Embro Dam and Conservation Area

Existing Environmental Conditions

Updated October 13, 2016

UPPER THAMES RIVER
CONSERVATION AUTHORITY

Table of Content

List of Figures

List of Tables

1 Introduction

The Upper Thames River Conservation Authority in partnership with Zorra Township is undertaking an environmental assessment of the Embro Dam under the Conservation Ontario Class Environmental Assessment process. This report describes much of the existing natural environment conditions for the Embro Dam and Conservation Area. This report includes measurement, inventory, analysis, and observations undertaken by Upper Thames River Conservation Authority (UTRCA) resources during 2015 of streamflow, water quality, aquatic environment, natural heritage, cultural setting, and limited hydrogeological background information. Similar information is gathered and interpreted routinely by the Authority in support of watershed focused environmental efforts. Contributing local watershed context and historical information where available is brought forward for comparisons. Community contributions have been considered to date.

The information in this report will be considered in the presentation and analysis of alternatives for the Embro Dam by the consultant. The consultant as contracted through the Terms of Reference for the overall Assessment has further augmented the environmental information with further study of the physical environment and will interpret all the resources information collected.

The report is a draft which will be finalized with additional information as required before final publication with the Assessments documentation.

2 Project Study Area

Embro Dam and Conservation Area is on Youngsville Drain, a tributary of Embro Creek. Embro Creek outlets into the North Branch Creek which eventually outlets into the Middle Thames River. Embro Conservation Area (Embro CA) is part of Mud Creek watershed. The Mud Creek watershed drains an area of approximately 157 km^2, and includes portions of the Townships of Zorra (69%) and East Zorra-Tavistock (31%). Land use within the Mud Creek watershed is primarily agriculture (86%) with other land use including natural vegetation (13%), urban (1%), water (<1%), and aggregates (<1%).

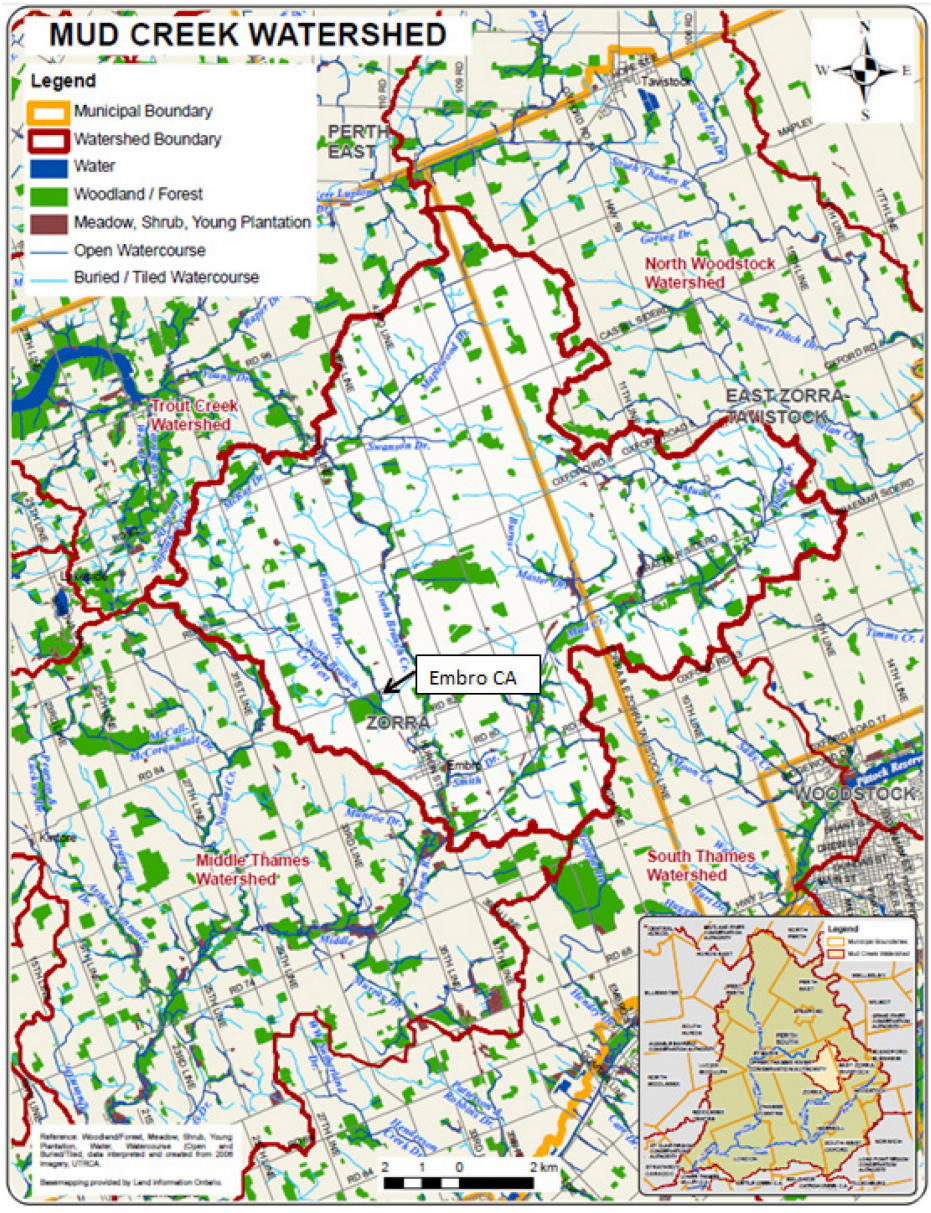

Figure 1 Mud Creek Watershed (Source: UTRCA)

