weir and Spillway, Construct New Weir Minimizing Weir Length, Construct New Pedestrian Bridge and Waterfall
  Note: New Weir Crest is 0.5m Below Existing Head Pond Level
- Retain Penstock Intake
- Remove Sediment to Create Head Pond Water Depth averaging 1.0m

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 13-5 Concept C- Dam Reconstruction with Headpond Retention.pdf

0 25 50 100 Meters

Source: © 2012 Cnes/Spot Image, Image © 2012 DigitalGlobe

Client:	OTONABEE CONSERVATION
Title:	Concept C: Dam Reconstruction with Headpond Retention
Prepared by:	MMM GROUP
14.12216.001.P01	Scale as Shown / Review: JB
Date: May 2013	Figure: 13-5



NOTES:

i) PROPOSED WEIR CREST IS AT AN APPROXIMATE ELEVATION OF 214.6m, WHICH IS 0.5m LOWER THAN THE EXISTING WEIR CREST
ii) FINAL DESIGN (ENGINEERING) STUDIES TO RE-ADDRESS WEIR CREST ELEVATION
iii) DREDGING OF HEADPOND IS NEEDED TO MAINTAIN WATER SURFACE AREA

Client:	**Otonabee Conservation**
Title:	**Concept C: Proposed Weir (Looking Upstream)**
Prepared by:	MMM GROUP
14.12216.001.P01	Not To Scale / Review: JB
Date: June 2013	**Figure:13-6**

M:\Jobs\2012\14.12216.001.P01 - Millbrook Dam EA\GIS\Documents\Figure 13-6 Concept C-Proposed Weir (Looking Upstream).pdf

13.5 Concept C: Spillway Reconstruction with Headpond Retention

Concept C (Figures 13-5 and 13-6) is based upon:

- replacement of the existing spillway with a new weir capable of passing the required design flows
- retention of the headpond and,
- headpond sediment removal
- retention of as many social functions/features as possible.

In order to achieve the planned outcome of Concept C, the following would be required.

- removal of the existing spillway and replacement with a new, stepped concrete weir – Figure 13-6 shows a schematic view of the downstream face of the proposed weir which would be built on the location of the existing spillway. The weir would be approximately 36m long (compared to the existing 7m spillway) which is the minimum length of a straight weir needed to convey the 100cms IDF. The weir crest would be set at approximate elevation 214.6m in order to safely convey design flows. This is the highest elevation that technically can be used, while still passing the required design flow. The weir crest would be "stepped" so that the entire weir length would be used to convey the required high flows while low flows would be contained in the lower step which, when conveying water over the dam would create a waterfall effect producing sights and sounds similar to the existing overflow (U-shaped weir). Inclusion of the waterfall effect was of public request.
- excavation of sediment accumulations in the headpond
- reinstatement of the headpond. The headpond surface would be controlled by the weir crest at approximate elevation 214.6m. The headpond bottom would be in the range of 212.8 and 213.9m approximating the "natural bottom" of the headpond as determined by the ORCA. Headpond depth would generally be in the order of approximately 1.25m after sediment removal. The proposed water surface would be approximately 0.5m below the existing headpond surface (Note: The consequences of dam breach are proportional to the volume of water held behind the dam. Modeling completed by IBI (2008) assumed a volume of water held behind the dam that had an average water depth of 1.75 metres when the dam breached. Therefore, sediment removal that creates an even greater volume of water held in the headpond than was assumed in the dam breach simulations would increase the extent, depth and velocity of floodwaters in the downstream overbank area, which in turn would increase the consequences of dam breach, and thus the Hazard Potential Classification and Inflow Design Flood. Given this connection between volume of water held in the headpond and HPC and IDF, the proposed maximum sediment removal will be, along with the HPC and IDF, peer-reviewed when the Class EA is approved and as a first step to Phase 2 of the project - detailed design)

- additional repair of earthen embankment is needed. Two repairs (Figure 13-5) are required to improve stability of the embankment including:
  i) installation of an impermeable barrier to prevent seepage beneath the dam. The barrier would extend from the west side of the new spillway to the west end of the earthen embankment, and, from the east side of the new spillway to the east end of the dam. Sheet pile is a likely choice of construction material.
  ii) placement and extension of the reinforcing/stabilizing berm near the west end of the embankment

Concept C would retain the existing penstock intake, but it would be rendered non-functional. A new pedestrian bridge would be placed over the new spillway.

From an engineering perspective, spillway reconstruction is technically feasible and, with the history of study on the site, there is a great deal of information available to use in developing a final design. The essential criterion for design is providing additional outflow capacity to ensure that the dam is only overtopped in extreme conditions with no increase in risk of "loss-of-life" or property damage to downstream users.

