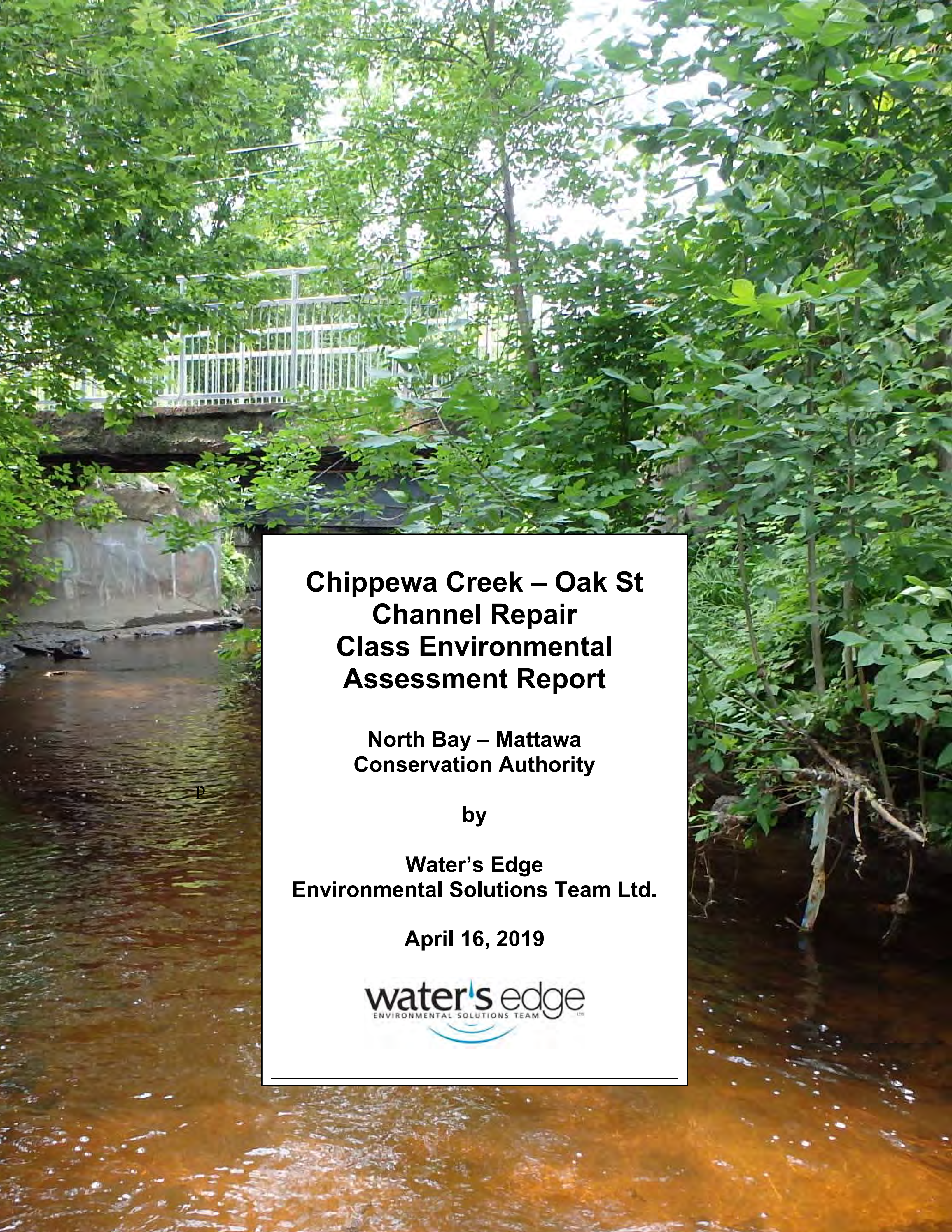

Chippewa Creek – Oak St Channel Repair Class Environmental Assessment Report

North Bay – Mattawa Conservation Authority

by

Water's Edge Environmental Solutions Team Ltd.

April 16, 2019

April 16, 2019
WE 18053

Mr. Brian Tayler
Chief Administrative Officer
North Bay – Mattawa Conservation Authority
15 Janey Avenue
North Bay, ON
P1C 1N1

Dear Mr. Taylor:

RE: Oak Street Pedestrian Bridge Class EA, NBMCA and City of North Bay

Water's Edge was authorized by the North Bay – Mattawa Conservation Authority to conduct the Conservation Authority Class Environmental Assessment for Remedial Flood and Erosion Projects (Class EA) in Chippewa Creek near the Oak Street pedestrian bridge. A notice of commencement was issued on October 23, 2018 and a Public Open House was held on November 8, 2018. Background site information was reviewed, a Baseline Environmental Inventory (BEI) was conducted and areas prone to erosion and bank stability were identified and other potential issue determined. Several alternative remediation options were developed to address these issues. The options were shared during the public consultations and comments were recorded and implemented into the report. The options were also evaluated based on their ability to address the issues identified in the BEI. Where all issues could not be entirely addressed by the design alternatives, mitigation strategies were provided. The preferred option was determined to be the removal of the pedestrian bridge, the old rail bridge, and any other hard structures, with a new retaining wall on the south bank and bank regrading north bank, new abutments, and a new pre-fabricated steel pedestrian bridge. This report contains details on the Class EA process, the BEI, the consultation process, design alternatives, evaluation of alternatives, and the selected preferred alternative.

Respectfully submitted,

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President, Sr. Geomorphologist
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1. INTRODUCTION

Water's Edge was authorized by the North Bay – Mattawa Conservation Authority to conduct the Conservation Authority Class Environmental Assessment (Class EA) for the Oak Street pedestrian bridge on Chippewa Creek. The Oak St. bridge was previously identified by Water's Edge as Priority Site 1 where repairs are needed to protect the integrity of the stream, infrastructure and property. The main issues associated with the Oak St. Bridge are insufficient conveyance leading to flooding upstream, erosion issues downstream, and infrastructure that has been undermined or is deteriorating due to the channel issues. The purpose of the project is to determine the existing conditions of the bridge and the stream in its immediate vicinity, develop design alternatives for addressing the erosion issues, evaluate the environmental impacts of the alternatives, develop plans to mitigate and monitor any environmental impacts, recommend a preferred solution, and advance the selected alternative to the detailed design stage. An important aspect of the Class EA process is consultation with stakeholders and other interested parties to develop consensus regarding the preferred alternative, which is achieved through public notices and information sessions about the project and proposed solutions.

The Oak Street bridge crosses Chippewa Creek approximately 300 m upstream of its mouth and provides a connection between the Kinsmen Trail and Oak Street. Despite the bridge being closed with a barrier and clear signage, many people continue to use the bridge by climbing over the barrier, as observed during our field visits. These observations combined with feedback from the public information session indicate the desire for a pedestrian bridge in the area.

The Study Area, shown in **Figure 1**, contains the reaches of the creek up- and downstream of the pedestrian bridge as well as the adjacent floodplains. An old rail bridge is present within the study area as well, which was also identified as a priority site and contributes to erosion and flooding issues observed in the area.

We have completed our assessment of Study Area in accordance with the approved project Terms of Reference. Data sources for the analysis include:

- Physiography of Southern Ontario by Chapman & Putnam (digital data from Ministry of Northern Development and Mines (MNDM));
- Site Inspections and Surveys;
- GIS, Maps, Engineering Design Manual, Engineering Drawings (City of North Bay, NBMCA)

Site inspections and topographic survey of Chippewa Creek within the Study Area were completed by Water's Edge staff in October 2018. The site inspection was undertaken after an initial review of the mapping and available literature was completed in order to confirm site and general system characteristics.

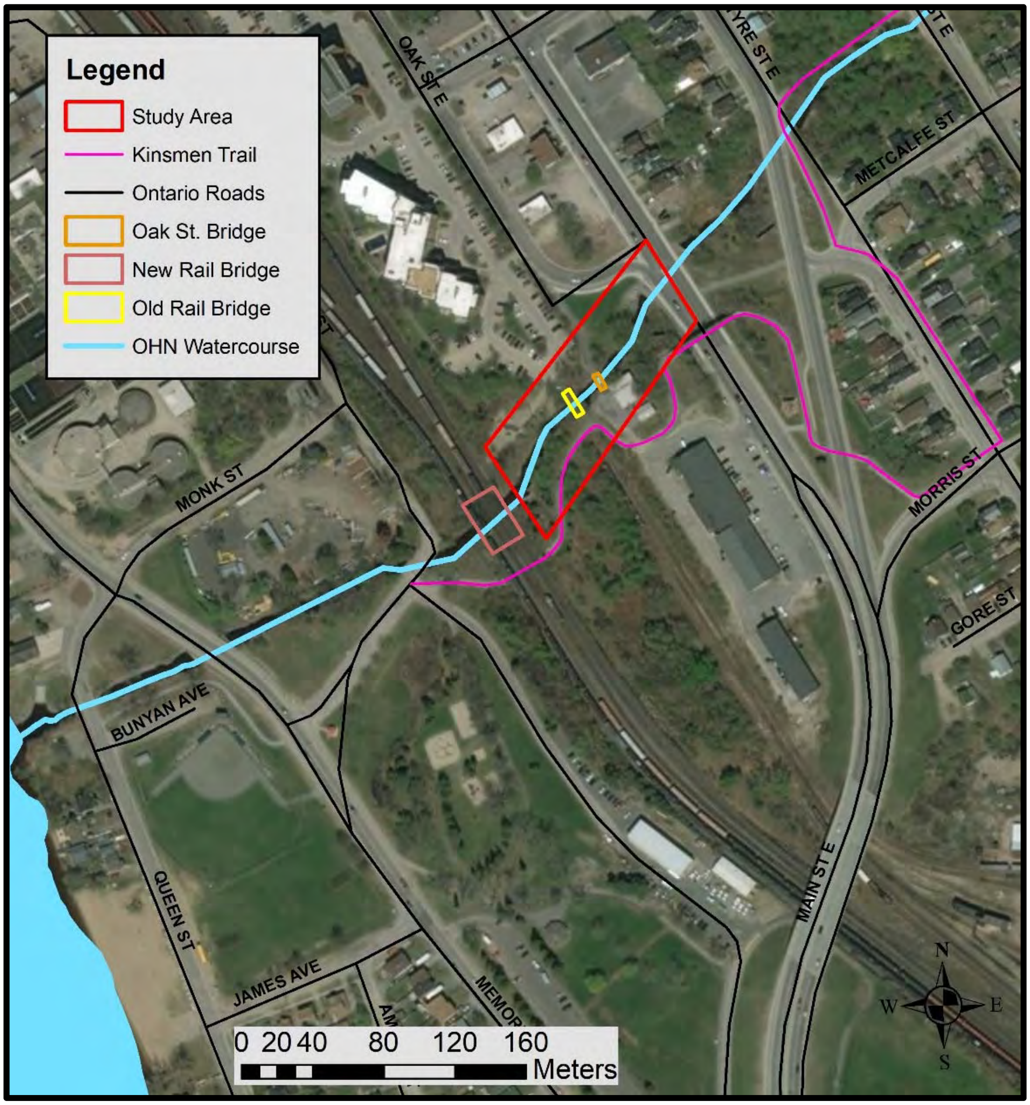

Figure 1: Location of Study Sites

2. BACKGROUND REVIEW

2.1. Watershed Conditions

The drainage area upstream of the Oak Street Bridge is 38.8 km^2 according to the Ontario Flow Assessment Tool III (OFAT) and is a third order channel. The main channel is 20.4 km long starting just south of Cooks Mills and flowing south over the escarpment and through North Bay before draining to Lake Nipissing. The average slope of the channel is 0.8%, with steeper reaches present on the escarpment. The landuse is dominated by community/infrastructure (49%), and treed areas (49%).

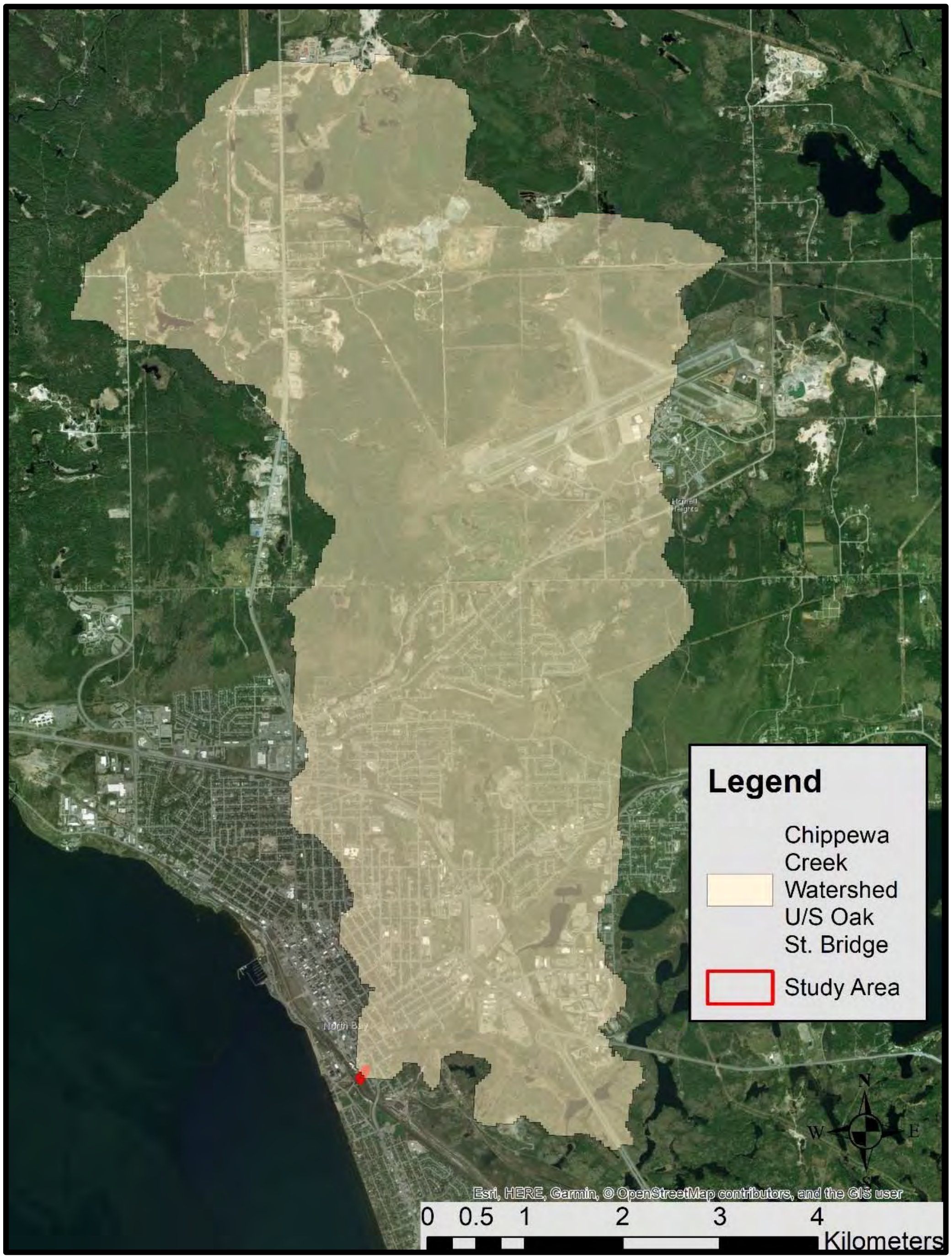

Figure 2: Chippewa Creek Watershed upstream of Oak Street Pedestrian Bridge

3. BASELINE ENVIRONMENTAL INVENTORY

The Baseline Environmental Inventory (BEI) is a key part of the Class EA process and is divided into five categories: physical, biological, cultural, socioeconomic, and engineering/technical. Each category was evaluated and are presented in this section.

3.1. Physical

The study site is located within the Algonquin Highlands physiographic region (Ministry of Northern Development and Mines, 2017). The underlying soils are a combination of Rockland (70%) and Monteagle Sandy Loam (30%) (Ministry of Natural Resources, 2012). Both soils are well drained and are in the hydrologic soil group B. The parent materials are primarily loamy tills.

Reviewing the site area's surficial materials is important to evaluate active channel processes. Stream channel form and sediment supply are controlled by the region's physiography and underlying surficial geology. At the upstream end of the study reach, a large sand deposit was present that restricted the flow in one of the double box culverts to approximately one third of the culvert width. The bottom of the channel between the upstream culvert and the pedestrian bridge was primarily sand. The toe of the banks in this section were also generally exposed, while the rest of the banks generally showed mature vegetation. The headwalls of the pedestrian bridge extend several metres upstream on both banks. The right bank headwall (looking downstream) is flared with some natural vegetation on a small bankfull step. The left bank headwall extends perpendicular to the bridge to a shorter stone retaining wall that extends another several metres upstream. A building is within 3m of the bridge and the stream on the left bank, so any rehabilitation works will be bounded by the building foundation.

The concrete headwalls and abutments for the bridge confine the stream and disconnect it from the floodplain. This constriction leads to deeper flows in the main channel that lead to increased bed shear stress and erosion. Clear evidence of a transitional sediment transport regime was observed. It is likely that the flow constriction associated with the bridge leads to significant backwater effects that slow the flow and allow entrained sediments to deposit on the bed. Signs of aggradation are not present under the bridge or further downstream in the study reach. This indicates that the flow velocity and energy gradient increases in the confined section, which also increases the sediment transport capacity.

No Areas of Natural or Scientific Interest are located within 120m of the channel in the study reach.

3.1.1. Flow Regression Analysis

Bankfull flows for natural river channels are typically associated with the 1.5-year return period. As such the 1.5-yr return period flow is used as the goal for designing the proposed channel. The results of the two OFAT models and the OFAT statistical analysis were used for the regression, as shown in **Figure 3**. Historical floods in Chippewa Creek have indicated that Hurricane Audrey in 1957 yielded approximately the 100-year flood flow which was determined to be 34-43 m^3/s at the flow gauge. The frequency analysis conducted on the flow gauge are not considered reliable due to the lack of an extreme event occurring since it was installed. The flow rates used in the 1984 Chippewa Creek Flood and Erosion Control Study Phase II were much higher than the results of the frequency analysis and most of the OFAT results. The OFAT Primary Multiple Regression was the only method that yielded flows higher than the what were used in the 1984 study. The Primary Multiple Regression data was used in the HEC-RAS models as it provided the most conservative estimate of the 100-year flow that was corroborated by observed flow estimates. It was the only method that yielded higher flow rates than the previous study, which would add a factor of safety to account for additional development in the watershed since 1984. The bankfull flow for the primary multiple regression was determined to be 10.6 m^3/s. The data used for the regression calculation and the regressed values are shown in **Table 1**.