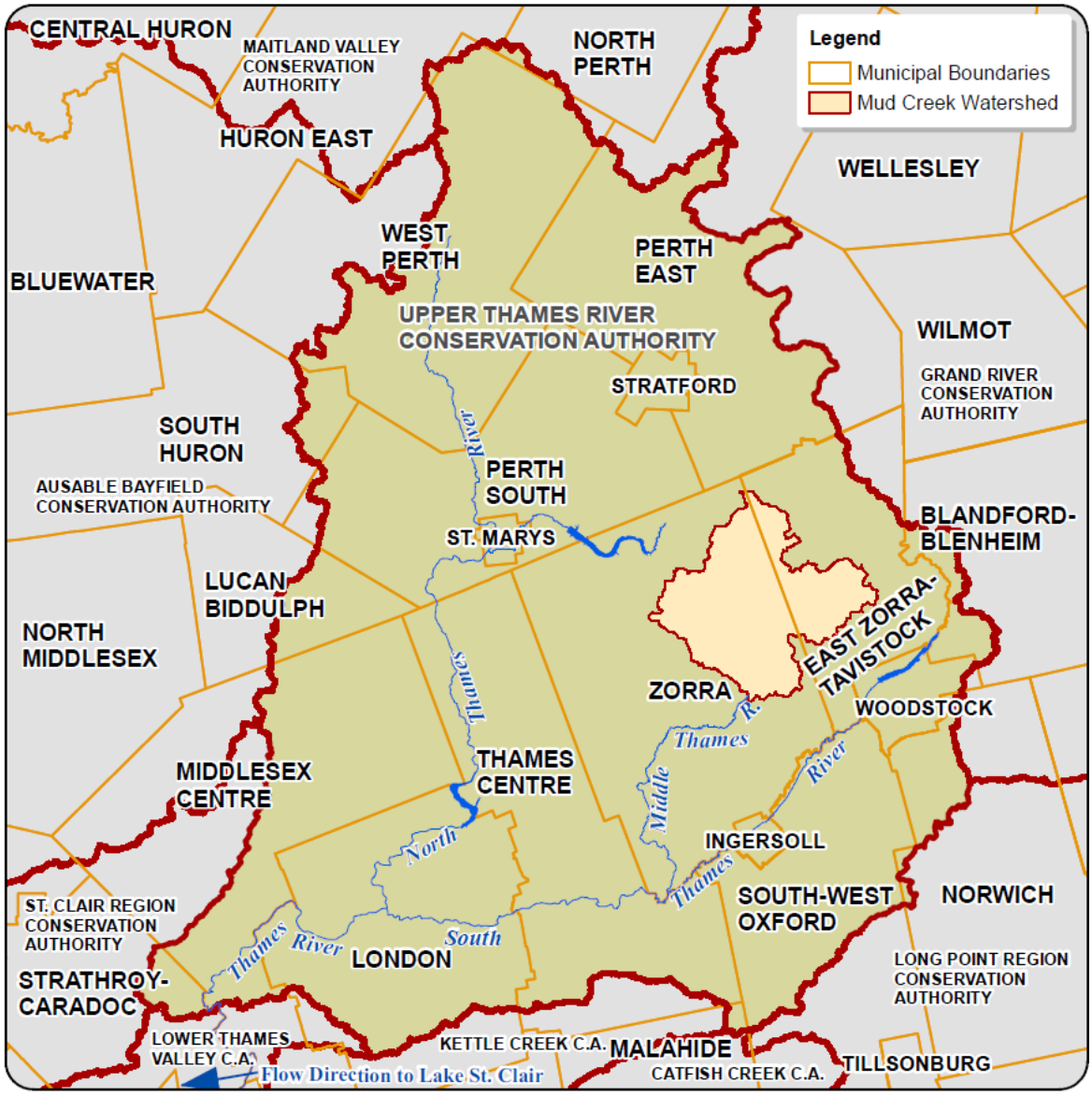

Figure 2 Mud Creek Watershed in Relation to Upper Thames Watershed (Source: UTRCA)

The study area for the Embro Dam will include the lands within the Embro Conservation Area (Embro CA) and adjacent lands as necessary. Embro CA is on County Road 84 in Oxford County, Township of Zorra, Lot 15, Concession 4.

Embro CA is about 8.5 hectares (21 acres) with approximately 5.7 hectares (14 acres) in tree cover, some of it mixed plantation and some natural woodland, and approximately 2 hectares (5 acres) of manicured lawn, unmanicured grass/marsh with a scattering of shade trees. The reservoir/pond area is approximately 0.8 hectares (2 acres).

Between 1997 and 2010, through various partnerships and programs, trees, wildflowers, and grasses have been planted in the Embro CA, with trail enhancements being carried out in 2012.

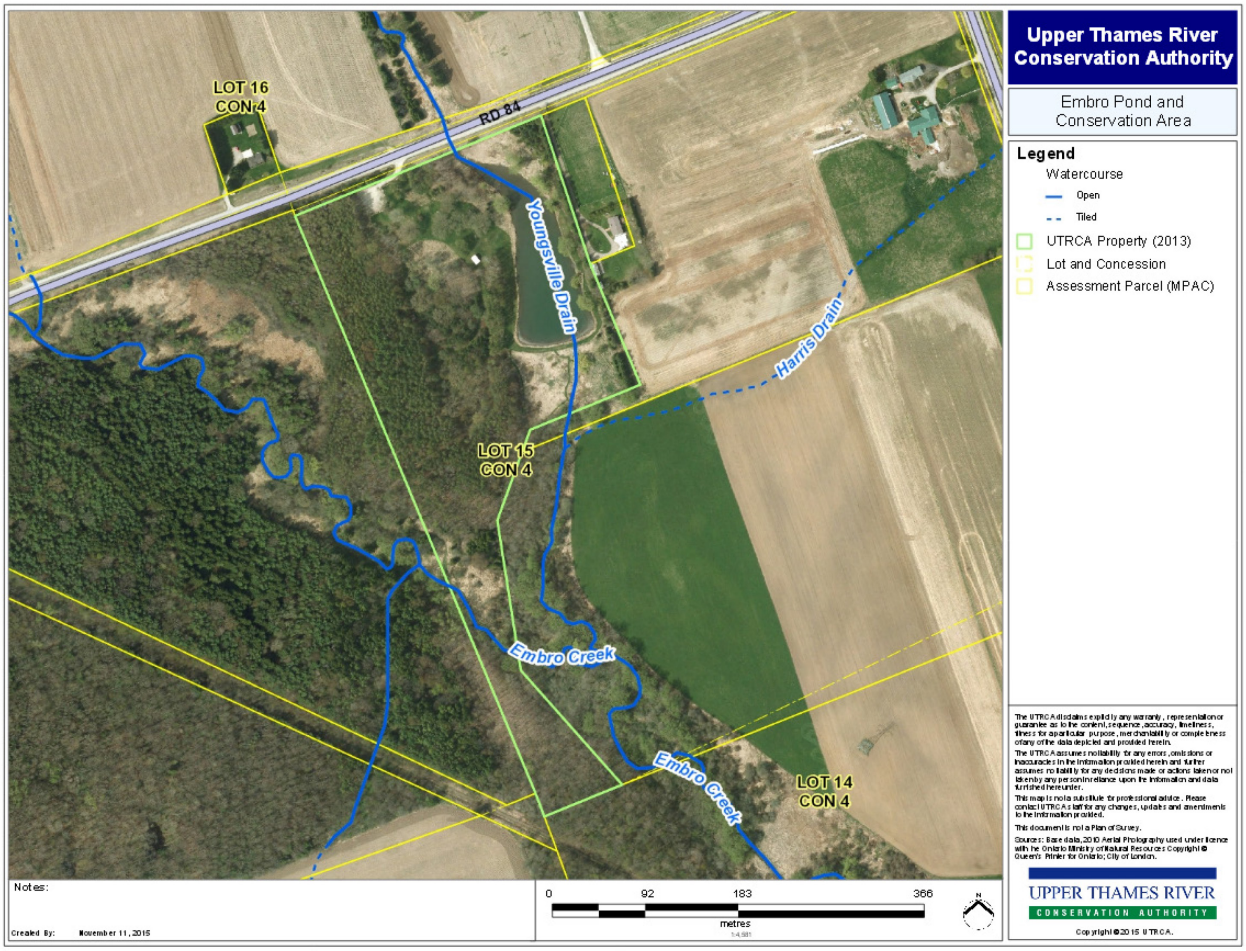

Figure 3 Embroil Conservation Area (Source: UTRCA)

More detailed information about various physical and biological features of the Embro Dam study area are discussed below.