The proposed weir (Figure 13-6) provides for increased discharge with a longer weir that would have a simple ogee crest. Final design would require delineation of the weir configuration and detailing of the approach and immediate downstream channel to pass the higher flows required. The spillway configuration can be made up of a combination of steps so that low flow is concentrated in one area providing base flow to the stream bed, while higher flows would be assimilated across the floodplain.

The scale of the required weir is in proportion to the size of the dam and volume of water retained in the pond. The dam blocks the natural river floodplain from bank to bank just upstream of the Millbrook Village centre. Buildings downstream are constructed within the floodplain and are within ORCA's Regulatory Floodline limits. From the Community Centre and King Street, the dam dominates the view to the south, emphasizing the situation that these buildings are within the floodplain. In an undeveloped location, with no structures located immediately downstream, a smaller weir might be constructed in the centre of the dam and then high flows would be allowed to spill over the dam's entire length. However, Millbrook Dam needs sufficient capacity near the south bank to direct flows into a narrow outlet that channels the water around Needler's Mill and continue safely downstream. In effect, the dam is a constriction and flows must pass around the dam without breaching it during extreme events.

Reconstruction would also provide an opportunity to address severe leakage problems which plague the present dam; permit reinforcement of the narrow dam section at Needler's Mill; and improve erosion protection on the downstream channel.

To minimize the length of the weir, a concrete structure is the ideal. Adjacent structures such as retaining walls and shoreline protection can be stone to maintain a more natural appearance.

Concept C shows a straight weir which is constructed near the alignment of the existing weir. A straight weir displays minimal weir crest length which translates into a maximal weir width. A weir whose shape and layout consists of horseshoe-shaped configuration or repeated geometric forms, such as trapezoid, (i.e., labyrinth weir) could, however, pass the same flows as a straight weir but do so over a significantly shorter width. Such configurations will be considered during detailed design to determine the optimal shape and layout.

Construction costs for Concept C are presented in Table 13-3 and are approximately $2.95M.

From a social perspective, Concept C generally fulfills all social requirements that can be accommodated within the ORCA's dam safety mandate. First and foremost, Concept C proposes to retain the physical and functional relationship among the dam, the headpond, the Conservation Area and Needler's Mill. Further, it protects Needler's Mill from flood damage and from foundation erosion. In doing so;

- the important personal and commercial history as expressed by village residents would be maintained
- the nearby business district would continue to benefit financially from the retained dam-headpond-mill complex
- passive and active recreation would continue, acknowledging temporary interruption during the construction period
- organized community activities such as the Lion's Club fishing derby, festivals, and other events would continue to find a focus in the study area
- the viewscape of adjacent residences would be retained

From an ecological perspective, Concept C will enhance the existing fishery and maintain fauna habitat, and accordingly is the **recommended concept** from an ecological perspective. Anticipated adverse impacts to the aquatic and terrestrial environment are anticipated to be **moderate,** relative to the existing conditions. This design will enhance current conditions, while reinforcing the weir. Sediment will be removed from the pond to achieve a greater depth; however, the ecological function of the pond will not be altered. The pond will provide suitable habitat for herpetofauna and migratory birds. Also, it is anticipated that removal of sediment will improve water quality and ultimately, the fishery.

Disturbances during construction will be temporary and will require utilization of mitigation and monitoring measures to ensure the immediate and downstream portions of the water course are not affected.

From a geomorphological perspective, Concept C would result in increased discharge from the dam at higher flows. As a result, Baxter Creek downstream of the dam would be subject to higher flows, velocities and shear stresses compared to existing conditions. The extent of the change would depend on final design and confirmation of the proposed weir configuration. The channel downstream of the millpond is currently in regime (i.e., in balance with ambient flows). A geomorphologist would be involved through the detailed design process to ensure that any increased erosion potential downstream is managed. This would be achieved through bioengineering, floodplain grading and planting as far as possible. The dam capacity can be made up of a combination of outlets so that low flow is concentrated in one area to feed the stream bed, while higher flows are released across the floodplain and the channel.