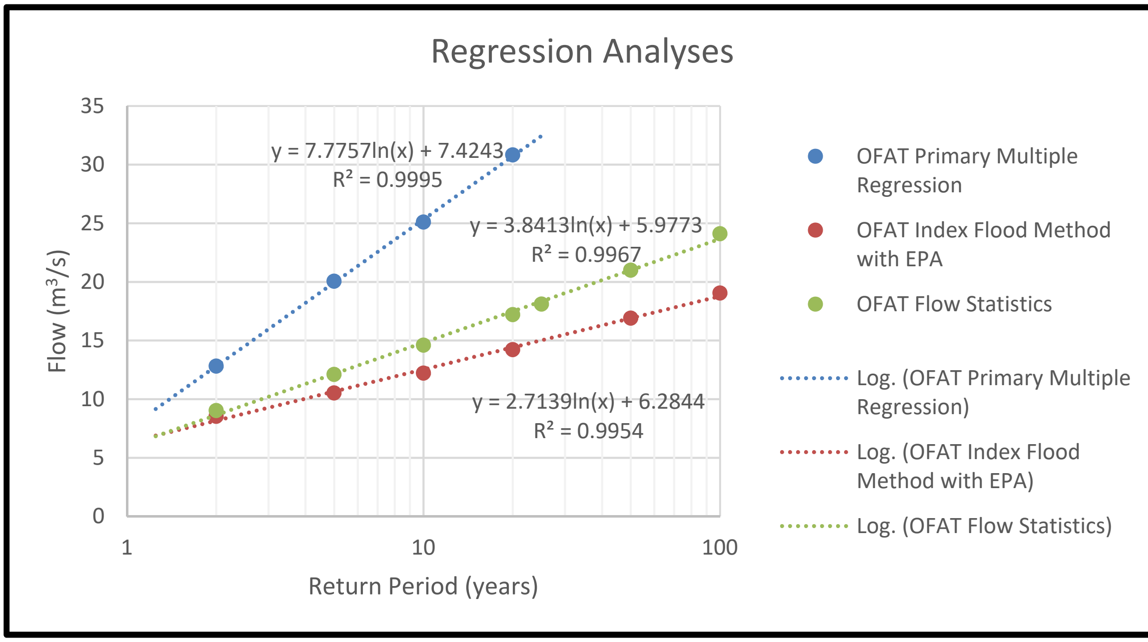

Figure 3: Flow Regression Analysis

Table 1: Return Period Flows at Oak Street Pedestrian Bridge

Return Periods	Flow Rates (m^3/s)						
	OFAT Primary Multiple Regression	OFAT Index Flood Method with EPA	OFAT Extreme Flow Frequency Statistics (Station 02DD014)	Generalized Extreme Value (Station 02DD014)	3 Parameter Lognormal (Station 02DD014)	Log-Pearson Type 3 (Station 02DD014)	1984 Flood and Erosion Control Study
1.25-yr		8.1					
1.5-yr*	10.58	7.38	7.53				
2-yr	12.81	8.53	9.02	6.46	6.44	6.43	
5-yr	20.06	10.52	12.1	8.32	8.32	8.27	12.69
10-yr	25.10	12.22	14.6	9.64	9.67	9.61	
20-yr	30.83	14.22	17.2	11	11	11	
25-yr			18.1				20.10
50-yr	35.21	16.91	21	12.8	12.9	12.9	23.36
100-yr	40.59	19.05	24.1	14.3	14.4	14.5	37.94
200-yr		21.32	27.5	15.9	15.9	16.2	
500-yr		23.88	32.4	18	18.1	18.7	

*determined by regression calculation

3.1.2. Rapid Assessments of Channel Conditions

In addition to classification of a stream system, various techniques for geomorphic assessments are used to better understand general stream conditions (stability, habitat, erosion/degradation, riparian, etc.). In our assessment of Chippewa Creek, we used Rapid Geomorphic Assessment and Rapid Stream Assessment Technique.

Rapid Geomorphic Assessment (RGA)

Creek stability was assessed using a Rapid Geomorphic Assessment (Ministry of the Environment, 2003). The RGA assessment focuses entirely on the geomorphic component of a river system. The RGA method consists of four factors that summarize various components of channel adjustment, specifically: aggradation, degradation, channel widening and plan form adjustment. Each factor is assessed separately, and the total score indicates the overall stability of the system. This methodology has been applied to numerous streams and rivers and the following table details the ranking criteria (see **Table 2**).

The RGA stability index for the study reach was determined to be 0.26, which classifies the river as transitional. Evidence of aggradation, widening and planimetric form adjustment were observed. Aggradation was primarily observed upstream of the pedestrian bridge where the constriction leads to lower flow velocities where sediment falls out of suspension. Evidence of widening was mostly observed downstream of the rail bridge, likely due to the high-velocity flow caused by the constrained section of the channel.

Table 2: Interpretation of RGA Score

Stability Index (SI) Value	Classification	Interpretation
SI ≤ 0.20	In Regime	The channel morphology is within a range of variance for rivers of similar hydrographic characteristics and evidence of instability is isolated or associated with normal river meander processes.
0.21 ≤ SI ≤0.40	Transitional/Stressed	Channel morphology is within a range of variance for rivers of similar hydrographic characteristics, but the evidence of instability is frequent.
SI ≥ 0.40	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is wide spread.

Rapid Stream Assessment Technique (RSAT)

Rapid Stream Assessment Technique was developed by John Galli and other staff of the Metropolitan Washington (DC) Council of Governments (Galli, 1996). The RSAT systematically focuses on conditions reflecting aquatic-system response to watershed urbanization. It groups responses into six categories, presumed to adequately evaluate the conditions of the river system at the time of measurement on a reach-by-reach basis. The six categories are:

1. Channel stability;
2. Channel scouring and sediment deposition;
3. Physical in-stream habitat;
4. Water quality;
5. Riparian habitat conditions; and
6. Biological conditions.

River channel stability and cross-sectional characterization is a critical component of RSAT. The entire channel was inspected for signs of instability (such as bank sloughing, recently exposed non-woody tree roots, general absence of vegetation within bottom third of the bank, recent tree falls, etc.) and channel degradation or downcutting (such as high banks in small headwater streams and erosion around man-made structures). Observations were noted, and cross-section measurements were made.

A rapid assessment of soil conditions along the river banks is also conducted to determine soil texture and potential erodibility of the watercourse bank. Qualitative water quality measurements were also made (temperature, turbidity, colour and odour) along with an indication of substrate fouling (i.e., the unwanted accumulation of sediment).

RSAT also typically involves a quantitative sampling and evaluation of benthic organisms. As no benthic sampling was undertaken, the score was based on site conditions and general observations of water quality.

Each category was assigned a value which was then summed to provide an overall score and ranking. **Table 3** details the range of scores and rankings with a higher score suggesting a healthier system. The scoring criteria for each subcategory is detailed in the rapid assessment sheets in **APPENDIX D.**

Within these broad categories, we evaluated the study site and determined an RSAT score of 29.25 for the study reach, which ranks the reach as "Good" condition. Interpretations of the RSAT scores can be seen in **Table 3**.

Most categories scored "fair" to "good" except for riparian habitat conditions, which was ranked "poor" due to the small riparian buffer and the disconnection between the channel and the floodplains due to the concrete abutments. The biological indicator category was not assessed and was assumed to be an average of the other categories. Sediment deposition was evident between Main St. and the pedestrian bridge, particularly at the outlet of the Main St. culvert. Little habitat variability was present, and the lack of a clear pool-riffle sequence contributed to the low scores in the reach. The riparian areas that were connected to the channel had little deep-rooting vegetation such as willow or alder trees to resist erosion and provide shade. The riparian buffer was rarely wider than a few meters, where an ideal stream would have more than 60m of forested buffers on each side. Bank erosion was observed, particularly downstream of the old rail bridge, although the erosion rates appear to be relatively low and bank failures are unlikely.

Table 3: Interpretation of RSAT Score

RSAT Score	Ranking
41-50	Excellent
31-40	Good
21-30	Fair
11-20	Poor
0-10	Degraded

3.1.3. Hydraulic Modelling

A HEC-RAS hydraulic model was developed for the study area to determine the water surface elevations (WSELs) for the existing site conditions. The reach was modelled between the Main St. culvert and 30m downstream of the old rail bridge. The flow rates from the primary multiple regression in OFAT (**Table 1**) were used for modelling. See **Section 3.1.1** Flow Regression Analysis for justification of the selected flow rates.

The model shows the existing conditions in the reach, which represents the "do nothing" option. The longitudinal profile of this model with the 100-year flood level is shown in **Figure 4**. The WSEL profile shows two distinct drops near each of the structures, indicating that the structures are creating a backwater effect and contributing to the upstream inundation. The WSEL drop downstream of the rail bridge may also create a hydraulic jump. The WSEL profile shows that both the 50- and 100-year floods will over-top the banks just downstream of Main St. in this scenario. Output summary tables for the HEC-RAS modelling are included in **Appendix E**.

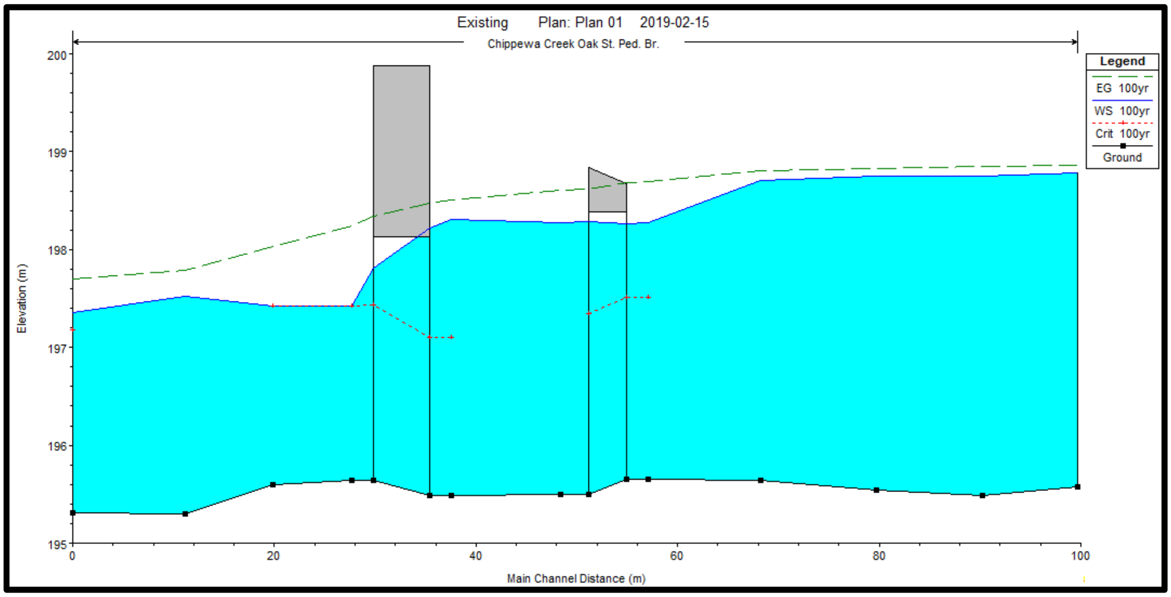

Figure 4: Existing Conditions HEC-RAS model showing the 100-year flood level

3.1.4. Bankfull Discharge

Bankfull flows are typically estimated for a channel based on the surveyed cross sections. Since the channel had been heavily modified, it was very difficult to identify bankfull markers on the banks in some cross-sections, and the estimates are likely unreliable. Despite this, Manning's equation was used to estimate the flow through the channel when the channel begins to flood the adjacent field, referred to as the channel-full flow. The topographic survey data was used to determine the cross-sectional area, wetted perimeters and slope for the calculations. Manning's n was estimated from literature based on observed site conditions (Chow, 1959). The values selected were n = 0.035 for the main channel and n = 0.08 for the floodplains. This flow rate was determined to be 25-29 m^3/s, which corresponds to approximately the 10- to 20-year return period flow. From the existing conditions HEC-RAS model, the bankfull flow is between the 2- and 5-year events with a flow rate of approximately 15-20 m^3/s, but this is likely not an accurate approximation due to the heavy historical modification of the channel. The channel-full flow from the HEC-RAS model was determined to be between the 20- and 50-year flow, or approximately 31-35 m^3/s.

3.2. Biological

The biological assessment was conducted by FRiCorp and included an ecological land classification within the study area. The full report is included in **Appendix B** and a summary is provided here. FRiCorp identified six ecosites within the study area, which are shown in **Figure 5.**

Figure 5: Study Area Ecosites

The habitat within the channel was also assessed, which confirmed the absence of critical spawning or nursery habitat within the reach, although the creek likely serves as a migration corridor for lamprey species. Fish population studies are typically conducted as part of the Class EA process, but due to constraints from fisheries timing window and the project timeline this wasn't possible. To compensate, FRiCorp synthesized data from previous fish studies in Chippewa Creek since 2011.

The potential impacts to Species-at-Risk (SAR) were evaluated by first identifying species that could be found in North Bay. Several bat and bird species were identified, along with Blanding's Turtle and the Eastern Hog-Nose Snake. No suitable bat or bird habitat was found within the study area, so no negative impacts are anticipated. The study area can be categorized as a Category 3 Blanding's Turtle Habitat, which is used for movement, but not nesting. It will not be necessary to obtain authorization under the Endangered Species Act (ESA) if the channel will continue to function as a movement corridor and the channel will remain hazard-free during the active season between April and October. Potential impacts during the active season can be mitigated through exclusion or reptile fencing around the site, which will remain in place until the site has been deemed safe for the turtles. The study area is presumed to be suitable Eastern Hog-Nosed Snake foraging habitat and can be mitigated through inspecting the site and relocating any snakes at least 500m away and by using exclusion fences around the site and any imported aggregates. Exclusion or reptile fences will be used such that they prevent the noted SAR from entering the terrestrial work areas on both sides of the creek, but do not obstruct the migration of species within the main channel.

3.3. Cultural

The cultural baseline inventory was conducted by Horizon Archaeology and included a Stage 1 Archaeological Assessment. The purpose of the assessment was to recover and assess the cultural heritage value or interest of any archaeological sites within the study area. The full report is included in **Appendix C**. Evidence of human activity has been observed for 7000-12000 years in central and northern Ontario, but evidence was not observed within the study area. The first Europeans visited the area in the early 17th century and North Bay began to develop substantially after the arrival of the railroad in 1882, becoming a town in 1891 and a city in 1925. North Bay was a hub for the Canadian National, Canadian-Pacific, and Temiskaming Northern Ontario Railroads, and was the Divisional Headquarters of Canadian Pacific from 1901-1960. The railroads led to significant industrial and resource extraction and processing operations in the region, without the "boom" and "bust" cycle of many other single-resource towns experienced. The rail line and abandoned rail bridge in the study area were part of the Temiskaming and Northern Ontario Railway, now known as Ontario Northland, with two spur lines connecting to the local mill complex. Much of the development surrounding the study area was related to the railroads, which demolished any existing structures on the site and eliminated any evidence of archaeological or cultural significance.

One registered archaeological site and two heritage structures were identified in the vicinity of the study area. The archaeological site was located on the shore of Delanely Lake, but no other information was available. The two heritage structures are related to the railroad; the former headquarters of the Temiskaming and Northern Ontario Railway is located 300m northwest of the study area and the Canadian Pacific Train Station is located about 1 km northwest of the study area and is now the city's museum.

Due to the historic modifications of the creek and the surrounding area, the archaeological potential of the site has been greatly reduced. The area assessed was found to have no archaeological concerns.

3.4. Socio-Economic

The study site is located in Downtown North Bay and is within 150m of residential areas. The elevated flood risks in the area can lower property values and stifle local investment. The Oak St. Pedestrian Bridge was identified as an important connection in the City's trail network through public consultation and by the City of North Bay. Somebody trying to access the Kinsmen Trail from Oak St. would have to walk more than 400m to get to the same point on the trail if the pedestrian bridge was not replaced. The public consultation process is discussed in **Section 4** with further details in **APPENDIX A**.

3.4.1. Property Ownership

The primary landowners in the study area are the City of North Bay, NBMCA and Ontario Northland. An additional private property is located southeast of the creek, where a building foundation is immediately adjacent to the pedestrian bridge footing, and to the northwest, where an apartment building and parking lot are located. The pedestrian bridge is on NBMCA property, while the old rail bridge is on Ontario Northland property. The land on Ontario Northland property surrounding the old rail bridge will need to be acquired before work can be commenced. Alternatively, a temporary construction easement could be required. All property owners in the vicinity of the study site have been notified of the Class EA.

3.5. Engineering/Technical

The primary technical concern leading to the Class EA process was the increased flood risk caused by the inadequate conveyance through the pedestrian and old rail bridges. The conveyance issue was mainly due to the undersized bridges confining the channel but is also exacerbated by the sediment deposition downstream of the Main St. culverts that reduces the cross-sectional area. Downstream of the channel, there is moderate bank erosion which is likely a result of a higher stream slope due to historic realignment and due to the acceleration of flows through the confined reach, where the concrete abutments provide little roughness to reduce flow velocities.

Ontario Northland indicated that a fibre optic cable may span a conduit under the old rail bridge, the so any option that would remove the bridge would need to account for a new conduit either underground or under the new pedestrian bridge. Bell phone boxes were also present in the riparian areas in the study area and may need to be relocated if bank regrading is undertaken.

4. PUBLIC CONSULTATION

Public Consultation is an important aspect of the Class EA process. It allows identified stakeholders and members of the public to share thoughts, concerns, and desired outcomes that are considered when selecting a preferred alternative solution. This section outlines the steps taken to engage the public and facilitate comments. Details of the materials provided to stakeholders, public advertisements, and comments received are included in **APPENDIX A**.

4.1. Notice of Commencement

The Notice of Commencement was issued on October 23, 2018. NBMCA compiled a list of stakeholders to distribute the notice to based on the defined criteria in the Class Environmental Assessment for Remedial Flood and Erosion Control Projects document (Association of Conservation Authorities of Ontario, 1993). The following organizations were sent notices through physical or electronic mail:

- City of North Bay
- Ontario Northland
- Nipissing First Nation #10
- Ministry of the Environment, Conservation and Parks (MECP)
- Conservation Ontario
- Fisheries and Oceans Canada
- Ministry of Natural Resources and Forestry (MNRF)
- Clean Water Solutions
- Private property owners adjacent to study site

In addition, a generic letter to property owners was provided to Water's Edge to distribute to property owners and other interested parties during field work.

4.2. Public Open House

The Public Open House (POH) was advertised in conjunction with the Notice of Commencement. The POH was advertised through a variety of media, including:

- Media Release to NBMCA Nipissing Media List
- North Bay Nugget Advertisement
- Tangr.com Event Calendar
- BayToday.ca Event Calendar
- Cogeco Your TV Event Calendar
- NBMCA Facebook Event
- Chippewa Creek EcoPath Facebook Event

The POH was held on November 8, 2018 at the NBMCA office. Water's Edge presented details of the Class EA process, background information, and several conceptual design options to address the erosion and sediment transport issues in the study area. The presentation was recorded and shared through social media following the POH. A sign-in sheet was used to track the people that attended, and comments from attendees were recorded. Public comments were also accepted via email until November 18, 2018.

5. ALTERNATIVE SOLUTIONS

5.1. Rationale

The objectives at the site will be to increase the conveyance of the channel, stabilize eroding banks and re-naturalize the channel and banks where possible. Since the primary cause of the issues in the reach are due to the under-sized pedestrian bridge, the alternative solutions focus on the bridge and solutions to the conveyance issue. The proposed conceptual designs will consider the criteria and constraints from the various stakeholders and regulators.

5.2. Alternatives

Conservation Ontario's Class Environmental Assessment for Remedial Flood and Erosion Control Projects (Class EA) provides details about planning and approval processes for remedial flood and erosion control projects. The Class EA also provides procedures and planning principles for these projects to ensure that environmental effects are considered at each stage of a project. All the methods outlined in the document were considered based on their applicability to the site conditions and the goals of the project. The proposed conceptual designs are presented below.

5.2.1. Option 1: Do Nothing

The "Do Nothing" option is usually considered as an option in order to compare the potential impacts of the current situation with the impacts of the remediation options. The "do nothing" approach will not resolve the conveyance issue in the creek and will likely lead to further degradation of the channel in the area due to the issues discussed previously. Since the current bridge has degraded and is no longer safe enough to remain open, the safety hazards will continue to increase, potentially putting the people that continue to use the closed bridge at risk. If the bridge were to fail and collapse into the creek, a significant obstruction would be created that would accelerate the degradation of the channel in the area and increase the flood risk upstream of the bridge. If the bridge fails, the remediation of the creek will become more complicated and expensive while putting the migration of species-at-risk in jeopardy.

5.2.2. Option 2: Removal of Bridge(s)

The removal of the pedestrian bridge and possibly the old rail bridge would eliminate the risk of a failure increasing the flood risk and causing ecological damage. The conveyance issue would also be alleviated, and the channel will slowly adjust to a new stable equilibrium. Since the channel south of Main St. has been historically realigned, the slope through the reach is likely higher than what is natural, so the creek will continue to erode banks and migrate laterally to create a sinuous planform in order to reduce the grade and dissipate energy. Significant conveyance issues will persist for high-flow events if the pedestrian bridge is removed but the rail bridge remains in place. HEC-RAS models showed only moderate reductions in flood WSELs if the rail bridge were to remain. Removal of both bridges is necessary to contain the 100-year flow within the channel, which is a typical stormwater management criterion for major systems in the MTO Drainage Management Manual and the MOE Stormwater Management and Design Manual (Ministry of the Environment, 2003; Ministry of Transportation Ontario, 1997).

The foundation of the building immediately adjacent to the pedestrian bridge would be at risk of being undermined in this scenario. The Oak St. Pedestrian Bridge was identified as an important trail connection between Oak St. and the Kinsen Trail, so removing the bridge without replacing it would represent a barrier to using the city's recreation infrastructure and make the city less walkable. This option would have the lowest initial capital cost, but additional expenses are possible due to the continuing channel evolution.

5.2.3. Option 3: Removal of Bridge(s) with New Pedestrian Bridge

The option of removing both bridges and adding a new pedestrian bridge would also alleviate the conveyance issues in the reach while maintaining the existing trail network. The channel will continue to evolve as in option 2, but the abutments of the new bridge can be designed to protect the building foundation immediately adjacent to the existing bridge. The new bridge will be pre-fabricated to the minimum available length that will adequately convey flow within the channel.