3 Flow Characteristics

To properly assess and design the different options that exist in regards to Embro Dam, it is necessary to understand the streamflow characteristics of Youngsville Drain. The flow characteristics were studied and the details of this study are located in Appendix A: Flow Characteristics of Harrington Creek at Harrington Dam and Youngsville Drain at Embro Dam. A prorating relationship between the flow downstream of Embro Dam and the flow downstream of Harrington Dam was developed with the flow at Embro being approximately 69% of the flow at Harrington. Based on this relationship it was determined that the 645.6 hectare catchment area of Youngsville Drain contributed greater unit area flow rates to the Thames River than those monitored at the following nearby stream gauging stations:

i) Trout Creek near Fairview
ii) Avon River above Stratford
iii) Fish Creek
iv) Trout Creek near St. Mary's

Based on the Harrington monitoring periods from May 24, 2008 – April 9, 2011, March 26, 2012 – September 12, 2012, and April 23, 2015 – August 28, 2015, the contribution of the flow calculated for downstream of Embro Dam to the total flow at the monitoring station downstream of Thamesford was 3.5%, 12.4%, and 6.4%, respectively. Based on the relationship in flows between Harrington Creek and Youngsville Drain, the groundwater recharge characteristics of the Youngsville catchment area, field observations of springs in the catchment area, and the close proximity to shallow overburden aquifers, it is predicted that Youngsville Drain has a high resiliency to drought/low flow conditions. Flow measurements during base flow conditions indicated that the flow upstream of the backwater effects of Embro Dam was approximately 92% of the flow measured at the location downstream of Embro Dam. Due to the low magnitude of the flows, the accuracy limitations of the flow velocity meter, and inflow to Youngsville Drain in between the upstream and the downstream measurement locations, it is recommended that monitoring be continued to increase the confidence in assessing the flow characteristics of Youngsville Drain and the effect of the water control structures on the flow.

3.1 Hydrogeology

The UTRCA collected physical geography map information and well record information to describe general information on the hydrogeological setting of Embro Conservation Area and the local area around the dam. Ministry of Environment and Climate Change (MOECC) well records were obtained. All information collected was transferred to the consultant Ecosystem Recovery Inc. for their analysis.

3.1.1 Topography, Geology, and Soils

The Embro Pond catchment area includes Sutherland-McDonald Drain, Ross Drain, Glendinning Drain, Matheson-McCorquodale Drain, and Matheson Smith Drain. Groundwater flow gradient is from the north to the south towards the community of Embro.

The following maps illustrate the physical surface and subsurface conditions and contribute to the understanding of surface and groundwater resources in the Youngsville Drain catchment.

The general topographic setting of Embro CA in the downstream reaches of Youngsville Drain catchment is shown on the map in Figure 4. North Branch Creek meets Embro Creek immediately south of Embro CA. The lowest elevation point the catchment area is 315 m at Embro CA where Embro Creek leaves the CA. Embro CA is located in some of the highest elevations in the UTRCA watershed.

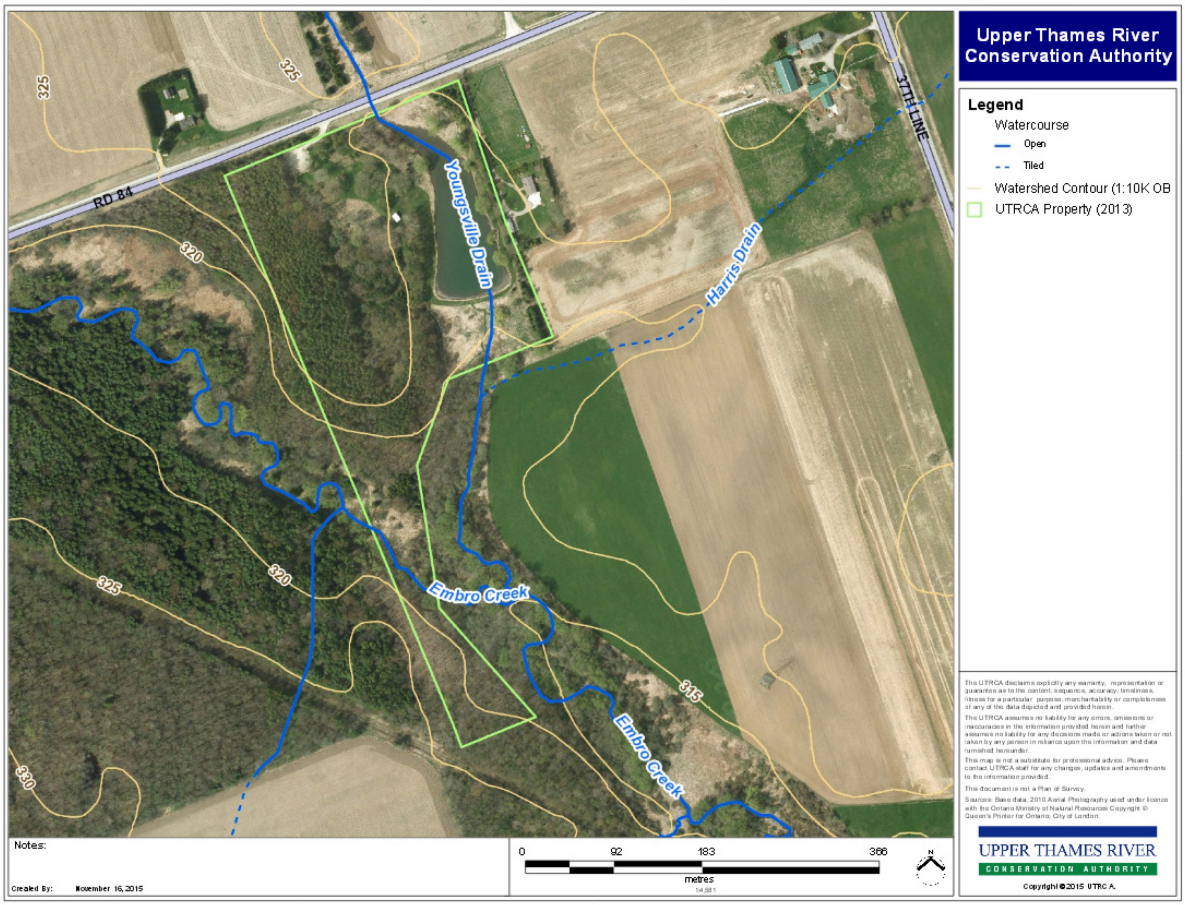

Figure 4 Elevation of Embro Conservation Area (Source: UTRCA)

The catchment area is dominated by till and has a moderate groundwater recharge rate. The surficial geology and groundwater recharge of the Embro CA area is shown in Figures 5 and 6, respectively.