Table 13-3

Preliminary Construction Cost

Concept C: Dam Reconstruction with Headpond Retention

1	Mobilization & Demobilization		$250,000
2	Cofferdam & Dewatering		
	2.1	Coffer Dam Downstream of the Existing Dam	$40,000
	2.2	Coffer Dam Upstream of the Existing Dam	$100,000
	2.3	Bypass Channel Through Earthen Section	$30,000
3	Remove Existing Pedestrian Bridge		$5,000
4	Remove Dam and Widen Spillway		
	4.1	Removal of Existing Concrete Abutment	$50,000
	4.2	Removal of Existing Weir	$30,000
	4.3	Removal of Existing Sheetpiles	$10,000
	4.4	Soil and Rock Excavation	$30,000
5	Remove Sediment to Create Head Pond Water Depth		$450,000
6	Place Impermeable Fill to Reinforce West End of Dam		$450,000
7	Install Impermeable Barrier to Prevent Seepage/Erosion of Dam Foundation		$150,000
8	Construct New Dam		
	8.1	Abutments	$35,000
	8.2	Sidewalls	$44,800
	8.3	Weir	$276,000
	8.4	Sill	$182,400
	8.5	Downsteam Channel Improvments	$70,000
9	Construct New Concrete Pedestrian Bridge and Waterfall		$30,000
10	New Pre-Engineered Pedestrian Bridge		$70,000
Engineering Fees			$184,000
Contingencies (20%)			$461,000
TOTAL			**$2,948,000**

*Note: Actual costs will only be determined once final design is in place.

In terms of sediment transport, continued sedimentation behind dam has maintenance implications as future periodic dredging would be required.

From the standpoint of channel processes and morphology, potential for increased erosion risk would be managed through detailed design. No improvement to morphological diversity in terms barrier removal is anticipated. Release of fine sediment during construction as well as erosion risk associated with construction would be managed through an erosion and sediment control plan.

In the opinion of the study team, Concept C substantially fulfills all engineering and social requirements and has been selected as the preferred solution.

14.0 THE PREFERRED CONCEPT

14.1 The Preferred Concept

The foregoing sections of the E.A. describe three concepts considered for remedial application. In essence, the following has emerged:

- all concepts satisfy the fundamental requirements for protection of property and human life
- ecological studies basically indicate that solely from an ecological perspective, the study area contains elements of local significance. That is, natural elements and process, while very important locally, are not of high regional, provincial or federal significance
- geomorphological studies indicate that the requirements for all concepts can be accommodated by known engineering or bio-engineering means, without long-term adverse effects
- the value of social aspects of the study is "invaluable", so much so, that retaining existing historic elements is described by the BIA as a pre-requisite (in part) for economic prosperity of the village
- comparison of construction costs for Concepts A to C are similar and a variance of only $300,000 exists among them. Concept C costs are lowest (Note: the construction costs are preliminary estimates developed for relative comparison purposes only).

Accordingly, the selection of a preferred concept depends on two elements: dam safety and social contribution. Concept C has been selected as the preferred solution since it jointly provides the needed physical safety features and the highest social benefit.

That said, implementation of Concept C requires some modification based on further technical reflection and input from the public.

- there is a public desire to shorten the length of proposed weir for aesthetic purposes. It is recommended that final detailed design studies analyze additional weir configurations which fulfill the same water conveyance capabilities while reducing weir length. Examples of additional considerations include a curved weir and a serpentine weir.
- Confirmation and/or refinement of the current dam breach model during final design is also recommended.
- Placement of the new weir as close to east bank as possible to mitigate flood and visual impingement on Needler's Mill.

It should be noted that implementation of Concept C will likely result in a somewhat smaller headpond area as compared to its existing size. The planned reduction in water level coupled with increased pond depth through sediment removal, may necessitate increasing the steepness of shoreline (both wet and dry) slopes. Flattening of backshore slopes and providing gentle in-water slopes, may in part remedy this condition and would be considered in final engineering design.

14.2 Mitigation

14.2.1 General Mitigation

Effective mitigation within the process of an E.A. is best completed at the concept planning phase. Application of mitigation at this early stage serves to "design out" many serious adverse environmental effects. From experience, in excess of 90% of required mitigation may be provided to advantage during project planning. Remaining mitigation may be addressed on an issue by issue basis. For the Millbrook Dam project, mitigation can be completed using known engineering, biological or construction methods.

For the Millbrook Dam EA, the design for each of the concepts proposed was approached by structural means specifically to "design out" environmental concerns while at the same time "designing in" social amenities. The three concepts show a positive progression from dam removal with minimal social amenity, to an off-line pond demonstrating partial retention of the headpond with some social amenities, to headpond retention which substantially retains and/or supports all current social amenities.

As required by regulation, the screening criteria previously described in Section 12.0 above and prescribed by Conservation Ontario (2009), have been applied to the preferred concept as a means of further ensuring identification of adverse environmental effects and of preparing mitigation for them. Table 14-1 presents the subject analysis and provides mitigation as required.

It is further recommended that an Environmental Management and Protection Plan be prepared to guide the construction phase and protect environmental features.