5.2.4. Option 4: Removal of Bridge(s) with New Pedestrian Bridge and Bank Stabilization

This option incorporates the previous options and adds bank stabilization and grading to minimize the risk of bank failure and planform migration. An armourstone treatment would be applied to the south bank to replace existing concrete structures and protect the adjacent building and trail infrastructure. The north bank would be regraded to stabilize the slope and add a bankfull bench. This will create a low-flow channel that will allow species including Blanding's Turtle to migrate through the creek throughout the year, while helping to dissipate energy and reduce shear stresses during large flood events. This option will provide the greatest ecological benefit to the creek while also alleviating the conveyance issues in the reach if both bridges are removed. Removing both the rail and pedestrian bridges would reduce liability to the city and improve connectivity between the channel and the riparian areas. Improved access to floodplains will allow more suspended sediment to settle outside of the channel during high flow events which will improve the conveyance of the channel and reduce the maintenance costs of clearing culverts and removing excess sediment. This option would have the highest capital costs for construction, but it would reduce liability of the city if the bridges fail, it reduces the flood risk of the surrounding neighbourhood, improves the ecological functionality of the creek and maintains the city's trail network connectivity. This option including removing the rail bridge was identified as the preferred option during the public open house. The comments also identified desired plant species to be used for vegetating the banks following the regrading, although some are not typical riparian plantings.

5.2.5. Option 5: Remove Pedestrian Bridge and Retrofit Old Rail Bridge (not fully evaluated)

Ontario Northland provided comments about the EA at a late stage that recommended the consideration of a fifth option. Due to restrictive timelines, this option could not be evaluated to the same level as other options. Ontario Northland suggested that the project team consider removing the pedestrian bridge and retrofit the old rail bridge for pedestrian use rather than remove the old rail bridge and add a new pedestrian bridge. It is expected that the steel beams of the old rail bridge are structurally sound enough to be used for a pedestrian bridge, although this would need to be confirmed through an inspection by a structural engineer. Additionally, retrofitting the bridge would require a new bridge deck and railings to be designed and built, and the paved pathways realigned. These costs are expected to be significantly higher, with longer timelines than using a prefabricated bridge.

A preliminary assessment of the hydraulics associated with this option showed that keeping the old rail bridge would significantly constrict flow and prevent the 100-year flow from being contained within the channel. While removing the pedestrian bridge by itself would provide marginal improvements to conveyance, the removal of both bridges and abutments is necessary to increase the conveyance and to satisfy the MTO design guidelines for major system drainage, which should contain at minimum the 100-year flood. Ontario Northland also raised concerns about land ownership related to the old rail bridge. The rail bridge is on Ontario Northland property, so a legal survey and land acquisition may be required before work can commence on the rail bridge. Ontario Northland also indicated that the pedestrian bridge may be within a historical right-of-way of the rail bridge. Since the property can be accessed from both sides of the creek, and the pedestrian bridge has been deemed unsafe, the pedestrian bridge no longer serves as a right-of-way. Replacement of the existing pedestrian bridge with a new pedestrian bridge, as per Options 3 and 4 above, would improve the current level of access.

5.3. Evaluation of Alternatives

In order to select the preferred alternative based on the results of the BEI, a decision matrix was created using each of the categories from the BEI as well as estimated costs. The engineering/technical criterion was not included in this evaluation as identified issues will need to be addressed for any of the options. Additional hydraulic modelling was also conducted to quantify the effects of selected alternatives on the water surface elevations under different flood conditions, as shown in **Section 5.3.1**. Each alternative was ranked in each category using a qualitative scoring system shown in **Table 4**. Each criterion was weighted equally in determining the overall score. The decision matrix including a brief rationale for each score is shown in **Table 6**, attached following the main body of this report.

A ranking of least desirable, with the empty circle indicates that the assessed alternative is likely to have a negative impact on the criteria evaluated without a significant benefit. The middle rating with a half-filled circle indicates moderate benefits or benefits offset by additional negative impacts. The most desirable ranking, with a full circle, indicates a beneficial solution with minimal negative impacts. The other two categories represent a middle ground between the categories described above.

Table 4: Criteria Scoring Scheme

Least Desirable	→			Most Desirable
○	◔	◑	◕	●

5.3.1. Hydraulic Modelling of Alternatives

In order to quantify the benefits to flood risk and erosion that the alternative design options could provide, HEC-RAS models were developed for select options. The same cross-section locations, boundary conditions and Manning's roughness were used for the existing and proposed models to facilitate comparison. A summary table showing the upstream WSEL for the modelled alternatives under different flood conditions is shown in **Table 5.**

The "proposed" model represents Option 4b, where both bridges are removed, a replacement pedestrian bridge is installed, with bank regrading and stabilization. The longitudinal profile of this model with the 100-year flood level is shown in **Figure 6**. In this scenario, a WSEL drop was observed downstream of the old rail bridge in approximately the same location as the existing conditions model, which suggests that the bed geometry causes the issue and the constriction from the bridge exacerbates it. The improved conveyance as a result of removing the bridges led to the flood levels of the 100-year flood being contained within the channel at all cross-sections. The WSEL immediately downstream of the Main St. culvert are significantly reduced by 49 cm in this scenario.

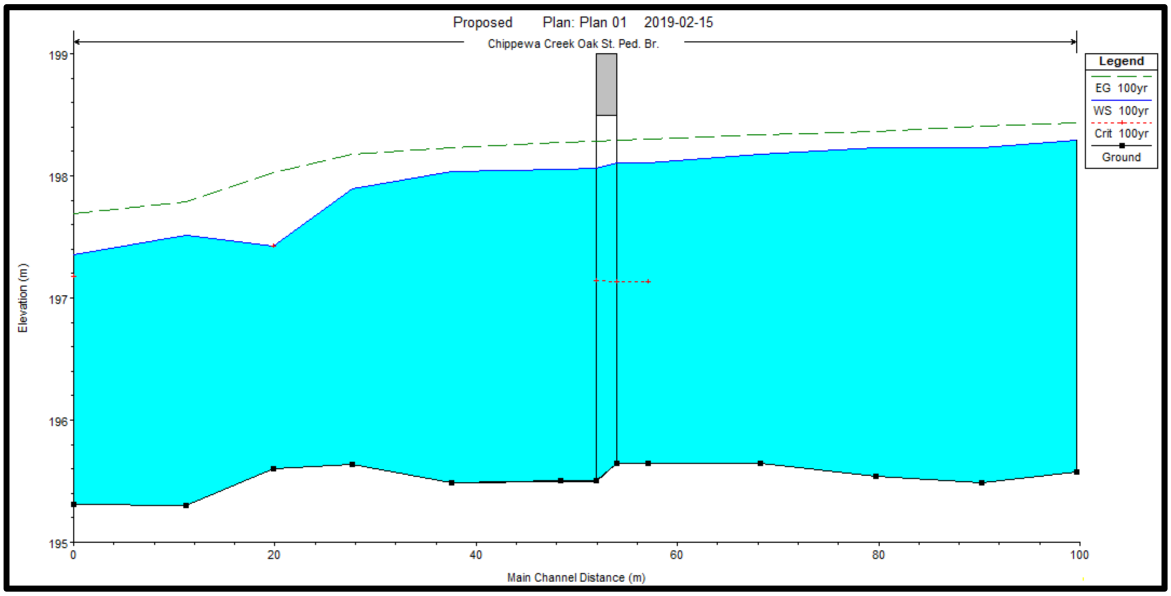

Figure 6: Option 4b HEC-RAS model showing the 100-year flood level

The final model represents Option 5, which was developed to illustrate the effects of removing just the pedestrian bridge and keeping the old rail bridge, an option suggested by Ontario Northland. For this option the pedestrian bridge would be removed, and banks would be regraded or stabilized, while the old rail bridge and surrounding banks would remain as-is. The longitudinal profile of this model with the 100-year flood level is shown in **Figure 7**. When compared to the existing conditions model, the WSEL profile is moderately lower, with a significant WSEL drop after the rail bridge with a likely hydraulic jump. The WSELs immediately downstream of the Main St. culvert are reduced by 23 cm compared to the existing conditions model for the 100-year storm. The WSEL profile is much smoother through this reach, although some cross-sections near the pedestrian bridge or between the two bridges have higher WSELs than the existing conditions model. This phenomenon is due to supercritical flows under the existing bridge and the hydraulic jump downstream of the bridge no longer being present. Despite the higher WSELs in some areas, the 50-year flood is contained within the channel in all cross-sections. The 100-year flood will continue over-top the banks near Main St. in this scenario.

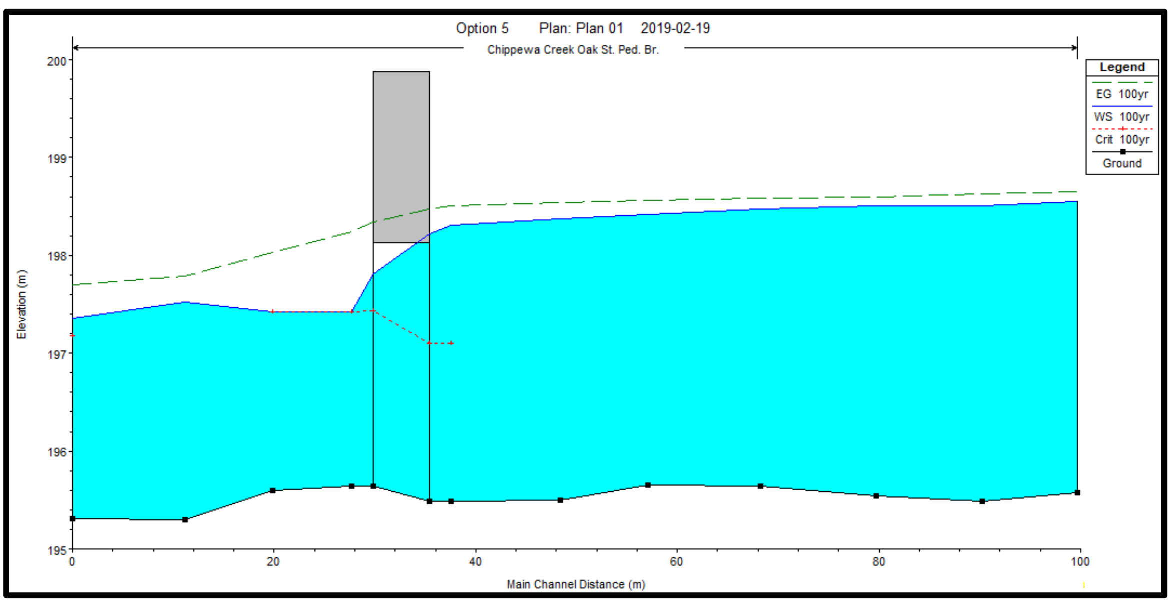

Figure 7: Option 5 HEC-RAS model showing the 100-year flood level

Based on the results of the hydraulic models, it will be necessary to remove both bridges to convey the 100-year flood within the channel, as per typical stormwater guidelines for major system conveyance. Any designs that do not achieve this criterion are considered inadequate infrastructure for stormwater management. The 100-year or regional storms are typically used for the design of major drainage systems including streams in Ontario (Ministry of Transportation Ontario, 1997).

Table 5: HEC-RAS upstream WSELs by Design Alternative and Storm Return Period

Storm Return Period	Water Surface Elevation D/S of Main St. Culvert (m)		
	Existing Conditions	Proposed Conditions (Option 4b)	Remove Ped. Bridge Only (Option 5)
1.5-year	197.07	196.98	196.99
5-year	197.65	197.49	197.5
10-year	197.93	197.70	197.75
20-year	198.24	197.93	198.04
50-year	198.47	198.10	198.25
100-year	198.78	198.29	198.55

5.3.2. Preferred Alternative

Option 4b was determined to be the most preferable option based on this evaluation. The "do nothing" approach scored the lowest. Option 4b ranked the highest for each criterion except for cost, where it is expected to be the most expensive option to construct. Any of the options that would remove both bridges would alleviate the flooding issues, but each of those options had different degrees of negative impacts, mostly related to the channel connection to the riparian areas and bank erosion. The "do nothing" approach would be the least expensive option in the short term, although the long-term cost could potentially be the highest, depending on whether the pedestrian bridge fails, if a major flooding event occurs, or if erosion hazards require more intensive remediation. The preliminary design of the preferred alternative is shown in **APPENDIX F**.

6. SUMMARY

The study site is located in the City of North Bay on Chippewa Creek between Main St. and the CPR Bridge. The existing Oak St. Pedestrian Bridge is undersized and provides inadequate conveyance. The Conservation Class EA Process for Remedial Flood and Erosion Control Projects was initiated by NBMCA and Water's Edge was retained to carry out the planning and design process. Water's Edge retained FRiCorp Ecological Services and Horizon Archaeology Inc. to conduct the biological and cultural components of the BEI, respectively. Water's Edge conducted the physical, socioeconomic and engineering/technical components of the BEI including a topographic survey and rapid field assessments. A Public Open House was conducted where four options for remediating the conveyance issues were presented for public comment. Comments received indicated that the removal of the pedestrian and rail bridge, with bank stabilization and a new bridge was the solution preferred by the public. All stakeholder comments received are included in **Appendix A**. This option was also considered the preferred solution by Water's Edge and the Study Team, as it would alleviate the conveyance issues while providing improved ecological functions. From the BEI and the evaluation of the preferred alternative, it is apparent that all possible negative impacts can be avoided or mitigated satisfactorily by following the recommendations in this report and the attached sub-consultant reports. This result is typical of small-scale flood and erosion projects in non-sensitive environments.
The following conclusions are provided:

1. The Oak St. Pedestrian Bridge is undersized and increases the flood risk upstream of the bridge;
2. The abandoned rail bridge is also likely undersized, based on the hydraulic analysis in **Section 5.3.1**;

3. SAR including Blanding's Turtle and the Eastern Hognose Snake could be present within the reach. Potential impacts can be mitigated, and the migration route maintained throughout the active months, eliminating the need for ESA authorization;
4. No archaeological or cultural heritage sites were identified within the study area;
5. The trail connection between Oak St. and the Kinsmen Trail is viewed as important by the public and the City;
6. The option involving the removal of both bridges, bank stabilization and a new bridge was identified as the preferred solution through Water's Edge's evaluation and through public comments; and,
7. All negative impacts associated with the preferred solution can be avoided or mitigated.

We trust that this is satisfactory to you, however, should you have any comments or questions, do not hesitate to contact the undersigned.

Respectfully submitted,

Ed Gazendam, Ph.D., P.Eng.,
President, Sr. Geomorphologist

Ryan Good, M.A.Sc., EIT
River Scientist

Water's Edge Environmental Solutions Team Ltd.

ATTACHMENTS:

Appendix A:	Public Consultations
Appendix B:	Baseline Environmental Assessment – Biological Component Report from FRiCorp Ecological Services
Appendix C:	Baseline Environmental Assessment – Cultural Component Report from Horizon Archaeology Inc.
Appendix D:	Rapid Assessment Sheets
Appendix E:	HEC-RAS Summary Tables
Appendix F:	Preliminary Design Drawings of Preferred Alternative

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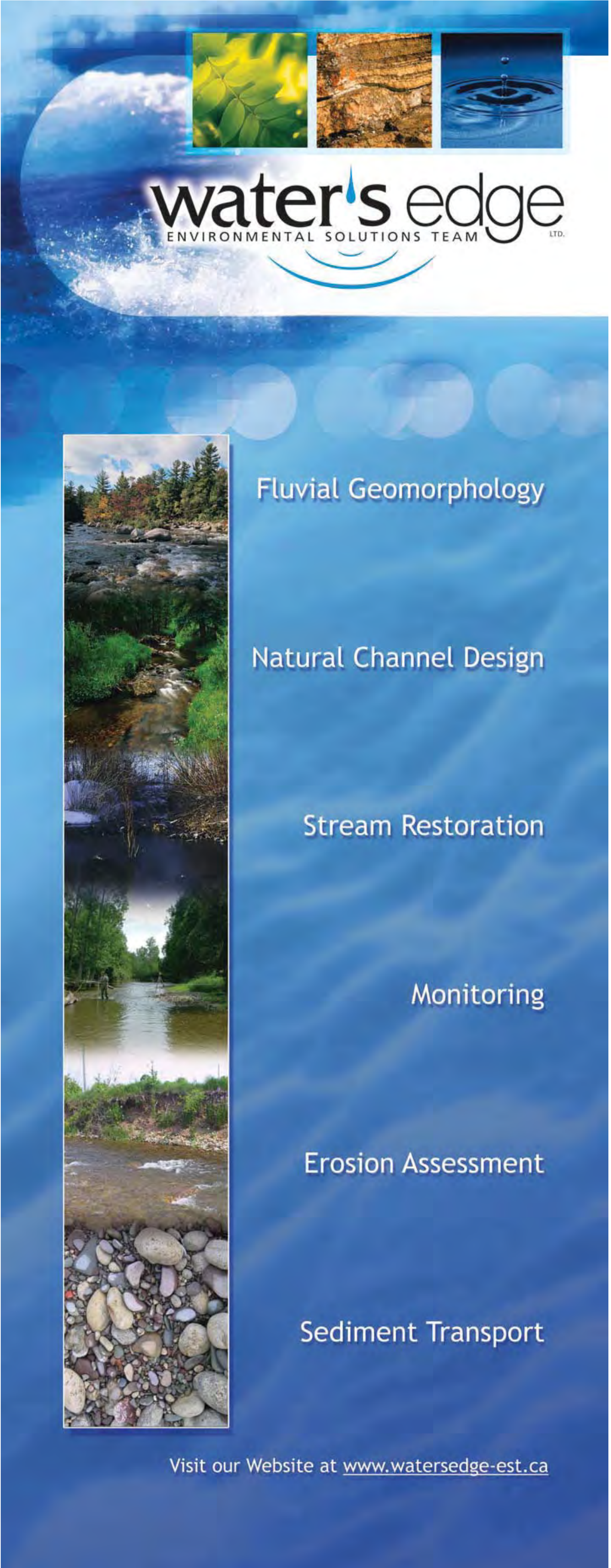
Table 6: Alternative Decision Matrix