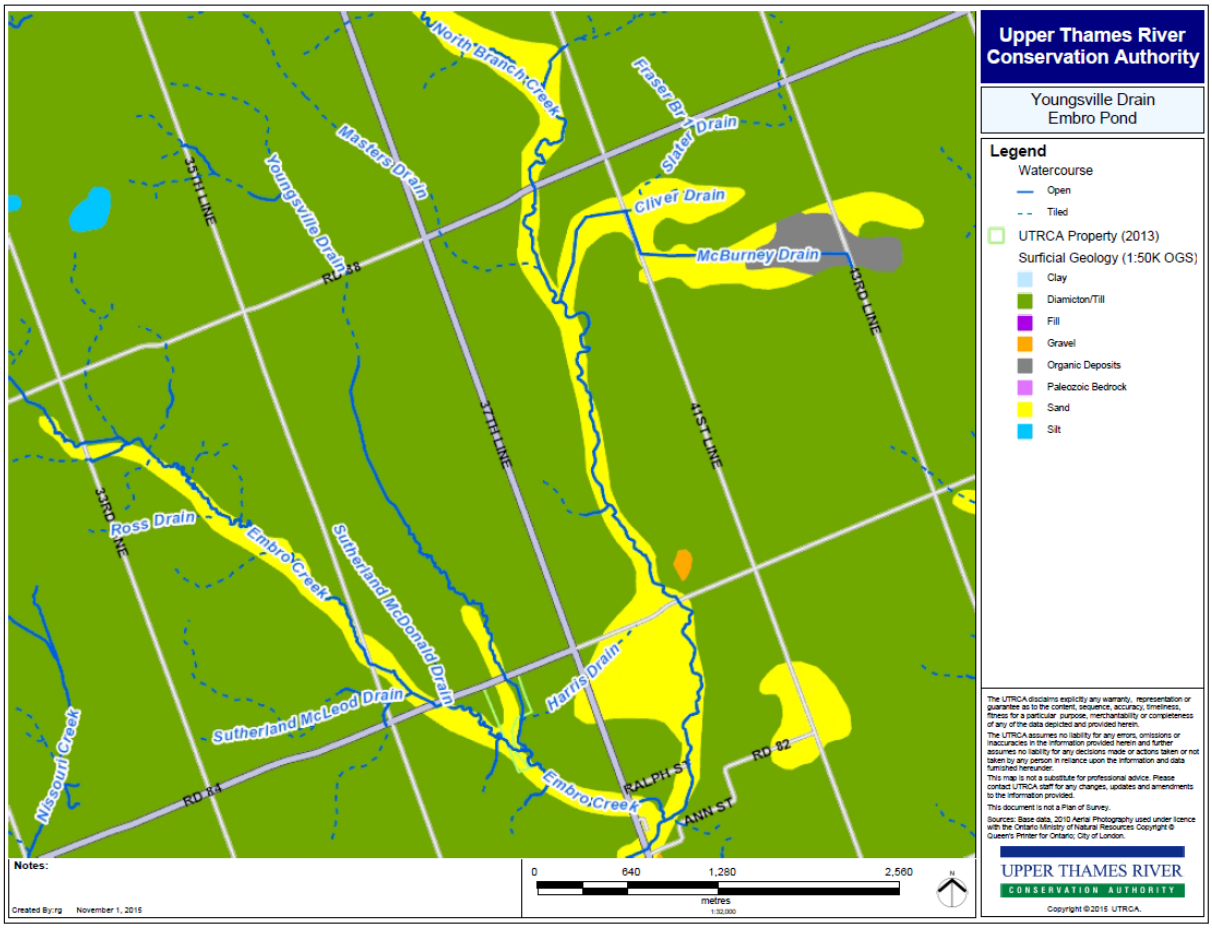

Figure 5 Surficial Geology of the Area around Embro CA (Source: UTRCA)

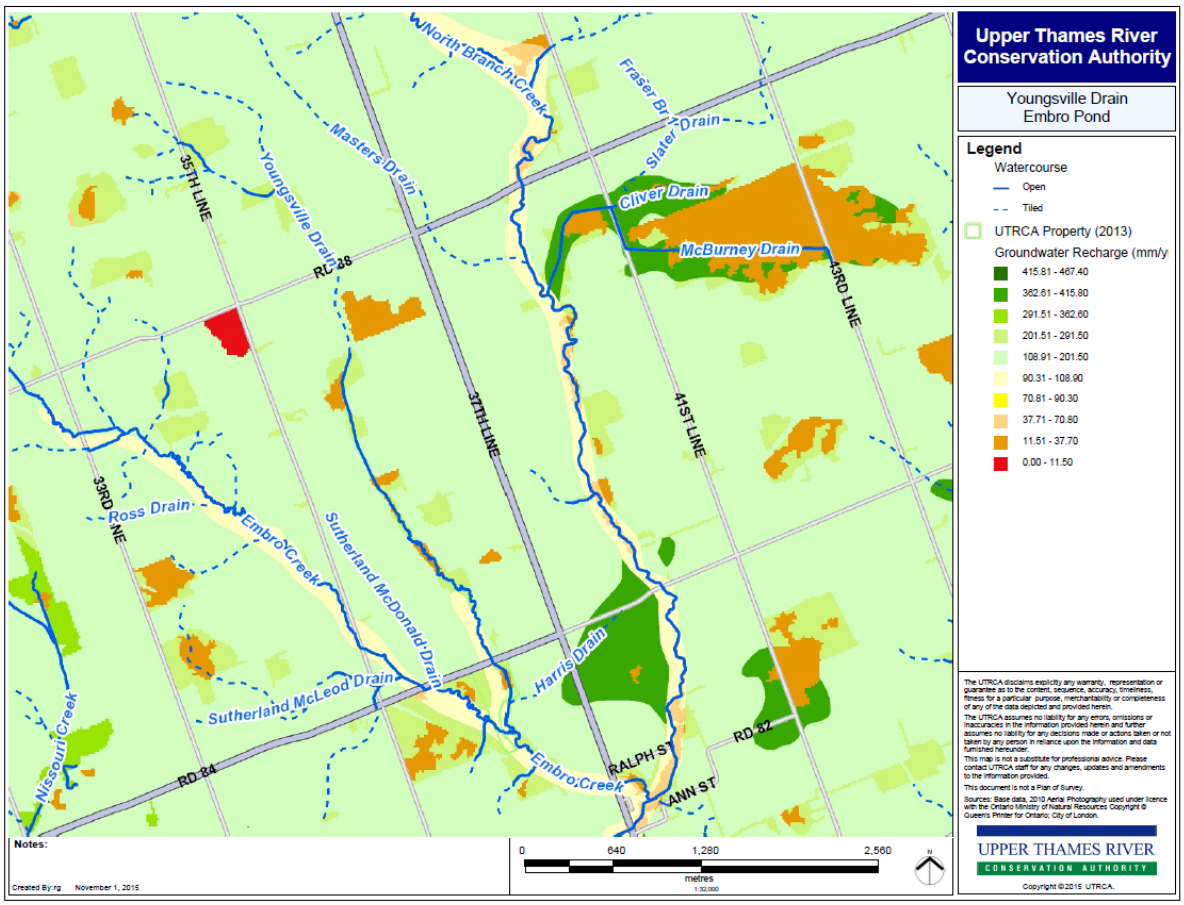

Figure 6 Groundwater Recharge (mm/y) of the Area around Harrington CA (Source: UTRCA)

3.1.2 Private Well Survey

All background information and individual well records were retrieved from the Ministry of the Environment and Climate Change (MOECC) and provided to Ecosystem Recovery Inc. for analysis by their sub-consultant Englobe (formerly LVM). Figure 7 shows the locations of the known wells in the area. The wells shown on the Embro Dam are Bore Holes for the past Dam Safety investigations.