14.2.2 Natural Heritage Mitigation

In order to protect the Natural Heritage Features located on and within the vicinity of the subject site, suitable mitigation measures are to be employed. Table 14-2 outlines general mitigation measures for treatment option consideration only. Additional mitigation must be provided during the detailed design phase of this project.

14.3 Monitoring

Two types of monitoring have been considered for the Millbrook Dam reconstruction project, construction monitoring, and effectiveness monitoring.

Construction Monitoring - all construction activities at the site would be subject to supervision and regular inspection by a qualified Engineer (with environmental expertise) who would oversee construction activities ensuring that:

i) all construction is completed according to approved plans and specifications; and, the Environmental Management and Protection Plan
ii) construction activities conform to relevant environmental and engineering codes of practice; and

Table 14-1

Concept C Environmental Analysis and Mitigation

Screening of Potential Effects as negative (-), neutral (NIL) or positive (+) and rating them as relatively high (H), medium (M), low (L) or not applicable (NA)

Screening Criteria	Rating of Potential Effect								Detailed Comments	Mitigation
	- H	- M	- L	NIL	+ L	+ M	+ H	NA		
Physical										
Unique Landforms								x		
Existing Mineral/Aggregate Resources Extraction Industries								x		
Earth Science - Areas of Natural and Scientific Interest								x		
Specialty Crop Areas								x		
Agricultural Lands or Production								x		
Niagara Escarpment								x		
Oak Ridges Moraine								x		
Environmentally Sensitive/Significant Areas (physical)								x		
Air Quality			x						Possible odour from vehicular exhaust during construction. Potential temporary odour from decomposition of sediments when headpond is drained for construction.	Odours from exhaust and sediments are temporary (construction phase only). Prevailing N/W winds would carry odours away from urban Millbrook. Construction equipment to be maintained properly to reduce odour emissions.
Agricultural Tile or Surface Drains								x		
Noise Levels and Vibration			x						Possible noise and vibration from operation of equipment during construction. Possible additional noise and vibration from driving sheet piling to seal the earth embankment.	Conduct noise and vibration emitting activities in accordance with local noise bylaw or contract specification. Liaise with nearby residents prior to and after conducting vibration-emitting activities.
High/Storm Water Flow Regime		x							Potential project damage / flooding during construction.	Contractor to ensure that cofferdam, dykes, diversion channels etc. are able to withstand severe weather events
Low/Base Water Flow Regime				x						
Existing Surface Drainage and Groundwater Seepage			x						Redirection of drainage & seepage to provide adequate outlet may be required during construction	Contractor to inspect and maintain said work on a regular basis to ensure functionality
Groundwater Recharge/Discharge Zones				x						
Littoral Drift								x		
Other Coastal Processes								x		
Water Quality		x							i) Possible sediment run-off/turbidity issues during construction phase that could be harmful to fish & fish habitat, ii) Thermal effects of impoundment.	Contractor to prepare and implement an effective sediment and erosion control plan. Control plan to be approved by the ORCA. Thermal effects occur at present and are not totally mitigatable. New adverse thermal effects would not exceed those at present which are assimilated by Baxter Creek. Measures such as planting shoreline vegetation to provide shading are encouraged.
Soil/Fill Quality				x					Importation of common fill is not anticipated.	
Contaminated Soils/Sediments/Seeps	x								Although one preliminary sediment analysis shows no contamination, additional sampling is needed.	A core sampling program for sediment quality and texture to be conducted during final design. Boreholes to determine equipment bearing capacity to be conducted for soils beneath sediments.

*All construction activities to be monitored by the ORCA or an independent, qualified environmental field officer.