	Physical		Biological		Cultural		Socio-Economic		Costs*		Overall	
	Evaluation	Rating	Evaluation	Rating	Evaluation	Rating	Evaluation	Rating	Evaluation	Rating	Evaluation	Rating
Option 1: Do Nothing	Conveyance and sediment issues persist. Further degradation is likely to occur, leading to increased flood risk	○	Channel degradation likely to cause further disconnects between the channel and the riparian areas, migration through channel is difficult in high flows	○	No significant impacts	●	Would leave the trail network disconnected and keep the nearby property at risk of flooding	○	No initial costs, but if the bridge(s) fail(s) immediate action would need to be taken to avoid increasing the flood risk	●	No conveyance improvements, flood risk remains the same or may increase due to sediment deposition or infrastructure failure	○
Option 2a: Remove Pedestrian Bridge	Conveyance will marginally improve; some conveyance issues are likely to persist due to the rail bridge. Flood risk will be reduced somewhat	◔	Connections between the channel and riparian areas are improved, constriction from the rail bridge could be a migration barrier in higher flows	◔	No significant impacts	●	Would leave the trail network disconnected and could potentially keep the nearby property at risk of flooding due to the rail bridge constriction	◔	Relatively low-cost, but rail bridge may need to be removed later if conveyance issues persist. Costs primarily related to hauling removed material (~$25,000)	◕	Some conveyance improvements, but rail bridge is likely to cause backwatering	◔
Option 2b: Remove Both Bridges	Conveyance and flood risk will significantly improve, but erosion and sediment transport issues are likely as the system adjusts	◑	Flow velocities are reduced improving migration ability.	◑	Rail bridge is part of the original northern Ontario route, but does not have significant heritage value	●	Would leave the trail network disconnected and would reduce the flood risk of nearby houses. Potential property issues related to the rail bridge.	◑	About 3 times the cost of removing the pedestrian bridge including relocating fiber optic line and removing all concrete (~$75,000)	◑	Would improve conveyance issues, but larger scale bank treatments may be needed if erosion continues or increases	◑
Option 3a: Removal and Replacement of Pedestrian Bridge	Conveyance will marginally improve; some conveyance issues are likely to persist due to the rail bridge. Flood risk will be reduced somewhat	◑	Connections between the channel and riparian areas are somewhat improved, constriction from the rail bridge could be a migration barrier in higher flows	◔	No significant impacts	●	Could potentially keep the nearby property at risk of flooding due to the rail bridge constriction	◔	Slightly lower cost compared to removing both bridges, but rail bridge may need to be removed later if conveyance issues persist (~$65,000)	◑	Some conveyance improvements, but rail bridge is likely to cause backwatering. Trail network is maintained	◔
Option 3b: Removal of Pedestrian and Rail Bridge with New Pedestrian Bridge	Conveyance and flood risk will significantly improve, but erosion and sediment transport issues are likely as the system adjusts	◕	Connections between the channel and riparian areas are somewhat improved, flow velocities are reduced improving migration ability	◑	Rail bridge is part of the original northern Ontario route, but does not have significant heritage value	●	Maintains trail connection while reducing flood risk to nearby property. Potential property issues related to the rail bridge.	●	About double the cost of option 3a (~$125,000)	◔	Conveyance issues are alleviated, and trail network is maintained. Bank erosion is likely to continue	◕
Option 4a: Removal and Replacement of Pedestrian Bridge with Bank Stabilization	Conveyance will marginally improve; some conveyance issues are likely to persist due to the rail bridge. Flood risk will be reduced somewhat. Potential erosion issues are mitigated through bank stabilization	◑	Connections between the channel and riparian areas are somewhat improved, constriction from the rail bridge could be a migration barrier in higher flows	◕	No significant impacts	●	Maintains trail connection but could potentially keep the nearby property at risk of flooding due to the rail bridge constriction	◕	Lower cost compared to option 3b, but rail bridge may need to be removed later if conveyance issues persist (~$90,000)	◔	Some conveyance improvements, but rail bridge is likely to cause backwatering. Trail network is maintained. Increased connection between channel and floodplain	◑
Option 4b: Remove Both Bridges, New Pedestrian Bridge and Bank Stabilization	Conveyance and flood risk will significantly improve, but erosion and sediment transport issues are likely as the system adjusts	●	Connections between the channel and riparian areas are somewhat improved, flow velocities are reduced improving migration ability	●	Rail bridge is part of the original northern Ontario route, but does not have significant heritage value	●	Maintains trail connection while reducing flood risk to nearby property. Aesthetics of the creek are improved significantly. Potential property issues related to the rail bridge.	●	Most expensive option, about double the cost of removing both bridges, while maintaining trail network, stream integrity and improving aesthetics (~$150,000)	○	Conveyance issues are alleviated, and trail network is maintained. Banks are stabilized in the reach but could cause issues downstream as the sediment transport regime adjusts	●
Option 5: Remove Pedestrian Bridge, Bank Stabilization, Retrofit Old Rail Bridge	Conveyance will moderately improve; some conveyance issues are likely to persist due to the rail bridge. Flood risk will be reduced somewhat	◔	Connections between the channel and riparian areas are somewhat improved, constriction from the rail bridge could be a migration barrier in higher flows	◕	No significant impacts	●	Maintains trail connection but could potentially keep the nearby property at risk of flooding due to the rail bridge constriction	◕	A retrofit of the rail bridge requires a structural inspection, additional design and custom fabrication. Costs are expected to be similar to Option 3b (~$110,000)	○	Some conveyance improvements, but rail bridge is likely to cause backwatering. Trail network is maintained.	◔

Least Desirable → Most Desirable				
○	◔	◑	◕	●



APPENDIX A:
Public Consultations

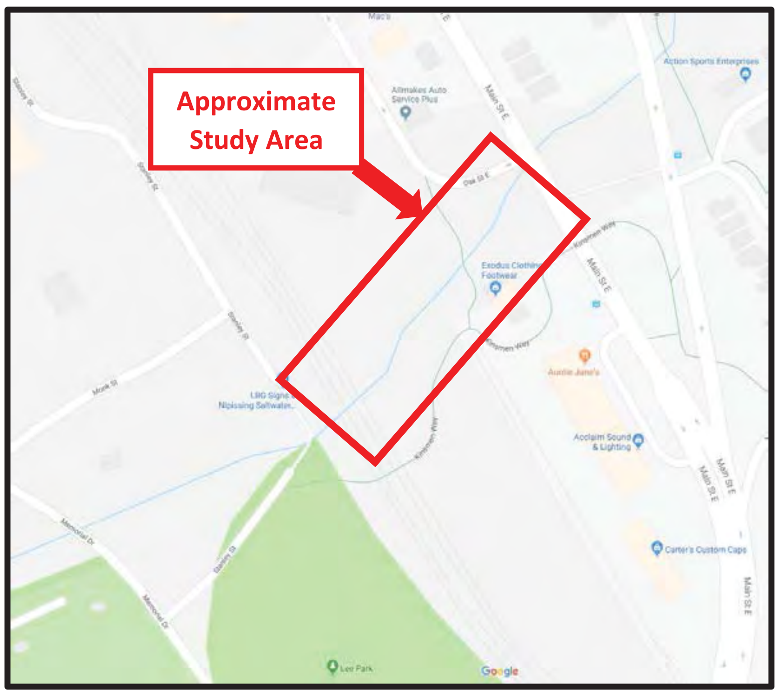
NORTH BAY-MATTAWA
CONSERVATION
AUTHORITY
www.nbmca.ca

NOTICE OF STUDY COMMENCEMENT
CLASS ENVIRONMENTAL ASSESSMENT
Oak Street Channel Repair
(Chippewa Creek)

The North Bay-Mattawa Conservation Authority, in conjunction with the City of North Bay, has initiated a Conservation Authority Class Environmental Assessment (Class EA) on Chippewa Creek to address long term erosion and bank instability in the creek. The study will also explore opportunities to improve the watercourse and fish habitat. The site had previously been identified in the Chippewa Creek Erosion Control Study (NBMCA, 2015) as Priority Item #1.

The project limits are from Main Street to the railroad bridge upstream of Stanley Street within the City of North Bay (refer to Key Plan). Once the overall deficiencies and surrounding environment are better understood through background investigations and technical assessments, a preliminary set of alternative solutions will be evaluated and presented to interested stakeholders at a Public Open House set for November 8, 2018. The Study will be completed and available for a 30-day public review in February 2019.

The Study shall be carried out in accordance with the *Class Environmental Assessment for Remedial Flood and Erosion Control Projects under the Environmental Assessment Act.* As part of the Class EA process an evaluation of alternatives, assessment of potential environmental effects and identification of mitigation measures for potential adverse impacts will be conducted and presented through public and agency consultations. Any potential changes to the creek bank which may result in the removal and/or replacement of two bridge structures in this reach of the creek which will be addressed in the study. The Class EA process will take into account adjacent private properties, aquatic habitat concerns, future operations and maintenance, aesthetics, safety, and social and recreational uses.



PUBLIC OPEN HOUSE
Interested stakeholders (public, landowners and regulatory agencies) are invited to a public Open House set for Thurs, Nov 8, 2018 - 4:30pm to 7:30pm at NBMCA Offices, 15 Janey Ave., North Bay.

For further information regarding this project, or to submit public comments/concerns, please contact either of the following:

Brian Tayler
CAO
North Bay-Mattawa Conservation Authority
15 Janey Avenue
North Bay, ON P1C 1N1
(705) 474-5420
brian.tayler@nbmca.ca

Ed Gazendam, Ph.D., P.Eng.
President, Sr. Engineer
Water's Edge Environmental Solutions Team Ltd.
25 Water Street South
Cambridge, Ontario N1R 3C7
(519) 651-2390
Ed@WatersEdge-EST.ca

Chippewa assessed for channel repairs

PHOTO BY WATERS EDGE ENVIRONMENTAL SOLUTIONS

A class EA study of Chippewa Creek is underway.

The North Bay-Mattawa Conservation Authority, in conjunction with the city, is undertaking a class environmental assessment (EA) to address long-term erosion and bank instability along Chippewa Creek near Oak Street.

The Chippewa Creek erosion control study completed in 2015 identified 10 high-priority sites where repairs are needed.

"The stretch of the creek near Oak Street was identified as priority site No. 1 in the Erosion Control Study," Brian Tayler, the authority's CAO states in a release. "The channel is degrading and needs to be addressed in order to protect the integrity of the channel, private property and public infrastructure."

Once the overall deficiencies and surrounding environment are better understood through background investigations and technical assessments, a set of alternative solutions will be evaluated and presented to interested stakeholders at a public open house set for Nov. 8 at the authority's office, 15 Janey Ave., from 4:30-7:30 pm.

The class EA is being undertaken as a remedial flood and erosion control project under the Environmental Assessment Act. The study area includes the creek from Main Street to the railway bridge upstream of Stanley Street.

As part of the Class EA process, an evaluation of alternative solutions will be made, as well as an assessment of the potential environmental effects. Mitigation measures will also be identified for potential adverse impacts of the proposed solutions.

The Class EA process will take into account adjacent private properties, aquatic habitat concerns, future operations and maintenance, aesthetics, safety, and social and recreational uses.

"Any potential changes to the creek bank which may result in the removal and/or replacement of two bridge structures in this reach of the creek will be addressed in the study. Once we receive the report and know what needs to be done to resolve the issues, the next step will be to secure the funds to complete the recommended work," Tayler adds.

The final report for the Class EA will be completed and available for a 30-day public review and comment in February 2019. Water's Edge Environmental Solutions is conducting the Class EA and study for the authority.

Chippewa Creek Class Environmental Assessment Public Open House – Social Media

Facebook Postings
www.facebook.com/theNBMCA

North Bay-Mattawa Conservation Authority
Oct 25, 2018

Media Release - NBMCA, in conjunction with the City of North Bay, is undertaking a Class Environmental Assessment (EA) to address long term erosion and bank instability along Chippewa Creek near Oak St.
The Chippewa Creek Erosion Control Study, completed in 2015, identified 10 high priority sites along Chippewa Creek where repairs are needed.
Full release: http://www.nbmca.on.ca/news.asp?id=292
Read Less

Boost Post

1 1

Write a comment...

North Bay-Mattawa Conservation Authority
Nov 5, 2018

REMINDER - Open House - Chippewa Creek Environmental Assessment - November 8, 2018 from 4:30pm to 7:30pm at the NBMCA Office, 15 Janey Avenue
http://www.nbmca.on.ca/events.asp?id=161
Read More

NBMCA Events - Open House - Chippewa Creek Environmental Assessment
www.nbmca.on.ca

North Bay-Mattawa Conservation Authority
Nov 8, 2018

Looking at options for Chippewa Creek erosion near Oak St during tonight's Open House at NBMCA. Questions? We're here til 730pm or contact us.

Boost Post

2

Write a comment...

North Bay-Mattawa Conservation Authority
Nov 15, 2018

The North Bay-Mattawa Conservation Authority, in conjunction with the City of North Bay, has initiated a Conservation Authority Class Environmental Assessment (Class EA) on Chippewa Creek to address long-term erosion and bank instability in the creek. The focus of this EA is on the creek between Main St. and Stanley St., North Bay.

A Public Open House was held on Nov 8, 2018, to explain the study. In this video, Ed Gazendam of Waters Edge Environmental Solutions explains the initial findings for the study during the Open House. If you have comments about the initial findings, please contact NBMCA by Nov 18, 2019.
https://youtu.be/n6hbVyaevis

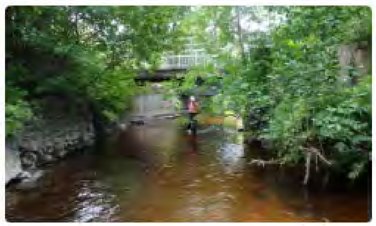
The Study will be completed and available for a 30-day public review in February 2019.
Read Less

Chippewa Creek Class Environmental Assessment Public Open House – Social Media

Twitter – @theNBMCA

NBMCA @theNBMCA
Oct 25, 2018

Media Release - NBMCA in conjunction with @cityofnorthbay , is undertaking a Class Environmental Assessment (EA) to address long term erosion and bank instability along Chippewa Creek near Oak St.
Full release: nbmca.on.ca/news.asp?id=292

NBMCA @theNBMCA
Nov 5, 2018

REMINDER - Open House - Chippewa Creek Environmental Assessment - November 8, 2018 from 4:30pm to 7:30pm at the NBMCA Office, 15 Janey Avenue
nbmca.on.ca/events.asp?id=...

NBMCA @theNBMCA
Nov 8, 2018

Looking at options for Chippewa Creek erosion near Oak St during NBMCA open house tonight. Questions? We're here til 7:30pm or contact us.

My Tweets theNBMCA

NBMCA @theNBMCA
Nov 15, 2018 · North Bay

Miss the Nov 8 Open House for the Chippewa Creek Class EA study to address long-term erosion and bank instability between Main & Stanley Sts? Catch up with this video youtu.be/n6hbVyaevis

Chippewa Creek Class Environmental Assessment Public Open House – Social Media

You Tube Open House Video
https://youtu.be/n6hbVyaevis

Oak Street Pedestrian Bridge Class EA
Public Information Centre
November 8, 2018

Sign-In Sheet

Name	Address	Phone	E-Mail Address	Additional Info (Y/N)
Johnny Canuck	123 Anywhere St. North Bay, ON P1C 1N1	(705) 123-4567	Jcanuck@waytogo.com	Y
Tray Storms	15 Janey NB.	(705) 494-5113	tray.storms@nbmca.ca	N
Paula McCloskey	200 McIntyre St	705-474-0626 Ext 2322	Paula.McCloskey@cityofnorthbay.ca	Y
[redacted]	[redacted]	[redacted]	[redacted]	N
[redacted]	[redacted]	[redacted]	[redacted]	Y

Sheet 1 of ____

WELCOME!

Welcome to the Public Information Centre
Chippewa Creek - Oak St. Channel Repair
Class EA for Remedial Flood and Erosion Control Projects

PUBLIC INFORMATION CENTRE

November 8, 2018
4:30 - 7:30 PM

PLEASE SIGN IN AT THE FRONT DESK

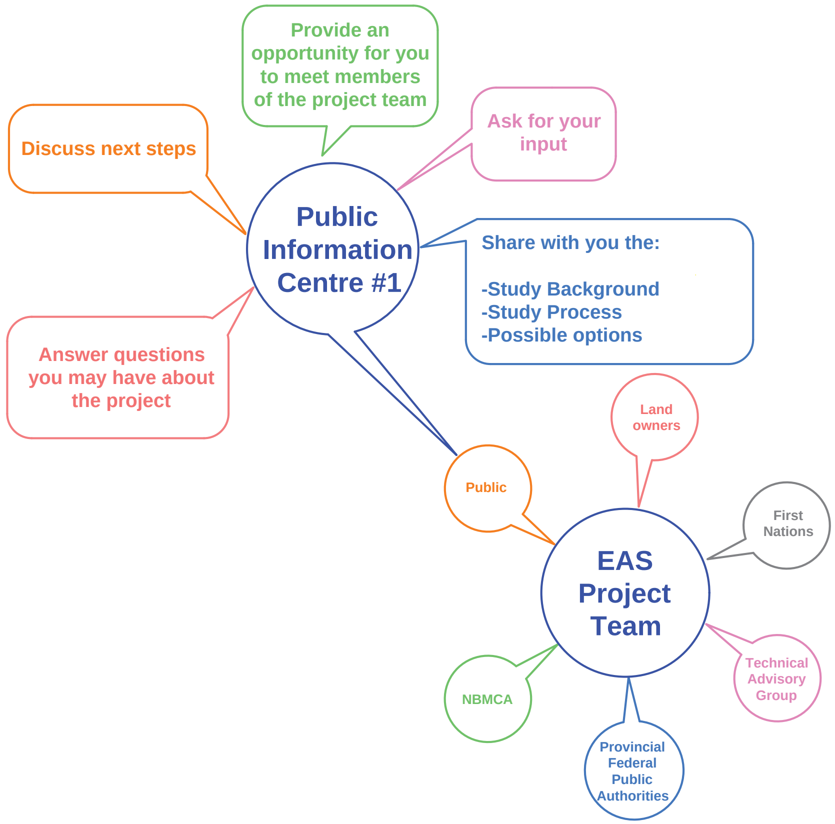
NORTH BAY-MATTAWA CONSERVATION AUTHORITY

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

WHY ARE WE HERE?

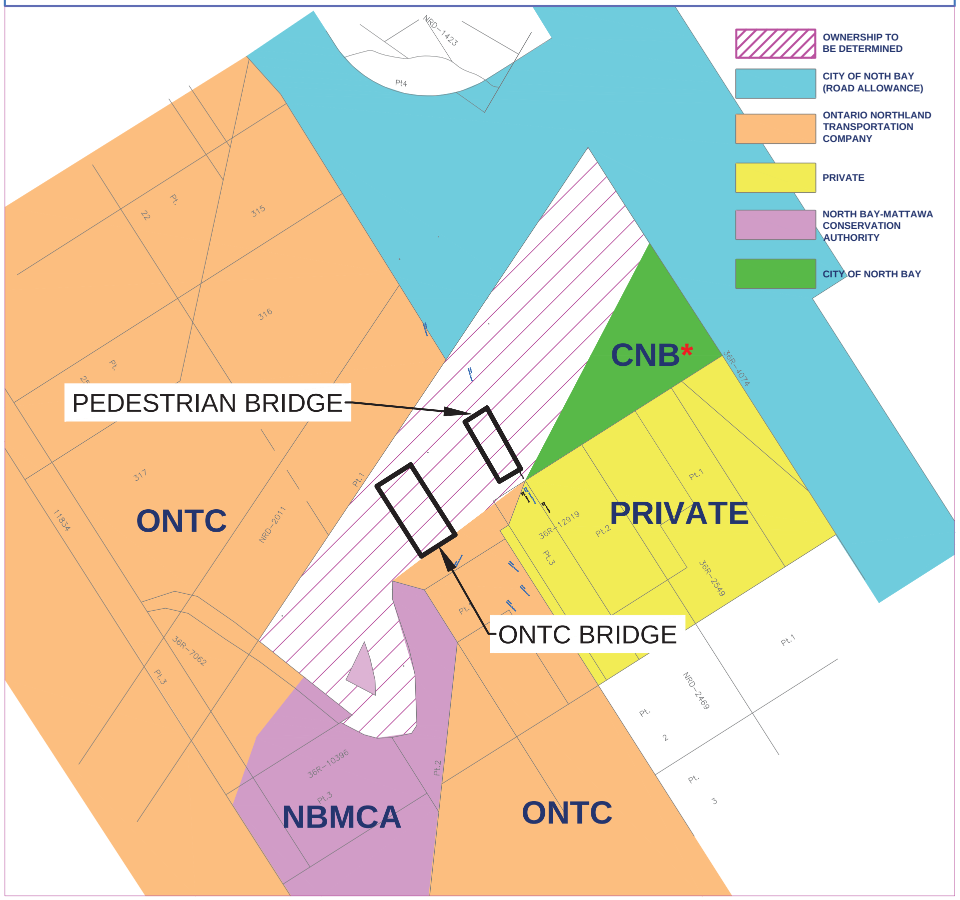
Consultation early in and throughout the process is a key feature of environmental assesment planning.