Figure 7 Known Wells in the Area of Embro CA (Source: MOECC)

4 Surface Water Quality

A series of five water samples were collected at four locations in the area of Embro CA: one upstream of the pond, two in the pond, and one downstream of the dam (see map in Figure 8). This monitoring provides a snapshot of water quality, and is limited to the conditions of April to October 2015. Embro Pond was part of a past targeted watershed study and remediation work, with water monitoring occurring from 1986 to 1994. This data has been included in the evaluation of the results, which can be found in Appendix B: Embro Pond Water Quality Assessment.

Most samples were taken during low flow conditions. The dry conditions in the summer and fall of 2015 resulted in minimal opportunity to monitor runoff conditions. There was some variation

in flow based on minimal rain but only one date had rain with full runoff conditions (June 1) and one date had rain with partial runoff conditions (October 9).

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

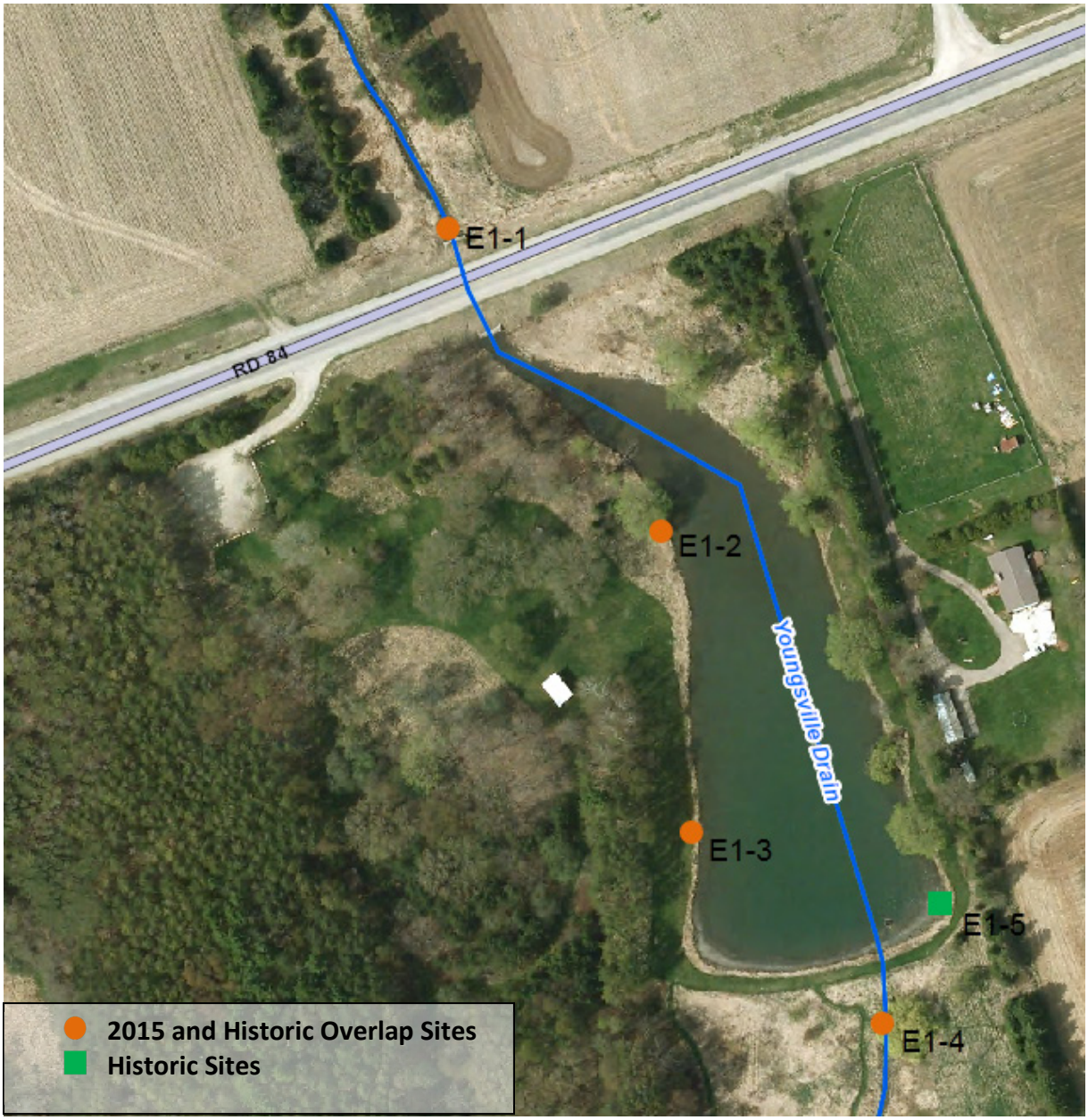

Figure 8 Embro Pond Water Quality Sampling Sites 2015 (Source: UTRCA)

In general, the water quality in the Youngsville Drain where it was sampled upstream, downstream and in Embro Pond showed levels typical of the Middle Thames watershed and other Upper Thames streams for 2015. The headwaters of this area include some healthy riparian areas with groundwater discharge creating this potential coldwater stream.

Most parameters showed similar results to the historic data with E. coli showing some improvement. Most parameters had relatively low levels with the exception of nitrate which was consistently above the guideline both historically and in 2015.

Temperature differences are apparent between upstream and downstream of the pond based on continuous measurements and show a greater difference as the summer progressed, likely as a result of the warming effect of the pond.

Both upstream and downstream temperatures show a diurnal pattern with daytime highs and night time lows. Upstream has a wider range of diurnal temperatures with approximately 6C change compared with 2-3C change downstream, as can be seen in Figure 10. Stream temperature data for June, July and August 2015 were taken during periods in which monthly air temperature averages were similar to historical monthly air temperature averages (ref. Environment Canada - London Airport). The September 2015 air temperature average was higher than historical September air temperature averages, which may have kept the water temperature higher than normal.