Table 14-1

Concept C Environmental Analysis and Mitigation (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments	Mitigation
	- H	- M	- L	NIL	+ L	+ M	+ H	NA		
Existing Transportation Routes			x						Possible disruption to normal flow of traffic during construction.	Prepare and implement a traffic management plan.
Constructed Crossings (e.g. bridges, walkway)			x						Possible disruption to normal flow of village traffic during construction.	As above.
Geomorphology			x						Potential watercourse and shoreline damage resulting from construction and/or operation.	Revisit flows and velocities during final design. Propose structures or bio-engineering methods for bank and shoreline training as required.
Other										
Biological										
Wildlife Habitat			x						Potential changes to nearshore terrestrial habitat for bird, mammals, and amphibians require further ecological study.	Completed and described in E.A.
Habitat Linkages or Corridors (Terrestrial)			x						Linkages are unknown and require further ecological study.	As above.
Significant Vegetation Communities			x						Requires further ecological study.	As above.
Environmentally Sensitive/Significant Areas (biological)			x						Requires further ecological study.	As above.
Fish Habitat	x								Only rudimentary facts are known- requires further ecological study.	As above. Additional fish studies may be required to consider fish passage, if considered by ORCA.
Species of Concern (e.g. species at risk, vulnerable/threatened/ endangered species, conservation priorities - either flora or fauna)	x								Requires further ecological study.	As above.
Exotic/Alien and Invasive Species			x						Requires further ecological study.	As above.
Wildlife/Bird Migration Patterns (No information)			x						See Habitat Linkages above.	
Wildlife Population				x					No significant changes anticipated.	
Wetlands	x								Unknown- requires study during E.A. – upstream wetlands are unevaluated, and therefore, potential loss of wetlands associated with removal or lowering of headpond requires further study.	No significant wetlands identified. During final design, consideration must be given to slumping of upstream wetland soils following headpond sediment removal.
Microclimate								x		
Life Science ANSI's								x		
Unique Habitats			x						Requires further ecological study.	No unique habitats identified by ecological studies.
Other: Riparian Habitats			x						Widespread adverse effects on riparian habitat are unlikely. Natural restoration would occur following construction.	Long-term adverse effects on riparian habitats are not anticipated
Cultural										
Traditional Land Uses			x						No known effects to First Nations rights/use or Metis harvesting rights anticipated. Consultation required.	No concerns cited during consultation.
Aboriginal Reserve or Community								x		

Table 14-1

Concept C Environmental Analysis and Mitigation (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments	Mitigation
	- H	- M	- L	NIL	+ L	+ M	+ H	NA		
Outstanding Native Land Claim			x						Requires further study.	None noted during consultation
Transboundary Water Management Issues								x		
Riparian Uses				x						
Recreational or Tourist Uses of a Water Body and/or Adjacent Lands	x								Potential changes to extensive headpond use for recreation/community gathering/fishing/viewing (critical importance)	No long term adverse effects anticipated. The preferred solution allows for continuation of recreational and tourist uses.
Recreational or Tourist Uses of Existing Shoreline Access Locations	x								As above (critical importance)	As above.
Aesthetic or Scenic Landscapes or Views	x								As above (critical importance)	As above. Although views will change following construction, appealing viewscapes will remain.
Archaeological Resources, Built Heritage Resources and Cultural Heritage Landscapes (Needler's Mill)	x								Built Heritage Resources (particularly Needler's Mill) are among the highest valued features of village residents. Archaeology Study required (critical importance)	Stage 1 Archaeology study has been completed and recommends involvement of an archaeologist during excavation or areas having archaeological potential.
Historic Canals								x		
Federal Property								x		
Heritage River System								x		
Other										
Socioeconomic										
Surrounding Neighbourhood or Community	x								Study area is the social centre of Millbrook. Residents have strong ties to the area. Downtown business and tourism are partially dependent on the dam and headpond area (critical importance).	Preferred concept designed to retain and support all known amenities/social activities.
Surrounding Land Uses or Growth Pressure	x								Residents backing onto the headpond consider it a important asset to their properties both monetarily and socially.	Shoreline alteration is expected to occur on ORCA-owned lands beyond the rear lots of adjoining shoreline residents. Proposed alteration plans to be completed during final design and discussed with relevant property owners prior to implementation.
Existing Infrastructure, Support Services, Facilities				x						
Pedestrian Traffic Routes			x						Potential route alteration during construction.	Route alteration is temporary with original routes restored following construction.
Property Values or Ownership	x								Perceived potential for property value reduction. Community perceives that neighbouring property values are higher because of adjacent millpond (critical importance).	The preferred concept recommends retention of the headpond. Loss in property values is not anticipated.
Existing Tourism Operations								x	No known current tourist operations.	
Property/Farm Accessibility			x						See "Existing Transportation Routes" above.	
Other: Life Cycle Costs to Dam Owner	x								Costs and liability to dam owner to accelerate with time.	Preferred concept recommends weir construction. Operation costs will not occur and maintenance costs are low relative to control dams. Insurance costs would decline.