- Conservation Authority Class EA Process
- Undersized concrete pedestrian bridge (too small for creek width)
- Bridge abutments and vertical retaining walls (tacked rock slabs) confining channel and causing degradation
- Identified as Priority Site #1 in Chippewa Creek Erosion Control Study and Inventory (NBMCA, 2015)
- Urgent need to examine and resolve bridge and creek issues



EXISTING CONDITIONS 1/4

OWNERSHIP



TRAIL SYSTEM

- City of North Bay has initiated the Active Transportation Plan Study
- All information is still draft and still requires final approval by City of North Bay
- The intersection of Lakeshore and Memorial Drive, and the adjacent trail and street connections, are an important traffic and active transportation connection
- The intersection of Lakeshore and Memorial Drive is also an important city gateway with the North Bay Arch and Fighter Jet at Lee Park
- Connectivity from the downtown area to the park site is re-established with an essential linkage at the Oak Street extension bridge (that previously linked to the Kinsmen Trail and ensures city-wide connectivity)
- Oak Street bridge should be re-established as an essential linkage in this Master Plan
- Existing concrete structure conflicts with the setting's important natural character
- Oak Street bridge provides linkage over an active and attractive stream
- Oak Street bridge should be replaced with a structurally and graphically relevant piece of trail infrastructure

EXISTING CONDITIONS 2/4

HYDROLOGY / HYDRAULICS

- The Chippewa Creek watershed at the Oak St. Pedestrian Bridge drains nearly 39 square kilometres of land
- During the 1 in 100-year flood, more than 40,000 litres per second will flow through the creek, compared to the average flow of about 600 L/s
- The Oak St. Pedestrian Bridge is not wide enough to move the high flows efficiently, which causes flooding upstream of the bridge
- The pedestrian bridge also causes flows to accelerate through, and downstream of the bridge
- The average channel slope through the reach is about 0.3%
- Railroad bridge causes similar problem

Old Rail Bridge (from Pedestrian Bridge)

FLUVIAL GEOMORPHOLOGY

- Chippewa Creek has been historically realigned through this reach
- Sand and other sediment is washed into the creek and transported downstream during storms
- The two existing bridges accelerate the creek flow which leads to erosion in-between and downstream of the bridges
- Chippewa Creek is constrained by the existing abutments and retaining walls
- Since Chippewa Creek is constrained laterally, it can only erode vertically
- Creek bed material is easily erodible sand and cobble (therefore bed and toe erosion are present)
- Bed and toe erosion have partially undermined the local bank structures

Pedestrian Bridge (facing downstream)

Pedestrian Bridge (facing upstream)

Rail Bridge (facing upstream with Pedestrian Bridge abutments visible in distance)

Rail Bridge (facing downstream)

EXISTING CONDITIONS 3/4

AQUATICS

Northern Brook Lamprey

- Storm events heavily influence water levels and flow rates
- Absence of aquatic vegetation in the creek, substrates are largely sand and cobble
- Shoreline erosion has contributed to large in-stream woody debris
- Extensive electrofishing efforts upstream from the study area have confirmed the presence of the follow fish species within Chippewa Creek: included northern brook lamprey, common white sucker, longnose dace, creek chub, common shiner, mottled sculpin, blacknose dace, finescale dace, burbot, Northern redbelly dace, johnny darter and log perch
- No specialized fish habitat in Chippewa Creek noted within the study area
- Three types of lamprey are known to exist in Lake Nipissing and its tributaries, including Chippewa Creek. These species include: silver lamprey, chestnut lamprey and the northern brook lamprey (see photo above)
- Presence of Northern Brook Lamprey (Special Concern Species at Risk) is highly likely through this section of Chippewa Creek
- Previous fishing efforts have yielded lamprey ranging from ~ 2 cm in total length to 15+ cm adults

TERRESTRIAL

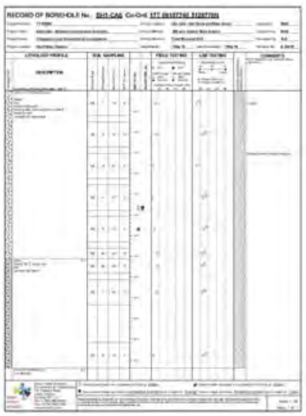
Representative photo of downstream riparian vegetation, south creek bank

Representative photo of riparian vegetation on upstream, north creek bank. In-stream woody debris present in Chippewa Creek, top right

- Riparian areas on the north creek bank are naturally vegetated approximately 2-5m back from the water's edge
- A more diverse and established naturally vegetated buffer exists along the south creek bank approximately 2-12 metres in width with tree species such as mature silver maple (*Acer saccharinum)* and red pine (*Pinus resinosa*) present in the canopy
- Upland areas of both banks include paved parking lots, maintained unbuffered lawns with minimal native terrestrial vegetation, and paved a multiuse trails and sidewalks
- Presence of an invasive species, Japanese Knotweed (*Fallopia japonica)*, was observed growing on the creek banks
- Ontario Regulation 354/16 under the Invasive Species Act (2015) lists Fallopia japonica as a restricted species

EXISTING CONDITIONS 4/4

GEOTECHNICAL / INFRASTRUCTURE



Site1 (CA-6) Located on right bank beside the Oak Street Pedestrian bridge (closed)

Silty Sand Fill

- A layer of brown fill, consisting mostly of silty sand with trace gravel, was encountered between 0.1m and 4.1 m below grade
- Trace organic material (wood chips) and glass
- Indicative of a fill material
- Material is very loose to compact
- Material as tested consists of 0% gravel, 72% sand and 28% silt / clay.
- Tested fill does not meet the OPSS 1010-3 gradation requirements for Granular 'B' Type I

Sandy Silt

- Below the Silty Sand Fill material, is a layer of grey, sandy silt between 4.1 and 6.1 m below grade
- Material is in loose to compact condition
- Material as tested consists of 0% gravel, 25% sand and 75% silt / clay

ARCHAEOLOGY

- Stage 1 Archaeological Assessment completed by Horizon Archaeology Inc.
- No previous archeological assessments have been completed within the Study Area
- There are no registered archaeological sites within 300 metres of the Study Area
- A Stage 1 Site Inspection (no disturbance nor removals) was completed on October 18, 2018
- The Study Area has been, and remains, highly disturbed
- The ONTC Railroad Trestle Bridge was constructed in 1906 by F. Munro
- The Archaeological Assessment concludes that the Pedestrian Bridge site contains no further archaeological concerns
- Removal of the second bridge (owned by ONTC) will require additional assessments still (to be determined still by City)

BACKGROUND INFORMATION

1. SITE LOCATION/DESCRIPTION

Approximately 60m downstream of Main Street East near Oak Street East.

This is a concrete bridge crossing that links Oak Street to the Kinsmen Way Trail through a property along the top of the left bank. Presumably this is an older bridge that has been repurposed as a pedestrian link.

CA-05 is located immediately downstream along the left bank.

2. PROBLEM DESCRIPTION

The bridge span is undersized with respect to the channel width. Bridge abutments and vertical retaining walls (stacked rock slabs) confine the channel, promoting degradation. As a result, bridge footings have become exposed.

CA-05 has been included in this figure because it shares similar problems along the left bank where the former railway bridge footing has become undermined and appears to be deteoriating. The vertical footing confines this side of the channel. Works can be undertaken at the same time.

3. DESIGN CONSIDERATIONS

A building adjacent to the creek on the left bank is within a few metres of the top of the retaining wall.

The function of each bridge crossing should be assessed for necessity. For example, connectivity to the trail network, construction access.

Main Street East can be used as an alternative crossing.

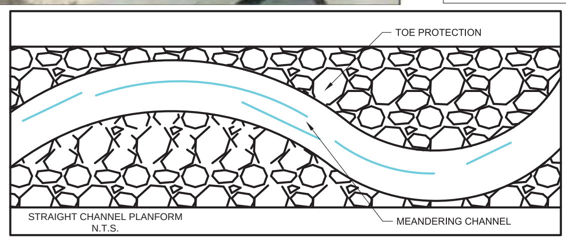
4. RECOMMENDATIONS

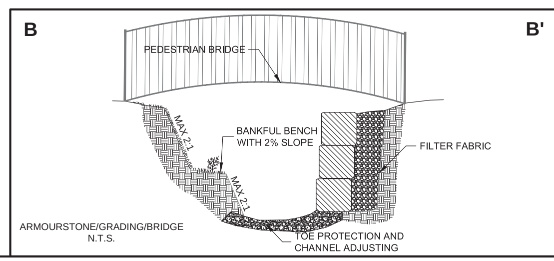
Undertake a structure examination of the concrete structure prior to any works in order to utilize the existing retaining wall along the left bank.

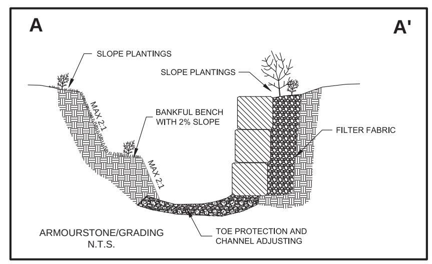
Remove old rail bridge at CA-05 and possibly at CA-06 if it is not deemed necessary to retain the crossing at this location.

Re-grade the right bank to reduce in channel stresses and provide some floodplain access, plant with riparian plantings. Blend into banks upstream and downstream.

With minimum setbacks to property along the left bank, a vertical armourstone wall with shrubs along the top should be constructed.







NOTE: THE TERMS "LEFT BANK" AND "RIGHT BANK" REFER TO A DOWNSTREAM VIEW OF THE CHANNEL

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

Chippewa Creek

Erosion Control Study and Inventory

Priority Sites

#1-CA (Reach CC-2a)

PROJECT FILE NO.	SHEET NO.
14040	1

OPTIONS 1/4

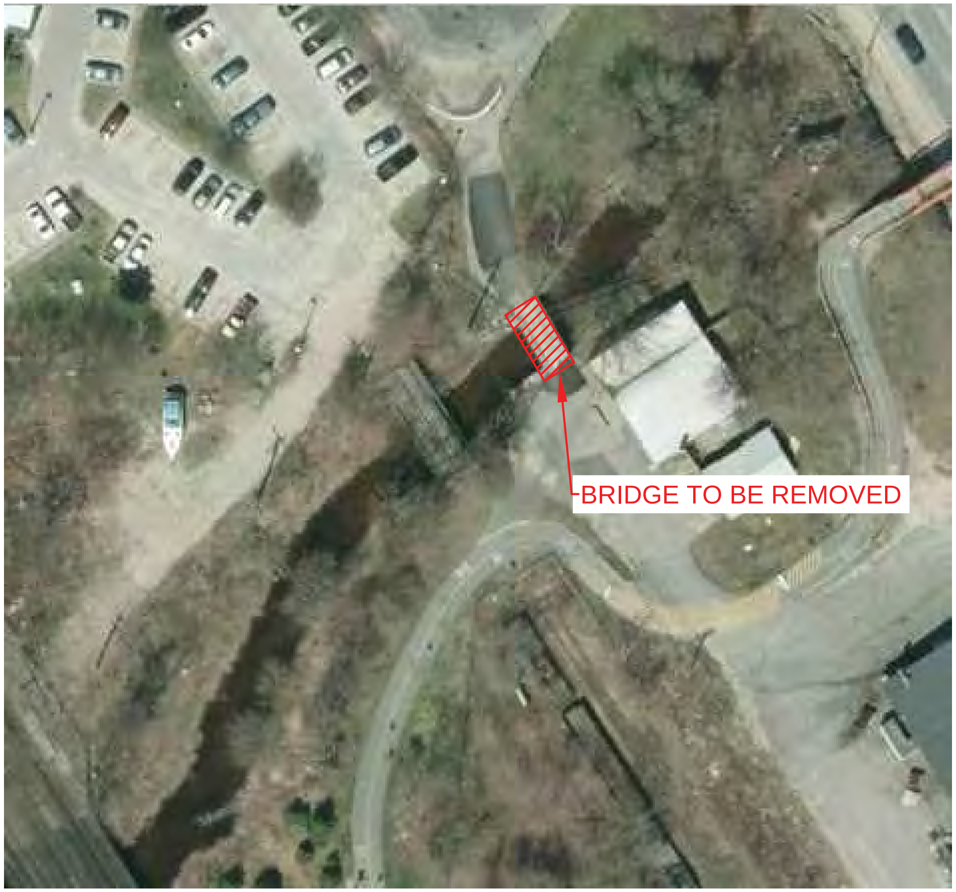
Option 1

Do Nothing

OPTIONS 2/4

Option 2a

Removal of Bridge 1



Option 2b

Removal of Bridges 1+2

OPTIONS 3/4

Option 3a

Pedestrian New Bridge

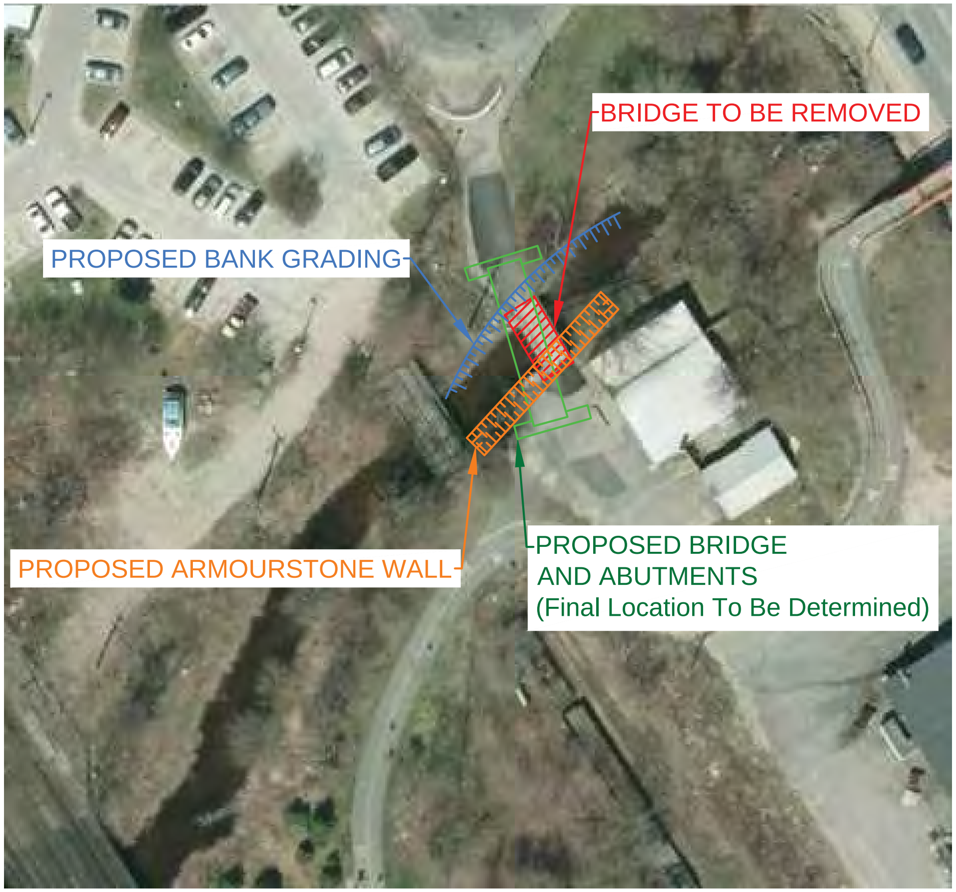
Option 3b

Remove Bridges 1+2 With New Pedestrian Bridge

OPTIONS 4/4

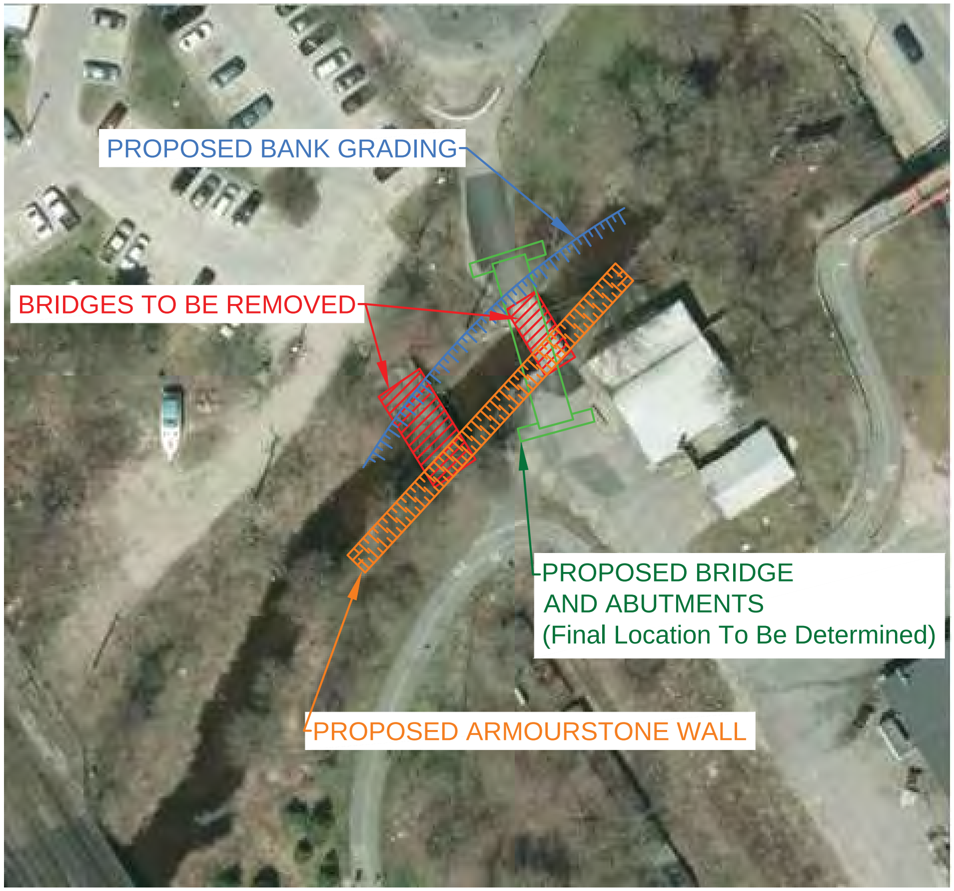
Option 4a

Bridge Removed + New Pedestrian Bridge With Bank Repairs



Option 4b

As 4a But With Removal of 2 Bridges and additional Bank Repairs



NEXT STEPS

After the Public Information Centre, the following will be carried out:

- Review the comments received and respond to any questions / concerns.
- Finalize all fieldwork/analysis
- Select preferred option
- Finalize Class EA report
- 30 day public review period
- Amend Class EA report (as necessary)
- Notice of completion

Please feel free to ask questions and fill out a comment sheet before you leave. Comments can be left in the box provided or forwarded to the Project Team by **November 18, 2018.**

CONTACT INFORMATION

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25 Water St. S.
Cambridge, On N1R 3C7

Phone: 519-651-2390
E-mail: Ed@watersedge-est.ca

THANK YOU FOR ATTENDING!

Public Comments

Comment 1 of 2:

Oak Street Pedestrian Bridge Class EA
Please consider this my Comment Sheet, for Submission
Name: [redacted]
Address: [redacted]
Phone #: [redacted]
E-mail: [redacted]
Comments:

- I like option 4B. Technically it could be split into four parts:
    1. Removal of both bridges
    2. build the bank up on one side
    3. build the bank up on the other side
    4. build a new bridge
- The four steps could technically be done over four years, preferable sooner.
- Wildflowers could be planted along the bank benching. Preferably milk weed, daisy, dark eyed susans, buttercups, etc.
- Willow trees and other deep rooting trees along the edges of the embankments, would also help with erosion.

Response to Comment 1:

Hi [redacted]

Many thanks for your input and feedback. Thanks also for attending. We will be taking your comments under advisement while completing the EA process and final design. Should you have any further comments or questions, do not hesitate to contact us.

Also, please note Brian Tayler's email address (e not o).

Regards,

Ed Gazendam, Ph.D., P.Eng.
President, Sr. Geomorphologist
Water's Edge
(519) 651-2390

Comment 2 of 2 (Received after comment period closed):

Hi Kurtis,

As discussed, please find below Ontario Northland's comments with regards to the PIC presentation and options presented.

- Regarding the options provided, Option 2b – 4b include the removal of ONTC's rail bridge. As a Crown Agency ONTC prepares a three year business plan that outlines projects and anticipated costs. If removal of the rail bridge is recommended, we will need an opportunity to review, determine scope, costs, and approvals. Time will be needed to determine if it is feasible to remove the structure at this time. Would cost sharing opportunities with NBMCA and the City of North Bay be available?

- Under Archaeology in slide 6, it is noted that removal of the ONTC rail bridge will require additional assessments to be determined by the City of North Bay. Would you please advise the nature of these additional assessments, timeframe for completion and estimated costs? If access to ONTC land is required, please contact me as soon as possible.

- ONTC has fibre optic cable that may span the bridge. If it is confirmed that there is conduit on the bridge, we will need time to assess the costs associated with relocation. As well Ontera and Bell have installations in the area. I believe these are aerial, but this will need to be considered if bank grading is completed.