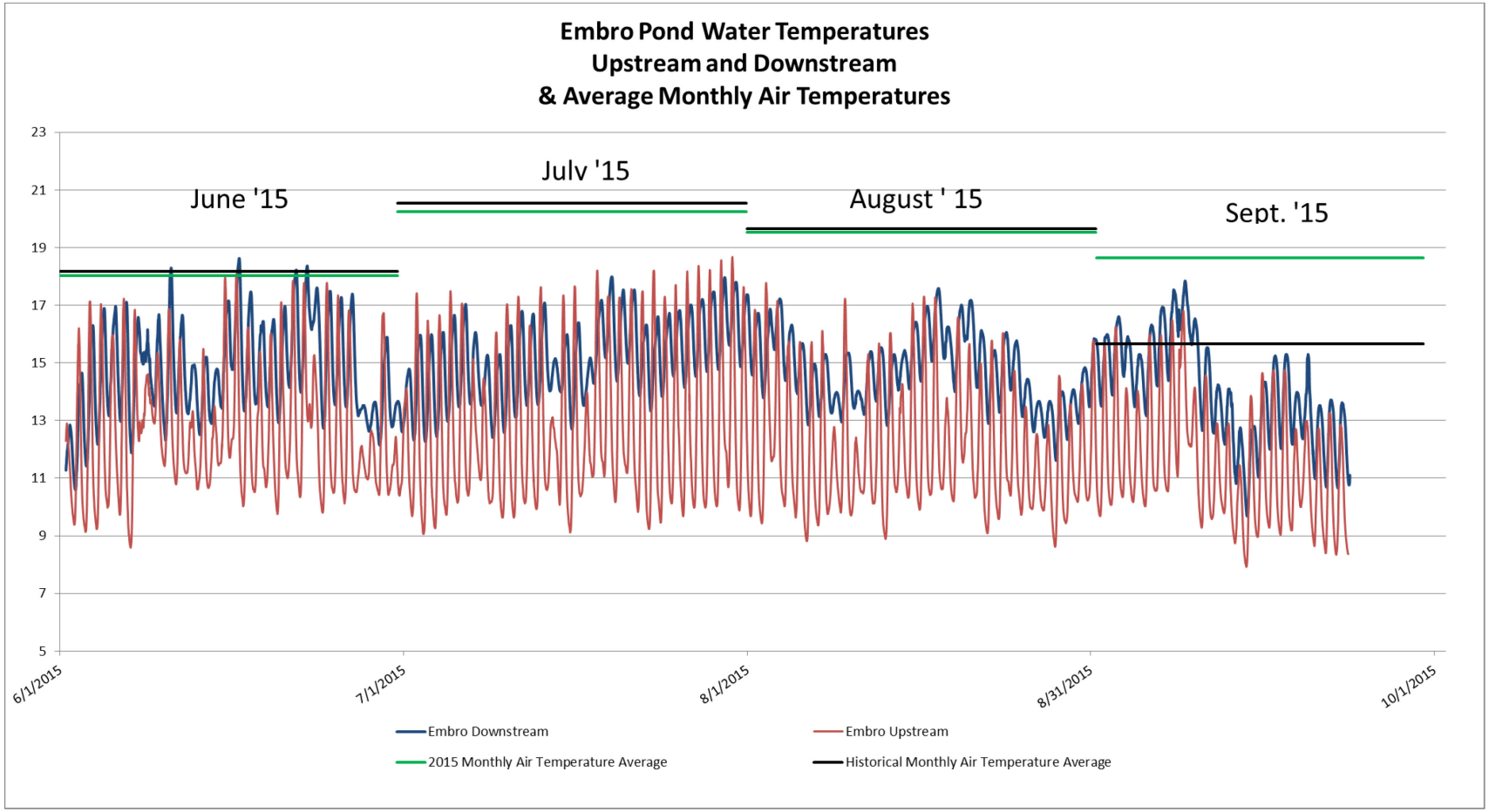

Figure 9 Temperature Upstream and Downstream of Embro Pond, June – Sept 2015 (Source: UTRCA)

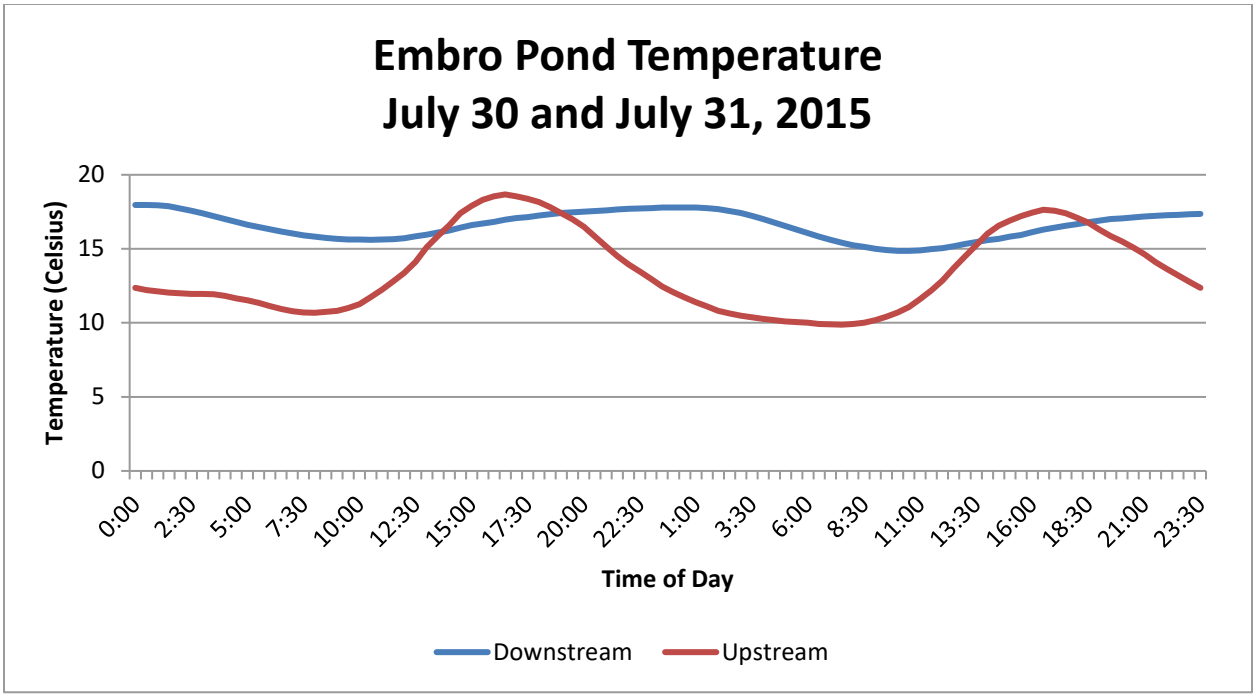

Figure 10 Temperature upstream and Downstream of Embro Pond Showing in Detail the Diurnal Changes, July 30 – 31, 2015 (Source: UTRCA)

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

5 Aquatic Ecology

Electrofishing and benthic surveys were carried out during the spring, summer and fall of 2015. The map in Figure 10 shows the different sampling sites. A list of recorded fish and benthic species, separated into sampling location, is provided in Appendix C: Embro Dam area Fish and Benthic Records.