Table 14-1

Concept C Environmental Analysis and Mitigation (Cont'd)

Screening Criteria	Rating of Potential Effect								Detailed Comments	Mitigation
	- H	- M	- L	NIL	+ L	+ M	+ H	NA		
Engineering/Technical										
Rate of Erosion in Ecosystem			x						Potential for erosion to occur during construction phase due to exposure of unconsolidated materials- mitigate with appropriate erosion control measures.	Prepare, implement, monitor and enforce an erosion and sediment control plan. Potential for Wetland soil slumping to be investigated during final engineering design.
Sediment Deposition Zones in Ecosystem	x								Significant volumes of sediment have accumulated in the headpond and must (in part at least) be removed prior to and/or during construction. Sediment releases to downstream Baxter Creek are a serious concern.	This is likely the most significant physical adverse effect that may occur. Careful attention to preparation, approval, implementation, monitoring and enforcement of the erosion and sediment control is required.
Flood Risk in Ecosystem (natural and Regulatory floodplain)								x		
Slope Stability		x		x					Concern for any grades of new headpond shoreline(wet and dry) slopes and backshore.	To be considered during final design. Common engineering or bio-engineering methods could be applied.
Existing Structures								x		
Hazardous Lands								x		
Hazardous Sites			x						Potential for soil contamination from previous coal storage. Neither dam removal nor replacement will impinge on former coal shed locations	No excavation planned in previous coal shed areas. Coal residues (contaminants) are typically quite sedentary if undisturbed.
Producing the desired effect by addressing the problem of incremental loss of life, property damage and environmental harm due to dam failture							x		Dam removal or replacement would eliminate future risks to incremental property damage and loss of life	Preferred concept design eliminates loss of property and life risks from incremental flooding.
Legal and Administrative Requirements including approvals under: Navigable Waters Protection Act; Fisheries Act; Permit to Take Water; Lakes & Rivers Improvement Act; Conservation Authorities Act, etc.			x						Approvals can be obtained using standard procedure. Limited risk anticipated.	Standard, implementable permit requirements/conditions are anticipated.
Safety and Liability Issues	x								Current high level of risk continues if incremental risk of property damage and loss remains unanticipated.	Preferred concept avoids risks. Interim risk (prior to construction) to be addressed by preparation and implementation of an Emergency Preparedness Plan.

Table 14-2

Impact, Mitigation Measures and Environmental Enhancement Opportunities

Potential Impact	**Mitigation/Enhancement Opportunity**
Impacts to fish and fish habitat	In-water works are necessary for Options A, B and C, therefore general mitigation measures should be considered: • In-water work may not occur during October 1st – May 31st or as directed otherwise by MNR, based on site-specific works. • Appropriate fish-out procedures, as determined by a qualified aquatic biologist, should be carried out to limit fish impacted by construction works. • Siltation, sedimentation and turbidity fencing/curtains should be employed to limit impacts to the immediate and downstream areas. • It may be necessary to monitor the water quality of the watercourse to ensure the erosion, sedimentation and turbidity measures are effective. Information regarding parameters such as temperature, pH, and dissolved oxygen should be collected as baseline conditions for future monitoring efforts.
Wildlife Considerations	• In Southern Ontario the core nesting period occurs between May1st and July 31st of any given year. Tree removal or vegetation removal shall not occur during this period. If tree removal is necessary during this time, a nest survey shall be completed by a qualified biologist. Each tree or area must be confirmed to be clear of nests or breeding birds prior to removal. If a nest is observed in a tree the area will be flagged and special authorization must first be sought from Environment Canada, prior to proceeding. • Wildlife may be encountered at the Site. Any wildlife observed during construction activities should be gently removed from the Site if it can be done safely. Photos for identification purposes should be taken of animals observed onsite, if possible. If a Species at Risk is encountered, the project biologist and Ministry of Natural Resources should be contacted immediately for further direction.
Species at Risk	• If a Species at Risk is encountered, all activities should stop immediately and the project biologist and Ministry of Natural Resources contacted immediately for further direction.
Short-term erosion and sedimentation • Terrestrial	• Erosion control fencing should be placed around all ongoing construction activity areas as well as adjacent to temporary storage locations for supplies, excavated materials and imported fill. Fencing should be properly installed and inspected at regular intervals and after significant rain events to confirm it is functioning properly. Fencing should be regularly cleared of silt accumulation to ensure the integrity of erosion prevention/sediment containment measures. Areas of exposed soil, especially newly graded areas that cannot be immediately stabilized with the final surface treatments should be appropriately treated to minimize erosion (e.g., straw mulch, erosion blanket, sod, or hydroseed). • Design and implement a containment plan to isolate all work to occur above water (e.g. cleaning, sandblasting, removal of existing structure, painting) to prevent entry of potentially deleterious materials to the watercourse. The design should include regular inspection, removal and disposal of materials generated and regular inspection of all vehicles prior to accessing the site.
• In-water works	• Temporarily store, handle and dispose of all materials used or generated (e.g.