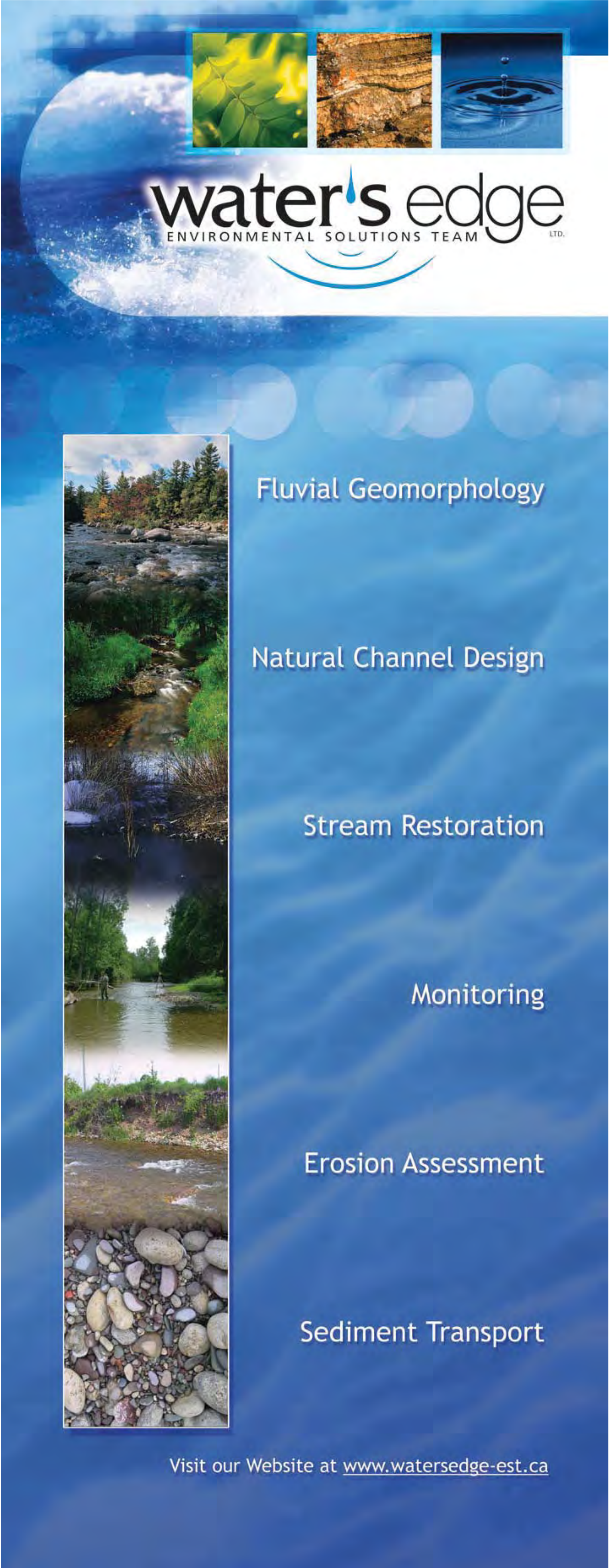
- If Option 4a or 4b is determined to be the preferred option, it appears that additional ONTC land may be required by the NBMCA. Please note that survey work in this area is costly and time consuming as the land has not been converted to Land Titles and there are many "Registry Non-Convert PINs" in the area. We will require adequate time to review and sell the required lands to NBMCA. Also, if the armourstone wall extends onto ONTC lands we will need to ensure the proper Permission to Construct Agreement is in place prior to the commencement of any work.

We would also like to present a fifth option where the pedestrian bridge is removed and ONTC's rail bridge is repaired and converted for use as part of the pedestrian corridor (as long as we are able to remove or have an easement for any cable that traverses the bridge). I believe the abutments of our bridge are larger than those of the pedestrian bridge and it does not limit water flow to the same degree as the pedestrian bridge. If this is a viable option, we would have to also discuss land acquisition as the public would require access from this location to Oak Street.

Lastly, I was able to locate an old file which references ONTC having a right of way over the pedestrian bridge. I don't believe this will affect the EA, but I do want to review the right of way document prior to the removal of the pedestrian bridge.

Once the EA is finalized, would you please forward us a copy for our information and review. I look forward to continue working with you on this project.

Erin



APPENDIX B:

FRiCorp Report

Chippewa Creek - Oak Street Channel Repair

Baseline Environmental Inventory

2018

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1.0 Introduction

FRi Ecological Services was retained on behalf of Water's Edge to prepare a baseline environmental inventory and expand on background information available for the study area as part of a Class Environmental Assessment for the Chippewa Creek Oak Street Channel Repair.

1.1 Project Location

The Oak Street Channel of Chippewa Creek within the study area flows southwest from the outlet of the twinned concrete box culvert under Main Street East to the existing ONR rail bridge approximately 145m downstream (Figure 1). The watercourse flows under the pedestrian bridge that historically connected Oak Street with the Kinsmen Trail. Chippewa Creek empties into Lake Nipissing approximately 400m downstream from the bridge.

1.2 Purpose

A specific recommendation was made to repair an undersized pedestrian bridge which confines the channel of Chippewa Creek near Oak Street. In order to protect the integrity of the creek and associated habitat, private property, and public infrastructure, a Class Environmental Assessment has been proposed for the site. This report inventories the background environmental information and existing natural heritage values with potential to occur in the study area. Recommended impact avoidance and mitigation measures for natural heritage features are detailed below.

Figure 1: Study area and pedestrian bridge
(located at UTM 17T 618776 5128763)

2.0 Background Information

A desktop review was conducted of the available information related to natural heritage values at and within 2km of the study area. The following sources of information were consulted:

- District Species at Risk Tool – Widdifield Township, MNRF (2013)
- Make-a-Map, Natural Heritage Values, MNRF
- North Bay District MNRF Office
- Significant Wildlife Habitat Ecoregion 5E Criterion Schedule (2012)
- City of North Bay Official Plan and online mapping
- e-Bird
- Atlas of the Breeding Birds of Ontario
- Ontario Reptile and Amphibian Atlas

Natural heritage values considered include:

- Habitat of endangered and threatened species;
- Significant wetlands;
- Significant wildlife habitat;
- Areas of Natural and Scientific Interest; and
- Fish habitat

3.0 Field Investigations

3.1 Methodology

Field investigations of Chippewa Creek were conducted to gather information on the physical surroundings of the study area and to identify any potential critical aquatic and terrestrial habitat that may be impacted by the proposed channel repair and pedestrian bridge replacement. Due to timing restrictions, the fisheries component of this report has been completed in part with existing studies and background information previously gathered by FRi upstream and downstream of the study area and background information provided by MNRF.

Prior to field investigations, digital maps were created in ArcGIS to assess the aerial imagery of the location. The maps were then uploaded to a tablet operating the ESRI Collector Application for use on site. Fish habitat information, terrestrial habitat features, land classification, and points of interest were recorded in the field and used to create digital mapping. Georeferenced photos were also taken at representative locations.

The area of investigation includes a section of Chippewa Creek 55m upstream and approximately 90m downstream of the existing pedestrian bridge and area surrounding the creek.

3.2 Ecological Land Classification

Ecosites for the study area were determined by the soil and vegetation characteristics found on site. These ecosites were then used to assess the potential of habitat and natural heritage features in the study area during the field investigations.

There were six ecosites identified on the subject property represented in natural and anthropogenically-altered forms (X), mapped in Figure 2 and described in the following section.

Figure 2: Mapped ecosites within the study area

G044N Dry to Fresh, Coarse: Field

A field ecosite is found to the north of the study area. The maintenance of structure and composition of species associated with this vegetation community are supported by continuous human disturbance. In the absence of continued mowing, it is likely this ecosite would, in time, succeed to a meadow ecosite.

Photo 1: Representative photo of the G044N ecosite

G061N Moist, Coarse: Meadow

This meadow ecosite is characterized by extensive herbaceous growth with sparse tree and shrub cover. Tree species, where present, include white birch, aspen, silver maple, and willow. Shrub species include speckled alder, red-osier dogwood, and red raspberry. Canada blue joint grass, fireweed, goldenrods, and jewelweed are found within the herbaceous understory of this ecosite.

Photo 2: Representative photo of the G061N ecosite

G076Tt Moist, Coarse: Mixedwood

This ecosite supports primarily deciduous tree species including silver maple, sugar maple, willow spp., large tooth aspen, cottonwood, white birch, and some coniferous species including white spruce, red pine, and scots pine clustered together to the west of the study area near the existing rail bridge. Although the canopy is relatively open, the understory is primarily broadleaf litter.

Photo 3: Representative photo of the G076Tt ecosite

G169X: Anthropogenic Coarse Shoreline

To the northeast of the study area, upstream from the existing pedestrian bridge, there is an abrupt change in elevation along the southern creek bank where the substrates are coarse rock fragments and boulders. This landscape feature is beneath the west bridge abutments of the pedestrian-only Kinsmen Bridge which spans the Main Street East overpass. The rock fill supports moderate herbaceous growth and an area of artificially hardened shoreline can be seen in the foreground of Photo 4.

Photo 4: Representative photo of the G169X ecosite

G193X: Active Coarse Clean Fill

This ecosite encroaches on the study area but is primarily located in the adjacent lands. Imported aggregate has been added to the area and it appears to be used as a driveway or access road with tire tracks present.

Photo 5: Representative photo of the G193X ecosite.

G197X: Pavement/Concrete

This ecosite is represented by the paved multiuse pathway, existing bridge structure, sidewalks, and the parking lot areas that are found within the study area.

Photo 6: Representative photo of the G197X ecosite

3.3 Site Assessment

Surrounding Land Uses

Land uses within and adjacent to the study area include a multi-use pathway (Kinsmen Trail), sidewalks, parking lots, a maintained mowed lawn area, municipal roadways (Oak Street and Main Street East), residential land, ONTC rail corridor, and commercial property. Apart from the relatively small, fragmented natural areas found directly adjacent to Chippewa Creek, the study area and its adjacent lands show evidence of historic human disturbance and are located within an urbanized area. Private land ownership and existing development greatly influence the natural habitat within the study area and further constrain the overall creek corridor.

Chippewa Creek

Chippewa Creek through the study area is a permanent, rapidly flowing watercourse with sand, silt, and cobble substrates. The creek depth is variable and dependent on storm and melt events as the surrounding areas are relatively impervious to runoff and several storm drains outlet into the creek. The creek channel in this section does not meander and has likely undergone historic channel realignment. The bankfull width is approximately 6m wide after passing under the Main Street East culvert and is constrained shortly downstream again by the concrete bridge abutments of the existing pedestrian bridge, abandoned ONTC rail bridge, and the subsequent active rail crossing where the channel width of the creek widens to approximately 8m. Field investigations confirmed the absence of any critical fish habitat through this section of the creek, such as spawning or nursery habitat. Chippewa Creek likely serves as a migration corridor for lamprey species, however.

There are willow trees growing along the banks in the large woody debris recruitment zone down from the bench-like terrace formation along the south creek bank (Photo 7). Large tooth aspen, white birch, and silver maple trees are found growing upland near to the multiuse pathway and some conifer cover is found growing downstream before the active rail bridge. There is in-stream woody debris up and downstream from the existing pedestrian bridge (Photo 8).

A summary of previous fishing efforts conducted by FRi that have taken place in Chippewa Creek is contained in Table 1. A cumulative electrofishing effort of over 6 hours and several hours of dip netting since 2011 have taken place at various points in the creek and have yielded the following species: Northern Brook lamprey, johnny darter, yellow perch, pumpkinseed, mottled sculpin, burbot, white sucker, northern pike, longnose dace, creek chub, common shiner, blacknose dace, finescale dace, northern redbelly dace, logperch, spottail shiner, emerald shiner, blacknose shiner, pearl dace, brook trout, blackside darter, finescale dace, slimy sculpin, and larval lamprey.


Photos 7 and 8: Terrace and riparian vegetation on south creek bank (left); in-stream woody debris upstream of pedestrian bridge (right)

Table 1: Summary of historic fishing effort in Chippewa Creek by FRi Ecological Services

Date	Location*	Total Fishing Effort	Species Collected
2005	(A) Worthington St E (Bridge reconstruction)	-	-
09/14/2011 09/15/2011	(B) Main Street E (north cell culvert clean out)	Electrofished (EF) for 1670 shocker seconds (ss)	Northern brook lamprey, johnny darter, yellow perch, pumpkinseed, mottled sculpin, burbot, white sucker, northern pike
11/22/2011 11/24/2011 12/08/2011 12/14/2011	(C) John Street bridge	Nov 22: EF 3543 ss; Nov 24: EF 3020 ss; Dec 14: EF 2768 ss and 1.5 hours of lamprey picking	Lamprey spp., common white sucker, Longnose dace, Creek chub, Common shiner, mottled sculpin, blacknose dace, finescale dace, burbot, northern redbelly dace, johnny darter, logperch

09/05/2012	(D) Mouth of Chippewa Creek @ Lake Nipissing	EF 1199 ss	Lamprey spp., blacknose dace, spottail shiner, emerald shiner, blacknose shiner, johnny darter
10/18/2014	(E) O'Brien St structural culvert (culvert replacement)	1 hour fishing; electrofishing, hand picking, and dipnetting	Pearl dace, northern brook lamprey
11/17/2014	(F) Milani Drive structural culvert (culvert replacement)	1 hour fishing; electrofishing and dipnetting	Brook trout, pearl dace, longnose dace, blacknose dace
07/06/2015	(G) High St Crossing	6 hours fishing; electrofishing and dipnetting	Blackside darter, creek chub, finescale dace, logperch, slimy sculpin, white sucker, larval lamprey, larval fish (species unknown)

**see Figure 3*

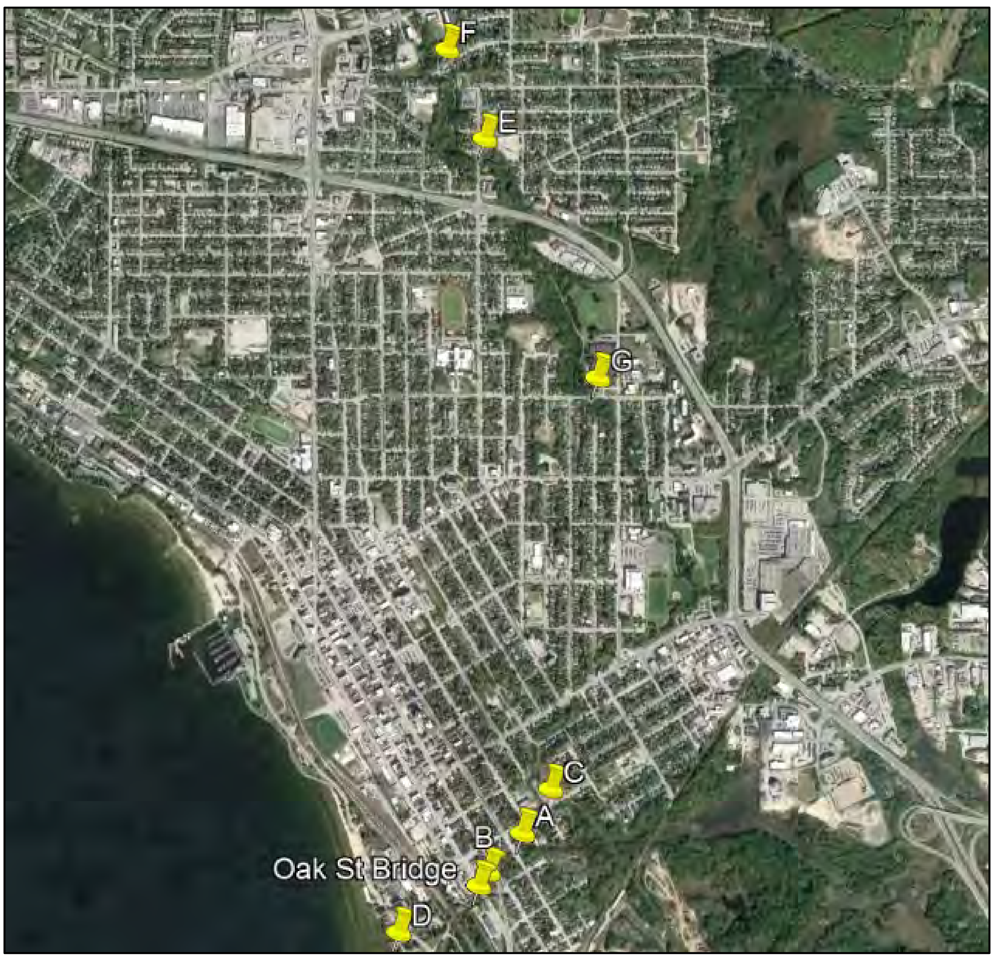

Figure 3: Locations corresponding to Table 1 of the previous fish collection and salvage efforts of FRi conducted in Chippewa Creek in North Bay. "Oak St Bridge" denotes the pedestrian bridge within the project study area.

4.0 Correspondence

Correspondence between the North Bay-Mattawa Conservation Authority, FRi Ecological Services, and the MNRF addressed natural heritage values with potential to be present within the study area. This correspondence is included in Appendix A. Information provided by the MNRF, coupled with field observations and additional background information were used to guide the assessment for each natural heritage value addressed in Sections 5.0 through 9.0 of this report.

5.0 Habitat of Endangered and Threatened Species

5.1 SAR Bats

Little Brown Myotis, Northern Myotis, Eastern Small-footed Myotis, and the Tricolored Bat are bat species that were recently listed as Endangered species at risk in Ontario. They are experiencing significant population declines because of a disease called White Nose Syndrome. During the active season, bats feed on insects at night and roost during the day. They roost either individually (males) or in groups (females with pups), usually in warm, elevated spaces. Bats often choose human-created roosts such as attics and abandoned buildings as they offer optimum habitat for summer roosts and are usually close to water and open areas for foraging. Natural roosts include large hollow trees and spaces behind loose bark. All four species hibernate in caves and abandoned mines in October through April where temperatures remain above freezing and humidity levels are high.

5.1.1 Little Brown Myotis (*Myotis lucifugus*)

According to the Significant Wildlife Habitat Technical Guide, Appendix G4, Table G4, Little Brown Myotis use caves, quarries, tunnels, hollow trees or buildings for roosting. Maternity colonies are most often found in warm dark areas, like barns, attics and old buildings. They overwinter in caves and mine adits (horizontal mine shafts) in Ontario. This species forages mainly over open areas including wetlands and near forest edges where insect densities are greatest.

5.1.2 Northern Myotis (*Myotis septentrionalis*)

Northern myotis are documented to roost in hollow trees or under loose bark. Males roost individually while females are found in maternity colonies of up to 60 adults. They overwinter in mines and caves similar to other species which hibernate in Ontario. Unlike Little Brown Myotis, Northern Myotis hunt primarily in forested areas, below the canopy.

5.1.3 Eastern Small-footed Myotis (*Myotis leibii*)

According to Bat Conservation International, Small-footed Myotis generally roost on the ground under rocks and in crevices and occasionally under tree bark or in buildings. According to the Significant Wildlife Habitat Technical Guide, Appendix G, Table G4, Eastern Small-footed Myotis roost in caves, mine shafts, crevices or buildings that are in or near a woodland and they tend to hunt primarily in forests. They hibernate in cold dry caves or mines; maternity colonies are in caves or buildings.

5.1.4 Tricolored Bat (*Perimyotis subflavus*)

The Tricolored Bat is named for the hairs on its back which are black, yellow and brown. It was formerly called the Eastern Pipistrelle. During the summer months, the Tricolored Bat can be found in a variety of forested habitats and will most often roost in mature forest or various human-made structures such as barns. This species is known to forage over water and along streams in the forest. They swarm caves and overwintering sites at the end of the summer and then subsequently overwinter at these locations, typically roosting individually rather than as a part of a group.

Assessment

An assessment was completed to identify potential roost trees within the study area. The study area does not support large cavity trees or any suitable natural roost habitat. No negative impacts to SAR bat species are anticipated.

5.2 Blanding's Turtle (*Emydoidea blandingii*)

The Blanding's turtle is a mostly aquatic turtle found in a variety of habitats, including lakes, ponds, marshes, ditches, creeks, rivers, and bogs. Within these habitats, the species generally prefers shallow water, organic substrates and dense submergent and/or emergent vegetation. Basking sites are a critical component of suitable habitat. These are characteristically floating vegetation mats, hummocks, partially submerged logs, rocks, bog mats, or suitable shoreline areas with access to full sunlight.

Blanding's turtles hibernate from October through April, usually in permanent bodies of water, often the same wetlands they utilize during the active season. Recent studies confirm seasonally isolated wet areas, ditches for example, are used for hibernacula in some years. Blanding's turtles will travel up to 6 km or more to nesting sites that are usually within 250m from the shore of some waterbody. Nesting activities generally occur at the end of June through the beginning of July. Nest sites are chosen in areas that offer suitable substrate for digging (e.g. loose soil), well-drained, open locations which increases the incubation temperatures because of sunlight exposure. This in turn increases nest success. Upland areas adjacent wetlands can be used for nesting, basking and travel between summer activity areas. Turtles regularly move up to 1 km between wetlands and will chose a 'wetted' corridor, rather than a direct route.[1] [2] [3] [4] [5]

Assessment

Correspondence with the North Bay MNRF District staff (Appendix A), local records of Blanding's turtles within the region, and site investigations all confirm the study area supports Category 3 Blanding's Turtle Habitat as per the species' General Habitat

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[1] COSEWIC 2005. COSEWIC assessment and update status report on the Blanding's Turtle *Emydoidea blandingii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 40 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[2] Edge, C. B. 2008. Multiple Scale Habitat Selection by Blanding's Turtles (*Emydoidea blandingii*). Master's Thesis. School of Graduate Studies, Laurentian University.