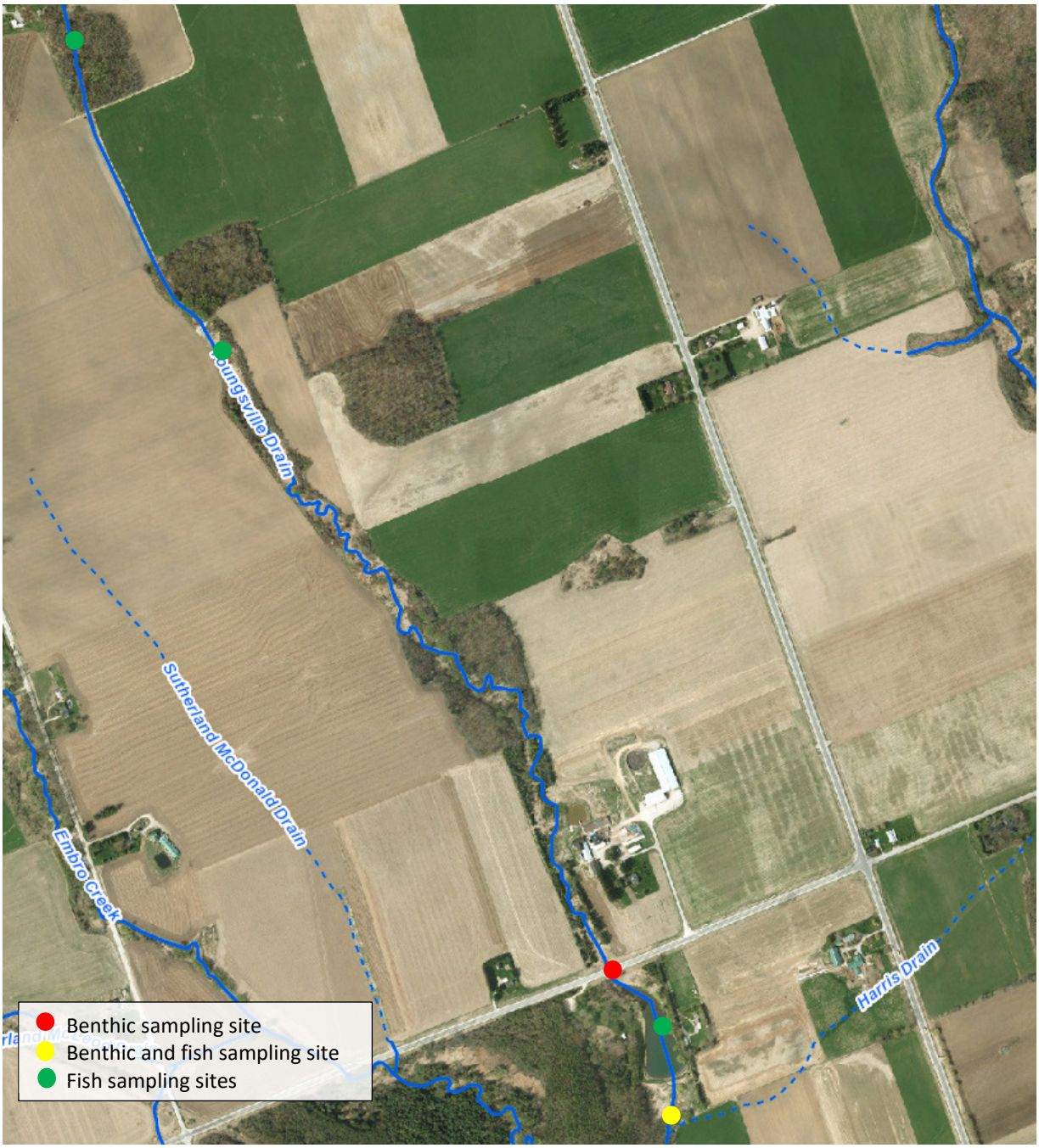

Figure 11 Embro Dam Area Benthic and Fish Sampling Sites (Source: UTRCA)

5.1 Fisheries Resources

An electrofishing survey of the Embro Pond as well as downstream of the dam was conducted on April 15, 2015. The site downstream of the dam was surveyed two more times, once on July 8, and once on October 19, 2015, to provide three season data. Youngsville Drain has been sampled extensively in the past, both upstream and downstream of pond, and found to support a fairly stable brook trout dominated community. Two samples on upstream reaches (May 7, 2015 and November 2014) were deemed adequate to confirm fish community composition. All specimens were identified to species, recorded, and released. Sample records, including historic records, are tracked in an MS Access database and provided in Appendix C: Embro CA Fish and Benthic Records.

Brook Trout, a coldwater species, were recorded in large numbers upstream of the dam, suggesting that Youngsville Drain provides good quality cold water habitat. The Brook Trout below the dam indicate that the numerous seeps and extensive aquatic vegetation that develops throughout the summer months (limiting sunlight penetration) counteract the warming effect of the pond allowing cool water habitat to persist. The absence of young- of-the- year trout in the samples indicate that the cool water habitat is somewhat marginal, not permitting trout recruitment. Trout present likely passed over and became trapped below the dam.

Based on 2015 and previous fish surveys, a large discrepancy in species diversity exists between up and downstream of the pond, with eight species recorded upstream and 21 species downstream. This species list can be found in Appendix C. The low species diversity is fairly typical of trout dominated systems but also likely reflects the impact of the barrier to fish movement presented by Embro Dam and Pond. The diverse downstream community includes cold water species and both permanent and seasonally present warm water species.

Five of the eight species historically found upstream of Embro Dam were recorded during 2015. As these were primarily the most commonly encountered fish in previous surveys, this is a fairly stable fish community. Thirteen of the 21 species sampled downstream of Embro Pond were found during 2015, also representing the more common species historically. This also indicates that Embro Dam is an effective barrier to fish movement limiting upstream fish community diversity.

5.2 Benthic Resources

Benthic invertebrates are organisms that live on the bottom or in the sediment of a water body. Because they are diverse, generally sedentary, and responsive to environmental alterations, benthic invertebrates are often sampled to study water quality (Jones, N.E. 2011).

To determine water quality, a value from 0 to 10, called a biotic index, is assigned to benthic invertebrate taxa. This value indicates their sensitivity and tolerance to pollution. Lower numbers indicate pollution sensitivity and high numbers indicate tolerance. A weighted average of the biotic index and the number of invertebrates in each taxa in the sample gives a value called a Family Biotic Index (FBI). The water quality ranges for the FBI values can be found in Table 1.

Table 1 Water Quality Ranges for FBI Values

FBI Value	Water Quality
<4.25	Excellent
4.25 – 5.00	Good
5.00 – 5.75	Fair
5.75 – 6.50	Fairly Poor
6.50 – 7.25	Poor
>7.25	Very Poor

Benthic invertebrate sampling was conducted in the spring (May 5) and fall (September 23), 2015, at sites on Youngsville Drain upstream of Embro Pond and downstream of the dam. Sampling was conducted using a traveling kick and sweep method, and samples handled and analyzed using methods consistent with Provincial (OBBN) and Federal (CABIN) protocols. Samples were preserved in the field, randomly subsampled in the lab and identified to the Family taxonomic level. Resulting data was entered into, and analyzed, using an MS Access database. Sample records (including historic records) with calculated Family Biotic Index (FBI) are provided in Appendix C: Embro Dam area Fish and Benthic Records.

While the 2015 spring results were almost identical, better water quality was evident upstream in the fall, with pollution sensitive taxa found above the pond replaced by more pollution tolerant taxa (primarily aquatic worms) below the dam. The minimal difference between upstream and downstream results could indicate that the upstream site is suffering somewhat from nutrient enrichment and the negative pond effects are counteracted by some nutrient filtering and assimilation.

Historic benthic invertebrate data for Youngsville Drain is limited to two samples upstream of Embro Pond (2003 FBI = 6.11, 2008 FBI = 6.04), and a one-time sample downstream of Embro Dam in 2010 (FBI = 5.81). All three historical FBI values indicate “fairly poor” water quality.

Table 2 below compares the FBI values of the 2015 Youngsville Drain samples to values of Mud Creek and Upper Thames watersheds. The 2015 Embro values indicate slightly poorer water quality than the average value for all samples of the Upper Thames watershed processed for 2015 to date (FBI = 5.68), and is similar to the long term UTRCA average of FBI = 5.99. It is slightly better than the value utilized for the most recent (2012) Mud Creek Watershed Report Card (FBI = 6.20). All values are within the same water quality range of “fair” to “fairly poor”, which is below the provincial guideline target of “good” water quality (FBI < 5.00).