Potential Impact	Mitigation/Enhancement Opportunity
	organics, soils, woody debris, temporary stockpiles, construction debris) during site preparation, construction and clean-up in a manner that prevents their entry to waterbody including temporarily storing and stockpiling materials a safe distance from the watercourse and stabilize/contain them. • The MNR, DFO, MOE, Transport Canada and other regulating agencies should be consulted prior to undertaking any in-water work. Based on detailed-design specific works, they will outline requirements and authorizations required to undertake proposed works. • For general considerations, the following recommendation should be incorporated into detailed-design mitigation methods: o A qualified project biologist must be present during all activities related to near or in-water work and aquatic habitat. o All aquatic habitats will not be disturbed or destroyed, unless agency approval is granted. Aquatic habitat will be restored to original or improved conditions. o Siltation fencing will be in place during all near-water works and regularly checked for efficiency. Where there is a breach of these controls, the project biologist will be contacted immediately. o The presence of Brook Trout downstream from the pond indicate that a coldwater construction timing window is applicable, whereby no in-water works are permitted between October 1 and May 31st, of any given year. Please confirm with the MNR upon completion of the detailed-design drawings. • Due to the nature of the potential works, it may be necessary to conduct work in the-dry, whereby the construction is isolated. Temporary dams, such as water-filled coffer dams (e.g., aquadams) or above-ground water storage systems (e.g., portadams), should be further explored to retain water, allowing work to be conducted in the dry. Appropriate de-watering methods should also be explored. • A fish salvage should be conducted prior and/or during installation of any water containment method system, to ensure fish are collected and released downstream of the work area, prior to dewatering.
Long-term erosion and sedimentation • Post-construction	• Trees and tall shrubs should be planted along the bank of the pond to stabilize soils and provide riparian cover to fish. • Areas of shallow depths should be maintained for emergent vegetation to flourish for herpetofauna life cycles. • The use of rip-rap should be used along the banks, where possible, for stabilization.

Potential Impact	Mitigation/Enhancement Opportunity
Operational Measures	In the event of a hydrocarbon spill, a contingency plan must be prepared and implemented following any spill event. Recommended steps involve the following: • Stop the release of the oil product • Contain as much as possible of the oil product in the immediate vicinity of the spill • Prevent or reduce the impact of released oil product on people, property or the environment • Recover as much of the oil product as possible • Clean up the affected area, to the extent practical, to pre-spill conditions • Comply with the legislative requirements of relevant regulating bodies • An emergency spill kit will be kept on site at all times during construction or when vehicles or equipment are present on-site. • Operating, refuelling and maintenance of construction equipment and the handling and storage of toxic materials (e.g. fuel, lubricants, and other chemicals) must be carried out in such a way as to avoid contamination of soils, groundwater and surface waters. • All parts of equipment shall be free of fluid leaks and externally cleaned/degreased offsite, in a contained environment.

iii) all mitigation measures are implemented and maintained

Periodic inspection would also be conducted by ORCA environmental personnel, as required.

Upon completion of the project, ORCA staff would undertake a final site inspection to confirm that works are completed satisfactorily. A summary report would be prepared documenting the implementation of mitigation measures and commenting on their success or need for improvement.

Effectiveness Monitoring - refers to long term, operational phase monitoring directed toward evaluating the operational effectiveness of the project relative to stated project objectives.
Using an adaptive management approach, new action may be considered periodically to improve effectiveness. In the case of Millbrook Dam, it is recommended that:

i) engineering inspection with appropriate frequency be completed to address weir stability and site erosion
ii) monitoring of sediment accumulations (initially or on a three-year basis) to determine sediment depths and plan future sediment removal activities. Sampling frequency may be altered as required.
iii) field inspection of the headpond shoreline and, downstream and upstream reaches by a qualified geomorphologist, one year after construction to identify potential erosion/sedimentation problems and remediation.

14.4 Interim Flood Protection Measures

Following the approval of the E.A., monies must be secured to fund the Millbrook Dam project. Funding approvals and detailed engineering design may take between one and three years. In the interim, Millbrook is still subject to flooding and property damage due to a potential dam breach. To provide protection during this period, the ORCA will prepare an Emergency Preparedness Plan to address situations where dam failure may occur.

15.0 CUMULATIVE EFFECTS

Cumulative environmental effects represent the combined total effects of two or more projects on the environment within a defined study area. Under certain circumstances, the residual effects of more than one project can interact/accumulate so that collectively they reach a critical threshold, or become compounded so that they create an effect that is greater than the sum of the individual effects. Cumulative effects may result from past, on-going, or future projects, particularly those occurring in close proximity to one another. To determine the status and potential interaction of such projects, consultation with knowledgeable individuals from relevant organizations was completed.