[3] Ontario Ministry of Natural Resources. 2012. Survey Protocol: Blanding's Turtle (*Emydoidea blandingii*). Policy Division, Species at Risk Branch. 15pp.

[4] Seburn, D. C. 2007. Recovery Strategy for Species at Risk Turtles in Ontario. Ontario Multi-Species Turtles at Risk Recovery Team. 83pp.

[5] Ontario Ministry of Natural Resources. 2013. General Habitat Description for the Blanding's turtle (*Emydoidea blandingii*).

Description[7]. The fast-flowing waters with no emergent vegetation and little in-stream cover through this section of the creek do not support a eutrophic aquatic environment required for Category 1 and 2 Blanding's turtle habitat and the notable absence of waterlilies and cattails continues through until the creek outlets in Lake Nipissing. The creek substrates are primarily cobble and sand, with some boulders and areas where the shoreline has been artificially hardened. There are no suitable wetlands present within the study area, as confirmed by MNRF staff. Desktop investigations confirmed the nearest suitable wetlands are located over 680m away across an urban area and several active rail lines (Figure 4).

Blanding's turtles are known to exist within other areas of the Chippewa Creek subwatershed and therefore this section of creek has potential to be used as a movement corridor. Although there is an upland gravel area located on ONTC lands to the north of the creek (Photo 9), Blanding's turtles most often select nest sites that are adjacent to undisturbed shallow weedy areas of marshes, lakes, or rivers and away from roads and sites and urban areas that are prone to egg predation by skunks, raccoons, and other animals. The Oak Street channel of Chippewa Creek is located in an urbanized area and most of the surrounding land has been anthropogenically modified and maintained as such. It is very unlikely that any of the riparian areas through the study area or the creek itself would provide terrestrial or adjacent aquatic habitat suitable for nesting turtles.

As Category 3 habitat, this movement corridor is tolerant to alteration; however, the function of these areas must be maintained to ensure compliance under the Endangered Species Act (ESA). It is not necessary to obtain authorization under the ESA if the Category 3 habitat can continue to function as a movement corridor and turtle passage through the study area limits shall remain hazard-free throughout the entire duration of the Blanding's turtle active season (April to October of any given year). Where creek channel repair work is proposed to take place within the active season window, it is recommended that exclusion or reptile fencing be installed along the creek banks prior to the commencement of any on-site work to prevent the potential upland movement of turtles into hazardous work areas. All installed temporary fencing shall remain functional post-construction until the site has been deemed safe for Blanding's turtles. Any sightings of Blanding's turtles within the study area should be reported to MNRF.

Photo 9: Gravel area adjacent and upland from Chippewa Creek

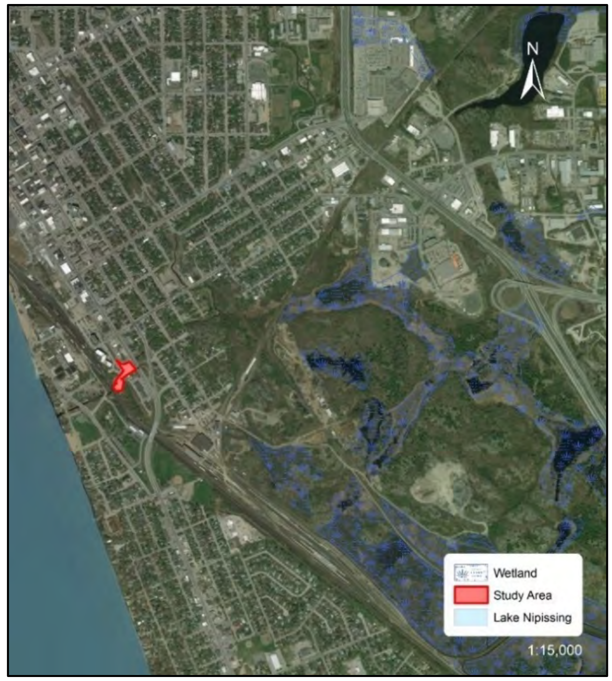

Figure 4: Mapped wetlands nearest the study area

5.3 Barn Swallow (*Hirundo rustica*)

Barn swallows are an aerial insectivore, known to build nests on barns, bridges and other buildings especially in open areas near water. Open habitats including grasslands, fields, right-of-ways, shorelines and wetlands are particularly important for foraging. They live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures. Swallows prefer structures with rough-surfaced ledges where they can build their nests. The cup-shaped mud nests are the critical habitat feature used for egg laying, incubation, feeding, resting and rearing of young. Barn swallows will use artificial nest cups and ledges; and are known to use the same nests in subsequent years. They are often found in colonies; breeding takes place from May through August. [6] [7] [8]

Assessment

All structures with potential to support barn swallow nesting were investigated on the site for evidence of barn swallow nesting, including the twin box culvert under Main St E, the pedestrian bridge, and two ONTC rail bridges. No evidence of barn swallow nesting was observed.

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[6] COSEWIC. 2011. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[7] http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_BRN_SWLLW_EN.html

[8] Ontario Ministry of Natural Resources. 2013. General Habitat Description for the Barn Swallow *Hirundo rustica*. http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/mnr_sar_ghd_brn_swllw_en.pdf

5.4 Chimney Swift (*Chaetura pelagica*)

Chimney swifts are an aerial insectivore; commonly seen foraging over open areas and wetlands. According to the Chimney Swift COSEWIC Status Report (2007), cavity trees with a diameter breast height (DBH) greater than 50 cm are required for nesting. Common tree species hosting nesting or roosting sites are white pine, yellow birch and sometimes aspen. While not common, pileated woodpecker cavities are sometimes used for nesting and roosting. Communities supporting trees >50 cm DBH and pileated woodpecker cavities are typical of old growth forests.

More typically, swifts nest and roost in human-created structures such as brick chimneys. At times, especially during migration and inclement weather, roosts may host hundreds or even thousands of birds. Structures functioning as nest features are usually occupied by a single breeding pair. Breeding pairs exhibit high site fidelity for structures used as nests and roosts and will continue to use these features as long as they are functional. In Ontario, swifts return in late April through early May and breed May through July. Migration begins in late August and is usually complete by mid-October.

The loss of artificial nest features (brick chimneys) has resulted in significant population declines over a short time period. Secondarily, the loss of old growth forests and large cavity trees has resulted in fewer natural nesting (and roosting) structures. [9] [10] [11] [12] [13]

Assessment

Although Chimney Swifts have been observed within 800m of the study area, the site does not support natural habitat that would be used for nesting or roosting such as large cavity trees, snags, or suitable anthropogenic structures. No impacts to chimney swifts are expected.

5.5 Eastern Hog-nosed Snake (*Heterodon platirhinos*)

Eastern hog-nosed snakes are highly mobile and have large home ranges. This makes it especially challenging to define specific habitat as important. Features which are required by hog-nosed are widespread and in relatively abundant supply at the northern edge of the species' range.[14] [15] [16]

Ontario has adopted the federal recovery strategy for hog-nosed snakes and included an addendum which outlines the recommended areas to be considered for a habitat regulation. Oviposition and hibernation sites are the areas described as critical habitat; essential for the long-term persistence of the species. Habitat used for foraging,

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[9] OMNR. 2013. General Habitat Description for the Chimney Swift. http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/mnr_sar_ghd_chmny_swft_en.pdf

[10] http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=951

[11] http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CHMNY_SWFT_EN.html

[12] Cink, Calvin L. and Charles T. Collins. 2002. Chimney Swift (*Chaetura pelagica*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/646

[13] COSEWIC 2007. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 49 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[14] Kraus, T. 2011. Recovery Strategy for the Eastern Hog-nosed Snake (*Heterodon platirhinos)* in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. i + 6 pp + Appendix vi + 24 pp. Adoption of the Recovery Strategy for the Eastern Hog-nosed Snake (*Heterodon platirhinos*) in Canada Seburn, 2009).

[15] COSEWIC. 2007. COSEWIC assessment and update status report on the Eastern Hog-nosed Snake *Heterodon platirhinos* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 36 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[16] http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_ESTRN_HG_NSD_SNK_EN.html

thermoregulating, mating and dispersal is also important. Contiguous natural habitat is generally described as open areas (meadow, sand, beach and beach dunes, open forest, brushland, rock barrens), wetlands, forest and forest edge in the species range.[17]

As outlined in the Recovery Strategy for the Eastern Hog-nosed Snake in Canada states the five physical features that are used to describe preferred habitat. They include well-drained loose or sandy soil, open vegetative cover such as open woods, brush land or forest edge, proximity to water, and climatic conditions typical of the eastern deciduous forest biome. Females lay eggs beginning in late June in sandy soils, sometimes under rocks and driftwood and tend to use the same general area for nesting in subsequent years. Hibernation sites are also found in sandy soils; and unlike other snakes, the Eastern hog-nosed usually hibernates alone. Hibernation takes place from October through April. The sites have been documented in upland intolerant forests below the frost line.

Assessment

The sandy soils, proximity to water, and open areas have potential to serve as suitable general foraging habitat for hog-nosed snakes. Based on correspondence from MNRF, there is a confirmed observation of an Eastern hog-nosed snake less than 600m from the study area. Given their large home ranges and the lack of specific critical habitat, it can be assumed that Eastern hog-nosed snakes are found within the study area. General mitigation for reptile species with potential to be found in the study area is included in Table 3. Any sightings of Eastern hog-nosed snakes within the study area should be reported to MNRF.

5.6 Eastern Whip-poor-will (*Antrostomus vociferus*)

Eastern Whip-poor-wills are found in a variety of open habitats and avoid areas where the forest canopy is extensive and closed. Breeding habitat is considered suitable when it contains features related to the following life processes: territory establishment, nesting, foraging and roosting. Whip-poor-wills typically select rock or sand barrens with scattered trees, savannahs, old burns, and open conifer plantations. These and other sites in a state of early to mid-forest succession are preferred for breeding.

Whip-poor-wills have been documented in a variety of semi-open habitats, usually near wetlands. Their eggs are laid directly on the ground in an area that provides sparse ground cover and offers shade and tree cover as well. Nest sites are usually close to open areas which are necessary for foraging. They are crepuscular insectivores, feeding predominantly on Lepidopterans (moths). Breeding is typically mid-May through mid-July.[18] [19] [20] [21]

[18] Desy, G. 2010. Habitat Description, Whip-poor-will (*Caprimulgus vociferus*): Threatened. Ontario Ministry of Natural Resources. 16 pp. DRAFT.

[19] Ontario Ministry of Natural Resources. 2013. General Habitat Description for the Eastern Whip-poor-will (*Caprimulgus vociferous*)

[20] COSEWIC. 2009. COSEWIC assessment and status report on the Whip-poor-will *Caprimulgus vociferus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

[21] Cink, Calvin L. 2002. Eastern Whip-poor-will (*Antrostomus vociferus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/620

Assessment
Whip-poor-will habitat that supports both nesting and foraging habitat must contain forest with sparse to moderate tree cover or open habitat and well-drained soils within an area that is a minimum of 3ha in size. There are no large tracts of forested area with openings or rock barrens present at or within 120m of the study area. No suitable nesting habitat is present for whip-poor-wills and no further study is required.

6.0 Significant Wetlands
There are no Provincially Significant Wetlands (PSWs) or unevaluated wetlands on or within 120 m of the site.

7.0 Significant Wildlife Habitat
Using the Significant Wildlife Habitat Technical Guide (SWHTG), all ecosites found within the study area were cross referenced with the database of significant wildlife habitat in the categories of Seasonal Concentration Areas, Rare Vegetation Communities, Specialized Habitat for Wildlife, and Habitat for Species of Conservation Concern, and Animal Movement Corridors. Habitat with potential to be present within the study area was given consideration based on field investigations and site characteristics. There are no potentially rare vegetation communities or specialized habitat for wildlife that have potential to be found on the subject property based on site specific characteristics such as the high degree of fragmentation and urbanization on and adjacent the study area. All potential significant wildlife habitat is discussed below.

7.1 Seasonal Concentration Areas
Seasonal concentration areas are defined by the SWHTG as areas where species of wildlife are concentrated at certain times of the year. Winter deer yards, reptile hibernacula and heronries are examples of seasonal concentration areas that may be present at a site.

Bat Maternity Colonies – G076
For Little Brown Myotis and Northern Myotis, the *Species at Risk (SAR) Bats Technical Note*[22] lists the following ecosites which could have maternity roosts: G015 – G019, G023 – G028, G039 – G043, G054 – G059, G069 – G076 and G087 – G092. According to a 2008 study by Johnson *et al.*, Eastern small-footed bats most commonly use ground level rocks, talus slopes, rock fields and vertical cliff faces for their summer roosts.[23]
The presence of potentially suitable roost trees was assessed during field investigations as noted above, however, based on the lack of suitable bat trees on the site and the limited number of trees overall, it is unlikely that the required density of suitable habitat to support a bat maternity roost is present.

[22] Technical Note, Species at Risk (SAR) Bats, Little brown myotis and Northern myotis. Regional Operations Division, June 2015.
[23] Johnson, J.S., J,D, Kiser., K.S. Wareous., T.S. Peterson (2011) "Day-Roost of *Myotis leibii* in the Appalachian Ridge and valley of Western Virginia", "Northern Naturalist", 18(1):96-106.

7.2 Habitat for Species of Conservation Concern

Species of Special Concern

Species currently listed as 'Special Concern' on the Species at Risk List in Ontario under the Endangered Species Act 2007, where present, are considered under significant wildlife habitat. Special Concern species that have potential to be found on the property, include Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Northern Brook Lamprey, Silver Lamprey, and Snapping Turtle.

Canada Warbler (Cardellina canadensis)

Canada Warblers are most often found in cool, wet, low-lying areas; including swamps, sphagnum bogs and moist forest edges and openings. They are often associated with sites that have a dense understory near open water, vegetation associations including alder and willow. Female Canada Warblers build a loosely constructed cup-shaped nest on or near the ground in early May. The nest is well-concealed, often in thickets or areas with dense ferns. These are typically wet, mossy areas within forest among ferns, stumps, and fallen logs. Nests have been documented in a variety of micro-habitats including within a recessed hole of upturned tree root mass, rotting tree stump or sphagnum moss hummock. They are also reported to be found within clumps of grass, at the base of tree stumps, tucked under overhanging banks, beside fallen logs, in rock cavities, at the base of a sedge tussock, under forest floor leaf litter, or in brush piles. Eggs are laid at the end of May, fledglings leave the nest and are ready to migrate by the end of July, early August. Migration peaks at the end of August, beginning of September. The loss of forested habitat on the wintering grounds is thought to be the primary reason for the Canada Warbler decline.[24] [25] [26]

Potential for Canada Warbler

There is potential that Canada Warblers nest and forage along sections of Chippewa Creek. Recommended mitigation for migratory breeding birds can be found in Table 2.

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[24] COSEWIC. 2008. COSEWIC assessment and status report on the Canada Warbler *Wilsonia Canadensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 35 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[25] Reitsma, Len, Marissa Goodnow, Michael T. Hallworth and Courtney J. Conway. 2010. Canada Warbler (*Cardellina canadensis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/421

[26] http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CND_WRBLR_EN.html

Common Nighthawk (Chordeiles minor)

Common nighthawks are a medium-sized insectivore that traditionally use open habitats such as rock barrens, forest clearings, gravel beaches and areas recently impacted by forest fire. They nest on open ground in these areas and are also known to use anthropogenic sites, especially flat gravel roofs in urban areas. No nest materials are used; ground cover at the nest sites includes gravel, sand, bare rock, leaves and lichen. Similar to Whip-poor-wills, Common Nighthawks are crepuscular (most active at dusk and dawn) insectivores. They commonly forage over open areas, often resting on gravel roads and airport runways or other similar features. [27]

Potential for Common Nighthawk

There is no suitable habitat for common nighthawks on the site, no further study is required.

Olive-sided Flycatcher (Contopus cooperi)

In the Ontario portion of its range, the Olive-sided Flycatcher breeds in the boreal forest, specifically riparian zones, bogs, cutovers and areas of recent fire. Olive-sided Flycatchers are a late migrant, arriving in Ontario from mid-May through mid-June. This late migration often results in migrating individuals incorrectly being identified as breeders. Olive-sided flycatchers are aerial insectivores, foraging above or near the top of the adjacent forest canopy. They use a technique known as 'sallying' to capture flying insects including bees, wasps, flying ants and less frequently moths from a perch. Coniferous trees, tall snags and semi-open areas for foraging are important features in a breeding territory. Males and females build open-cup nests usually in a conifer tree; approximately 1-meter away from the trunk of the tree and between 3 and 15 meters off the ground although there is some variability in nest heights.

Potential for Olive-sided Flycatcher

Olive-sided flycatchers may forage along Chippewa Creek. Recommended mitigation for migratory breeding birds can be found in Table 2. No negative impacts to Olive-sided Flycatchers are anticipated.

SAR Lampreys

Both the Northern Brook Lamprey and the Silver Lamprey have been known to exist within many areas of Chippewa Creek. These species of lamprey are almost genetically identical, however there are behavioural and size differences that distinguish the two. The silver lamprey is parasitic and much larger than its counterpart, the Northern Brook Lamprey. Both species are considered jawless fish and are native species in the region and play an important role within local aquatic ecosystems.

Northern Brook Lamprey (Ichthyomyzon fossor)

Northern Brook Lampreys have two distinct life stages – larval and adult. Larval lampreys (ammocoetes) spend up to six years burrowed in silt and sand substrates. This species is not a parasitic feeder, rather it consumes microscopic animals, plants,

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[27] Brigham, R. M., Janet Ng, R. G. Poulin and S. D. Grindal. 2011. Common Nighthawk (*Chordeiles minor*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/213

and pollen through filter feeding. Once developed, these adult Northern Brook Lampreys emerge in the spring from the sediment and disperse to the spawning grounds, which are often gravelly riffles, and die shortly after spawning. Upon reaching adulthood, these lampreys cease to feed entirely and do not parasitize fish.

Silver Lamprey (Ichthyomyzon unicuspis)
Unlike the Northern Brook Lamprey, Silver Lampreys parasitize fish and feed on their bodily fluids and blood of their host. These lampreys are yellow to grey with silver bellies and range in length from 10 - 40cm and can be very difficult to distinguish from other lamprey species. Silver lamprey adults spawn in stream beds that they migrate to from lake habitats and require a clear migratory pathway to complete their lifecycle. Silver lampreys die after spawning but tend to be vulnerable to environmental changes due to the variety of habitat types required throughout their lives.

Potential for SAR Lampreys
Lampreys are known to exist upstream and downstream of this section of Chippewa Creek. Recommended mitigation for lamprey species is included in Table 2. Any sightings of Silver Lamprey or Northern Brook Lamprey should be reported to MNRF.

Snapping Turtle (Chelydra serpentina)
The Snapping turtle is the largest freshwater turtle in Canada, reaching an average length of 20-36cm and a weight of 4.5-16kg. Snapping turtles have large black, olive, or brown shells typically covered in algae. Their tails, which can be longer than their bodies, have triangular crests along their length. Snapping turtles spend most of their lives in water. They prefer shallow water so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid-summer, female snapping turtles travel overland in search of a suitable nesting site, which is usually gravelly or sandy area along streams. Snapping turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.
Potential for Snapping Turtle
Like Blanding's turtles, there is limited suitable aquatic habitat for snapping turtles within the area of interest on the subject property, notably the absence of open-water marsh type wetlands. Snapping turtles that use the study area as a movement corridor will benefit from the recommended mitigation for Blanding's turtles. No negative impacts to snapping turtles are anticipated.

8.0 Areas of Natural and Scientific Interest (ANSI)
There are no known ANSI on or within 120m of the study area.

9.0 Fish Habitat
Chippewa Creek flows down the escarpment and through the City of North Bay where increasingly urban land uses contribute to physical and chemical changes to the watercourse and its associated riparian areas caused by vegetation removal, pollution,

increased stormwater runoff, and sections of channel realignment. Although evidence of a cool water fishery has been observed closer to the creek headwaters, the lower reaches of Chippewa Creek, including those found within the study area, are considered to have a warm water thermal regime and water temperatures routinely surpass 20°C in the summer months. The warm waters of Lake Nipissing may also influence temperatures and fish species observed near the creek mouth. It is likely that fish species known to exist in Lake Nipissing such as walleye, pike, and perch may also persist through this section of Chippewa Creek. As noted in section 7.3, silver and northern brook lamprey, species of special concern, are known to exist within the watercourse.
FRi has encountered and relocated lampreys present upstream and downstream of the study area during fish salvage operations and in-water work carried out in 2005, 2011, 2014, and 2015. General harm mitigation recommendations for land-based and in-water work in the study area are detailed in Table 2.