Table 2 Comparison of FBI values for Embro CA, Mud Creek, and UTRCA watersheds (Source: UTRCA)

Benthic Sample Location	Spring 2015 FBI	Fall 2015 FBI	Average FBI	Water Quality
Youngsville Drain upstream of Embro Pond	5.82	6.06	5.94	Fairly poor
Youngsville Drain downstream of Embro Dam	5.84	6.37	6.12	Fairly poor
Mud Creek watershed 2012	N/A	N/A	6.20	Fairly poor
UTRCA watershed 2015	N/A	N/A	5.68	Fair
Provincial Guideline (target only)	N/A	N/A	<5.00	Good

6 Vegetation and Wildlife Inventory

This study examines the vegetation and bird and wildlife of Embro CA to determine the habitat quality and to flag any rare or sensitive species or communities that might be impacted if the Embro Dam and reservoir area were changed.

A three-season botanical inventory was completed in 2015 of 5.4 ha of the Embro CA, within 100 m of the reservoir. Of the 198 plant species found, 31% are non-native, an average or moderate number compared to other natural areas and parks within the Upper Thames watershed. The overall quality of the terrestrial habitats (Cultural Savanna, Cultural Meadow and Mixed Forest) was assessed as average or moderate. Efforts to plant native trees and tallgrass prairie plants into the CA have added to the diversity of the site. The reservoir has a dense growth of rooted aquatic waterweeds and pondweeds, but all three native species are common. There are very few rooted emergent wetland plants along the edges of the pond owing to the steep sides and constant water levels.

No plant species-at-risk or Special Concern species were found in the study area (on the land or in the water) and no records of plant Species at Risk were found within a 2 km radius. The four plant species with SRanks of S1-S3 (rare or uncommon) have all been planted in the two tallgrass prairie plots in Community 1 and are not dependent on the pond habitat. No plant Species at Risk or rare or uncommon or sensitive species were found on the land or in the reservoir that would be a limiting factor to future site works or conservation area changes. There are no wetlands within the 120 m trigger distance of the Embro CA that need to be considered and, in fact, no wetlands within 1000 m of the study area.

The wooded areas of Embro CA area part of a larger significant natural heritage feature that includes the Oxford County Forest as defined by the Oxford Natural Heritage System (ONHS 2006). This feature would not be a limiting factor to future site changes.

A three season bird survey was undertaken in 2015 as well. Most of the 40 species of birds recorded in the study area are common species and most are forest birds. One bird species-at-risk, the Barn Swallow (Threatened), was seen in the study area but it was not nesting here. Since it nests in old buildings, its nesting habitat will be unaffected by changes to the dam/reservoir.

The reservoir does provide limited significance for a few resident waterfowl for raising broods (e.g., Wood Ducks, Canada Geese). These are common species. Migrating waterfowl make little use of the Embro Reservoir during spring migration, likely due to the isolation of this pond from other ponds or lakes in the area.

The only species that should be given consideration is the Snapping Turtle, a species of Special Concern that was seen in the reservoir by the UTRCA surveyor. Should a lowering of the reservoir be required, a slow summer-time drawdown of the reservoir should safeguard any individuals by allowing them to move into nearby stream habitats, and ultimately, back into the restored creek within Embro CA.

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

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

7 Cultural

7.1 History of Study Area

As written in the book “25 Years of Conservation on the Upper Thames Watershed 1947-1973”, the UTRCA acquired the dam in disrepair in 1958. The dam was replaced with a 91 m (300 ft.) structure and a lake 183 m long by 91 m wide (600 x 300 ft.) was created. After purchasing 5.7 hectares (14 acres) of the Oxford County Forest and 2.7 hectares (6.7 acres) of the Charles Harris property, the Embro Conservation Area officially opened on October 26, 1959, embracing an area of approximately 11.7 hectares (29 acres). In 1968, the conservation area was expanded to accommodate the general public (Upper Thames River Conservation, 1973).

In 1993, the Embro Pond Community Association took over management of the conservation area.

7.2 Current Uses

A system of hiking and cross-country skiing trails, totaling 2.4 km, exist in the plantation of the Embro CA and neighbouring Oxford County Forest. The trails are accessed from the conservation area parking area, off Road 84. Picnic tables and shelters are also located in the CA.

Through various partnerships and programs, trees, wildflowers, and grasses have been planted in the Embro CA. In July 2015, a “Memorial Tree Sign” was unveiled within the Embro CA. In a program run through the Township of Zorra, in the future, memorial trees purchased through UTRCA may be planted within the CA. About six memorial trees have been planted in the CA in previous years.

7.3 Bibliography and Reference Documents

Jones, N.E. 2011. Benthic Sampling in Natural and Regulated Rivers. Sampling Methodologies for Ontario’s Flowing Waters. Ontario Ministry of Natural Resources, Aquatic Research and Development Section, River and Stream Ecology Lab, Aquatic Research Series 2011-05. Retrieved from https://dr6j45jk9xcmk.cloudfront.net/documents/2668/stdprod-103416.pdf.

Upper Thames River Conservation Authority. 1973. Twenty-five years of Conservation on the Upper Thames Watershed 1947-1973.

See the following reference documents:

- Embro Dam Safety Review HATCH, 2007
- Mud Creek Watershed Report Card, 2012. Retrieve from http://thamesriver.on.ca/wp-content/uploads//WatershedReportCards/RC_Mud.pdf

Appendices

Appendix A: Flow Characteristics of Harrington Creek at Harrington Dam and Youngsville Drain at Embro Dam

Appendix B: Embro Pond Water Quality Assessment

Appendix C: Embro Dam area Fish and Benthic Records

Appendix D: Embro Conservation Area Vegetation and Bird Inventory 2015

UPPER THAMES RIVER CONSERVATION AUTHORITY

"Inspiring a Healthy Environment"

Addendum to the Embro Dam and Conservation Area – Existing Environmental Conditions (2016), Upper Thames River Conservation Authority

Introduction

The Upper Thames River Conservation Authority (UTRCA) has engaged with its consultant Matrix Solutions Inc. for the continuation of the Class Environmental Assessment for the Embro Dam. The study was initiated in 2015, completed by Ecosystems Recovery Inc., which later merged with Matrix Solutions Inc. The final study report was submitted to the UTRCA in 2017.

This document serves as an addendum to the Existing Environmental Conditions report (2016), completed by the UTRCA staff. The document contains updates (if any) to streamflow, surface water quality, aquatic and terrestrial biology, and cultural evaluation.

Flow Characteristics

There is no update on the flow characteristics.

Hydrogeology

A map of well records from well records map of the Ontario Ministry of Environment, Conservation and Park (MECP) was retrieved and reviewed for any updates. No changes to the well records were noticed.

Latitude:43.17491, Longitude:-80.91853 (UTM Zone:17, Easting:506621, Northing:4780242)

Image 1 MECP Well Records Map (https://www.ontario.ca/page/map-well-records)

Surface Water Quality

No surface water sampling has been conducted on the site since October, 2016.

Fisheries and Benthic

Additional sampling for fish and benthic at and near the subject area has been conducted since 2015. Please refer to Appendix A for the information.

Terrestrial Ecology

No further data has been acquired since 2016.

Cultural

In 2021, the UTRCA engaged with TMHC Inc. to conduct cultural heritage evaluation that considers the potential heritage value or interest of the site. The final report was submitted in 2022.

Appendix A
Update on Fisheries and Benthic data since 2016