Staff of the ORCA, the Township of Cavan Monaghan, and the MNR, report little development within their areas of jurisdiction. Three potential issues, however, were noted:

i) several fishing ponds have been created by MNR on Baxter Creek upstream from the Millbrook site. No known works are planned at these ponds.
ii) an E.A. has been completed for expansion of the Millbrook Sewage Treatment Plant (STP). The STP is located on Baxter Creek in Millbrook, a short distance below the Millbrook Dam. Effluent discharge is to Baxter Creek. Construction may occur within 1-2 years.
iii) The Township is completing a Secondary Plan which will enable the development of infill areas in Millbrook and new subdivisions.

No known past or ongoing projects, which could potentially interact with the Millbrook Dam construction, were noted.

It would appear that no cumulative effects bear upon the MNR fishing ponds since no known construction is planned. Regarding the STP expansion, construction is expected within 1-2 years. Recognizing that Millbrook Dam construction may commence in 3 years potential interaction in terms of residual construction effects may occur. Although the potential occurrence of cumulative effects between these two projects should be revisited in advance of dam construction, the planned new subdivision development is remote from Baxter Creek and timing is distant. Cumulative effects require further consideration at the time of dam/weir construction. Environmental effects of both the STP expansion project and subdivision development would be mitigated on an individual basis.

16.0 REGULATORY APPROVALS

The need for regulatory approvals was identified by reference to similar recent projects and by discussion with selected regulatory agencies. Provincial and federal approvals/permitting are in part dependent on project activities, all of which have not been defined at this time but, would be determined during final design.

16.1 Federal Approvals

Federal approval requirements are currently in a state of flux particularly with regard to the Canadian Environmental Assessment Act (CEAA), the Fisheries Act and the Navigable Waters Protection Act (NWPA), the latter being administered by Transport Canada. Since the Millbrook Dam is likely several years from construction, consultation at that time will be required to definitively identify approval requirements. Based on existing knowledge and with reference to CEAA's "designated project list of April 20, 2013", the Millbrook project would not be subject to Federal E.A.

Potential federal permits/approval are listed as follows;

i) Fisheries and Oceans Canada – consent under the Fisheries Act legislation would be required. Baxter Creek is a coldwater stream, the footprint of the new weir is substantially larger, concerns for erosion and sedimentation exist and fish passage may be considered during final design. It is in the opinion of the study team that a Fisheries Act consent would be considered by "Letter of Advice".

ii) Transport Canada (NWPA Branch) - Millbrook Dam appears to be an "unregistered dam" and significant works to rehabilitate the dam are proposed. As such, current legislation would require formal NWPA approval. New legislation to be enacted in 2014 requires approvals for projects on "scheduled waterways". Although Baxter Creek does not appear as a scheduled waterway, the Otonabee River is shown "from Clear Lake to Rice Lake". It is unclear at this time if Baxter Creek (as a tributary of the Otonabee) would be considered for approval (personal communication, NWPA Branch). Pre-construction consultation is required.

16.2 Provincial Approvals

i) Ministry of Natural Resources - the LRIA requires approval for alteration, improvement or repair of dams. The application would require submission of a design brief, detailed design drawings and specifications

ii) Ministry of the Environment - Two approvals are envisaged:
   - Permit to Take Water (PTTW) – would be obtained under the Ontario Water Resources Act. This permit would address temporary headpond drainage, removal of water within the coffer dammed area and, diversion of flows around

the construction site. This approval may be viewed as the responsibility of the contractor who constructs the new weir.

- Certificate of Approval for the Industrial Sewage Works – Leakage, runoff, and groundwater seepage collected within the coffer dam would be pumped out, ultimately to the creek. MOE requires approval for discharge to receiving waters. This approval may be obtained by the contractor.

iii) Ministry of Tourism, Culture and Sport (MTCS) – requires consideration under the *Heritage Act*. The Millbrook Dam archaeological report has been submitted to MTCS as required and has received formal clearance. The clearance letter provides conditions for construction as reported in previous sections.

17.0 NOTICE OF FILING

The issuance of the "Notice of Filing" provides the final opportunity for public input under the Conservation Ontario E.A. process. Subject to comments received and the receipt of the necessary approvals, the ORCA intends to proceed to peer-review of the HPC, IDF and headpond water level elevations and depth, followed by detailed engineering design of the weir and appurtenances and then, to construction.

18.0 NOTICE OF APPROVAL

Consistent with Conservation Ontario (2009) requirements and following formal approval of the E.A., the ORCA will forward notices of "Project Approval" to all parties on the project mailing list and to Conservation Ontario, as well as publish the notice in the Peterborough Examiner and Millbrook Times newspapers.

19.0 REFERENCES

19.1 Report References

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