Table 2: Recommendations to avoid, mitigate, or offset harm to fish and aquatic SAR

	Recommendations
Timing	o Based on correspondence with the MNRF, this section of Chippewa Creek is considered to have a warm water thermal regime and no in-water work shall be permitted between April 1st and July 15th inclusive (timing window accounts for spawning and hatching of special concern lampreys) o Stage work to minimize duration of in-water work as much as possible o Conduct instream work during periods of low flow to further reduce the risk to fish and their habitat or to allow in-water work to be isolated from flows o Schedule work to avoid wet, windy, and rainy periods that may increase erosion and sedimentation; preferably complete work during winter months if possible
Site Selection	o Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized o Design and construct approaches to the waterbody such that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation o Avoid building structures on active floodplains or any other area that is inherently unstable and may result in erosion and scouring of the stream bed or the built structures

Contaminant and Spill Management	o Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site o Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish
Erosion and Sediment Control	o Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation of the waterbody during all phases of the project. o Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. o The Erosion and Sediment Control Plan will include: • Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the water body • Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody • Site isolation measures (e.g., silt boom or silt curtain) for containing suspended sediment where in-water work is required • Measures for containing and stabilizing waste material above the high-water mark of nearby waterbodies to prevent re-entry • Regular inspection and maintenance of erosion and sediment control measures and structures during construction • Repairs to erosion and sediment control measures and structures if damage occurs • Removal of non-biodegradable erosion and sediment control materials once site is stabilized

Shoreline Revegetation and Stabilization	o Clearing of riparian vegetation should be kept to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting o Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high-water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed o Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site o Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage should be restored o If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment o Remove all construction materials from site upon project completion
Fish Protection	o Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict the channel width, or reduce flows; temporary barriers to fish passage should be in place only for the time required to complete the in-water work in isolation; barriers should be removed and flow established as soon as the work is complete and stabilized o Retain a qualified environmental professional to ensure applicable permits for relocating fish are obtained and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters o Screen any water intakes or outlet pipes to prevent entrainment or impingement of fish

Operation of Machinery	o Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds. o Whenever possible, operate machinery on land above the high-water mark, on ice, or from a floating barge in a manner that minimizes disturbance to the banks and bed of the waterbody. o Wash, refuel, and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water o If replacement rock reinforcement and/or armouring are required to stabilize eroding areas around bridge structures • Place appropriately-sized, clean rocks into the eroding area; • Do not obtain rocks from below the high-water level of any waterbody; • Avoid the use of rock that is acid-generating and rock that fractures and breaks down quickly when exposed to the elements; • Install rock at a similar slope to maintain a uniform watercourse bank and natural watercourse alignment; and • Ensure rock does not interfere with fish passage or reduce the width of the watercourse

10.0 Summary of Natural Heritage Features

Table 3: Natural Heritage Features with potential to be present in the study area

Natural Heritage Category	Species/ Habitat	Presence in Study Area	Recommendations
Habitat of Endangered/ Threatened Species	Blanding's Turtle	Potential	See Table 4
	Eastern Hog-nosed Snake	Presumed	See Table 4
Significant Wetlands	None present on or within 120m of the study area		
Significant Wildlife Habitat: Habitat of Species of Conservation Concern	Canada Warbler, Olive-sided Flycatcher	Presumed	• Any vegetation clearing shall occur outside of the breeding bird window of April 15 – August 31 to comply with the Migratory Birds Convention Act and protect any nesting special concern birds • Where the breeding bird vegetation clearing window cannot be respected, a qualified avian professional may evaluate the site to ensure there are no active nests within the area to be cleared
	Northern Brook, Silver Lamprey	Presumed	No in-water work before July 15th to allow for spawning and hatching of lamprey
	Snapping Turtle	Potential	See Table 4
ANSIs	None present on or within 120m of the study area		
Fish Habitat	Warm water thermal regime	Presumed	See Table 2

Table 4: Recommended mitigation for reptiles with potential to be present in the study area

PRE-CONSTRUCTION		
Potential Risk	**Recommended Mitigation**	**Outstanding Risk**
Reptiles moving over land to access aquatic and terrestrial habitats	• Isolate and sweep work areas if working during the active season; • If found, relocate reptiles outside of work area (safe place within 500 m); alternatively, allow turtle/snake to move away on its own • Installation of exclusion fencing to maintain the Category 3 Blanding's Turtle Habitat form and function of this section of Chippewa Creek (movement corridor) during active season (April to October)	If work areas are properly swept and isolated, little to no risk of harm
CONSTRUCTION		
Potential Risk	**Recommended Mitigation**	**Outstanding Risk**
Harm to individuals	• A qualified member shall be onsite prior to operations to ensure that the work area is clear of any SAR species so that work can occur without any risk to species. • The perimeter of all exclusion fencing shall be monitored during work operations and if any turtles are encountered at the fence, they will be relocated on the opposite side of the exclusion fencing in the general direction of travel so as not to impede their movements during the construction period or monitored until they are safely away from the work area as directed by MNRF	Turtles - little to none; overland movements aren't frequent and tend to follow shortest, wettest path; not expected in work areas Snakes – low; potentially suitable foraging habitat or movement corridor along riparian area
Creation of suitable nest sites through imported aggregate	• Isolate any imported aggregate stockpiles to prohibit use by turtles and snakes – sediment fencing works well for this • 'Fresh' aggregate should be dealt with at once e.g. graded/ installed/ covered, if not, it should be isolated as above • Areas immediately adjacent to Chippewa where clearing has occurred shall be re-planted with native shrubs and vegetation as required	Little to none; turtles and snakes demonstrate nest site fidelity so are less likely to use a 'new' site (recently placed aggregate)

11.0 Conclusion

In conclusion, the existing environmental conditions of the study area and adjacent lands were reviewed and outlined in this baseline environmental inventory. Site-specific applicable natural heritage values including habitat of endangered and threatened species, significant wildlife habitat, and fish habitat were investigated and considered in the assessment of potential impacts. Field investigations and synthesis of background information identified those values with potential to exist and be impacted by channel repair. Recommended mitigation measures, as outlined in this report, will serve to achieve impact avoidance where applied as directed to remain compliant with the Endangered Species Act (2007) and the Migratory Birds Convention Act (1994).

Respectfully submitted,

Hannah Wolfram
Biologist

Appendix A: Correspondence

From: Robinson, Julie (MNRF) <Julie.Robinson@ontario.ca>
Sent: October 24, 2018 3:56 PM
To: Brian Tayler <Brian.Tayler@nbmca.ca>
Cc: 'Ed Gazendam' <ed@watersedge-est.ca>
Subject: RE: MNRF Input -- Notice of Commencement - Class EA Chippewa Creek

MNRF Tracking No: NB2018-0820 Conservation Authority Class Environmental Assessment

Hello Brian:

Thank you for circulating to the Ministry of Natural Resources and Forestry (MNRF), North Bay District office, on the Notice of Commencement for a Class Environmental Assessment for erosion control along Chippewa Creek (Oak Street Channel Repair). We understand the project limits are from Main Street to the railroad bridge upstream of Stanley Street within the City of North Bay. We have reviewed all available natural heritage information for this area and we provide the following input for consideration in project planning:

Significant Wetlands (PSW):
There are no PSWs on or within 120 m of the site. There are no unevaluated wetlands on the site.

Significant Habitat of Threatened and Endangered Species:
Blanding's Turtle (Threatened - species and habitat protected under the Endangered Species Act)
Based on nearby occurrences, this area is considered to be category 2 and 3 habitat for Blanding's turtle as per the General Habitat Description for Blanding's Turtle.
The GHD can be found here:
https://files.ontario.ca/environment-and-energy/species-atrisk/mnr_sar_ghd_bln_trtl_en.pdf
Activities in Blanding's Turtle habitat:
Generally compatible:
Recreational use of the water such as swimming, boating, and fishing.
Small-scale alterations to land cover that do not impede overland movements or impair nesting sites.
Generally not compatible:*
Significant draining, infilling, dredging, or other significant alteration of wetlands or other suitable waterbodies.
Significant alteration of shorelines, especially hardening (e.g. the use of gabion baskets, rip-rap, and rock armour).

Eastern Hog-nosed Snake (Threatened - species and habitat protected) - this area is within Eastern Hog-nosed snake habitat with the nearest observation noted 600 m from the study area.
More information on Eastern Hog-nosed snake can be found here:
https://www.ontario.ca/page/eastern-hog-nosed-snake
Other listed species that are likely to occur in the area include:
Bats Spc. (Little Brown Myotis, Eastern Small Footed Myotis, Northern Mytois, Tricolored Bat)

Barn swallow (Threatened – species and habitat protected)
Whip-poor-will (Threatened – species and habitat protected)
Chimney Swift (Threatened – species and habitat protected) - observation approximately 800 m from the study area; depending on buildings in the area habitat could be present in the study area.
Short eared owl (Special concern – mitigate potential impacts)
Common Nighthawk (Special concern – mitigate potential impacts)
Olive-sided flycatcher (Special concern – mitigate potential impacts)
Canada Warbler (Special concern – mitigate potential impacts)
Snapping Turtle (Special concern – mitigate potential impacts)
Given that the area is known to support ESA habitat, authorization under the ESA may be required prior to proceeding with site alteration; however, this is dependent on the nature of the project activities. Once the project details are clearly defined, MNRF strongly recommends that an Information Gathering Form be submitted to our office. This form provides information to help MNRF determine if an authorization is required under the ESA and if the activity can be supported under the Act.
The Information Gathering Form can be found here:
http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/MinistryDetail?OpenForm&ACT=RDR&TAB=PROFILE&ENV=WWE&NO=018-0180E

Significant Areas of Natural and Scientific Interest (ANSI:
None present in the study area.

Significant Wildlife Habitat:
There is potential for significant wildlife habitat of snakes, turtles and amphibians in the area. Areas of sand and /or soil that are well-drained have potential to be used as nesting sites by turtles and snakes. Inspection for signs of recent nesting should take place prior to site alteration.

Fish Habitat:
The thermal regime at this location should be consistent with the warm water thermal regime. No in-water work from April 1 to July 15. This waterbody has silver and northern brook lamprey, species of special concern. The July 15th timing window will also allow for spawning and hatch of lamprey. Please report any sightings of Silver Lamprey (Special Concern) or Northern Brook Lamprey (Special Concern) to MNRF.
Thank you again for the opportunity to provide information to support this project. We are available to provide technical information or advice and are happy to meet to discuss any of the above information further.

Sincerely,

Julie

Julie Robinson | District Planner | Ministry of Natural Resources and Forestry | North Bay District | ☎705-475-5569 |

APPENDIX C:

Horizon Archaeology Report

Stage 1 Archaeological Assessment of Chippewa Creek- Oak Street Channel Repair Part Lot 20 Concession D, Township of Widdifield, City of North Bay District of Nipissing P335-0068-2018

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Date: October 19, 2018
Type of Report: Original

Executive Summary

This report describes the methodology and results of the Stage 1 Archaeological Assessment of Chippewa Creek- Oak Street Channel Repair project, Part Lot 20 Concession D, Township of Widdifield, in the City of North Bay, District of Nipissing . The project aims to repair an undersized pedestrian foot bridge that constricts the creek's channel and causes bank degradation in the area..

This study was conducted under Archaeological Consulting License P-335 issued to Dayle Elder, by the Minister of Tourism, Culture and Sport for the Province of Ontario. This assessment was undertaken in order to recover and assess the cultural heritage value or interest of any archaeological sites within the project boundaries. All work was conducted in conformity with Ontario Ministry of Tourism, Culture and Sport (MTCS) *Standards and Guidelines for Consultant Archaeologists* (MTCS 2011) and the Ontario Heritage Amendment Act (SO 2005).

Horizon Archaeology Inc. was engaged by the proponent to undertake a Stage 1 Archaeological Assessment of the study area and was granted permission to carry out archaeological fieldwork by the property owner. The study area was subject to a Stage 2 assessment on October 18, 2018.As per Section 1.1.2 of the Standards and Guidelines for Consultant Archaeologists the mapping provided by the proponent represents the best available (MTCS 2011).

Approximately 40% of the property composed of a narrow band of creek bank, 30% is Chippewa Creek, 20% is composed of the rail and pedestrian bridges, and 10% pavement, either parking lot, community trails, or sidewalks. The creek course has been altered, and the banks disturbed through a century of development. The pedestrian bridge is currently closed to traffic, and the rail bridge has been separated from the existing rails to the south by the paved Kinsmen path, and to the north, the rail lines have been ripped up, and the apartment complex and parking lot separate it from the TNO head office building.

Based on the results of the Stage 1 Archaeological Assessments it is recommended that:

1) All areas of the Chippewa Creek- Oak Street Channel Repair Project be cleared of any further archaeological concerns.

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Project Personnel

Consulting Archaeologist: Dayle A. Elder, MA (P335)

Report Preparation: Dayle A. Elder

Draughting: Dayle A. Elder
Proponent

Photography: Dayle A. Elder

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1.0 Project Context

1.1 Objectives

The objectives of a Stage 1 archaeological assessment, as outlined by the Standards and Guidelines for Consultant Archaeologists (2011), are as follows:

1) To provide information about the property's geography, history, previous archaeological fieldwork and current land conditions
2) To evaluate in detail the property's archaeological potential, which will support recommendations for Stage 2 survey for all or parts of the property
3) To recommend appropriate strategies for Stage 2 survey

1.2 Development Context

This report describes the methodology and results of the Stage 1 Archaeological Assessment of Chippewa Creek- Oak Street Channel Repair project, Part Lot 20 Concession D, Township of Widdifield, in the City of North Bay, District of Nipissing (**Maps 1 & 2**) . The project aims to conduct work on Chippewa Creek's banks in the project area in an effort to reduce the effects of flooding. The project was triggered by the Environmental Assessment Act, and aims to repair an undersized pedestrian food bridge that constricts the creek's channel and causes bank degradation in the area.

This study was conducted under Archaeological Consulting License P-335 issued to Dayle Elder, by the Minister of Tourism, Culture and Sport for the Province of Ontario. This assessment was undertaken in order to recover and assess the cultural heritage value or interest of any archaeological sites within the project boundaries. All work was conducted in conformity with Ontario Ministry of Tourism, Culture and Sport (MTCS) *Standards and Guidelines for Consultant Archaeologists* (MTCS 2011) and the Ontario Heritage Amendment Act (SO 2005).

All records, documentation, field notes and photographs related to the conduct and findings of the these investigations are held at the office of the licensee. The documentary record generated in the field includes three pages of handwritten notes and sketch maps, GPS points, and 40 digital photographs.

1.3 Historical Context

1.3.1 Pre-Contact Period

Palaeo-Indian sites date 10,000 to 5,000 B.C., and at that time were located in a tundra like environment as the glaciers retreated northward. In such an environment, fruits, nuts and other sources of food harvested from trees or other plants are rare, and it is thought that the Palaeo-

Indians subsisted largely by hunting, trapping and fishing (Ellis 2013: 36). Palaeo-Indian sites are most often located on relic beach ridges associated with glacial lakeshores (Stork 1984). They have also been located at ancient river crossings, places where modern caribou hunters often assemble as the animals my slow and file through a narrow area making them easier to hunt (Ellis 2013: 36). The predominance of sites being located on ancient strandlines may be more indicative of the survey methodology employed to find them rather than an actual preference for site situation on the part of the Palaeo-Indian peoples of Ontario, as a number of sites have been recovered away from ancient shorelines (Ellis & Deller 1990: 50)

Most Palaeo-Indian sites are small, indicating campsites that were inhabited briefly as its occupants followed the seasonal routes and cycles of their prey. Larger sites seem to be associated with animal migration routes, primarily at river crossing as mentioned above (Ellis 2013: 35-6).

Large, fluted spear points define an Early Palaeo-Indian sites. While one of the earliest artefacts in North America, they are also one of the most technologically advanced stone tools on the continent (Ellis 2013: 37-8). Other artefacts encountered include hammerstones, and large choppers, knives / cutting tools, lunate bifaces, and piece esquillee's, possibly employed as wedges for wood or bone working, unifacial triangular end scrapers, beaked scrapers, spokeshaves, burins or gravers (Ellis & Deller 1990: 43, 47-9).

Late Palaeo-Indian points do not exhibit the same fluting that is present on Earlier assemblages. Two point types are found on Late Palaeo-Indian sites, one group having a concave base with either rounded or pointed ears, and the other group comprising lanceoloate forms (Ellis 1990: 57-8). Most of the lithic tool kit continues from the Early Palaeo-Indian Period, however there a few new forms or tools that appeared, including: drills, and small thumbnail or fan shaped end scrapers replace the unifacial triangular end scraper (Ellis & Deller 1990: 59).

The toolstone recovered from Palaeo-Indian sites in Ontario has been sourced to quarry sites up to 200 km away. The tool stone was likely at least roughed out at the quarry site and carried to the site on seasonal routes. Other sources originated further afield from sources in Ohio or Michigan, and were likely obtained through trade (Ellis & Deller 1990: 43).

The Archaic peoples were still nomadic hunter-gatherers, however the greater range of tools has caused some to hypothesise that this indicated a shift from exploiting large-game over a large area to a more extensive, localised range (Ellis et al 1990: 67). This could also be a factor of preservation of perishable materials, which is also a factor from the earlier Palaeo-Indian period.. There is also evidence, through presence of imported / exotic cherts, that great distances were still covered during seasonal rounds (Ellis et al 1990: 78).

In southern Ontario, the Archaic is subdivided into Early, Middle, and Late periods, which in turn are further subdivided into horizons based upon point types (Ellis et al 1990). In northern Ontario, there is no such subdivision and the entire period is known as the Shield Archaic (Wright 1972, Hamilton 2013). Areas around the north shore of the Great Lakes, and along the southern border between northwestern Ontario and Minnesota could possibly have been part of the Middle Archaic "Laurentian Archaic" group found in southern Ontario (Hamilton 2013, Ellis et al 1990).

The Archaic period also witnessed the rise of the "Old Copper" culture centred around Lake Superior."Old Copper" culture is a name given to the people from this area who exploited the available copper veins or outcroppings, and not a distinct Archaic group separate from others based upon material culture, settlement patterns etc. Copper artefacts from this area have been recovered from sites in Southern Ontario, west to into Saskatchewan, and south of Lake Michigan into Illinios (Hamilton 2013: 89). Copper artefacts include spear points, knives, chisels, and celts (Dawson 1966). Most of these artefacts have been found by collectors or out of context and their role in society is open for debate.

A major change in the Archaic tool-kit from that of the Palaeo-Indian period is the appearance of smaller, notched points that replace the large lanceolate forms. This has been thought to indicate a technological advance; the adoption of the spear-thrower, or *atl atl* . Other artefacts typical of the Archaic period include those associated with wood-working such as axes, gouges and adzes (Ellis et al 1990: 65). These woodworking tools have been thought to indicate that the dug-out canoe was introduced during this period.

Archaic houses are rare, however the Davidson Site (AhHk-54) along the Ausable River inland from Lake Huron has revealed a number of features that have been identified as pit-houses, dating to the Late Archaic, predating 3000 BP based upon dates from carbonised remains found in flood deposits above the floor (Ellis et al 2010).

The house was circular, approximately 5 metres in diametre, had a sloping entrance, interior hearth, posts, and a bench surrounding the edges of the structure, and likely possessed a soil or sod roof. It was hypothesised that this structure was a cold weather domicile, owing to the greater insulating properties of pit-houses (Ellis et al 2010: 10). The labour involved in construction of such a house is also believed to indicate a more-or-less sedentary lifestyle, those occupying it relying on stored foodstuffs (Ellis et al 2010: 10).

Burials from southern Ontario date to the Late Archaic, and have been divided into two complexes, the Haldimand and Glacial Kame. While it has been hypothesised that the Haldimand Complex groups interred their dead in what could be the first cemeteries in the province, it is fairly certain that the Glacial Kame culture had deliberate cemeteries to bury their deceased, possibly in an annual ritual or celebration (Ellis et al 1990: 116-8). Haldimand Complex burials included projectile points, chert bifaces, red ochre, copper artefacts including beads and awls, and beaver incisor grave goods (Ellis et al 1990: 116). Glacial Kame burials were composed both of inhumations as well as cremations. Grave goods were rather elaborate, and included bannerstones, bird stones, stone pipes, copper artefacts including adzes, awls and beads, bear maxilla masks, exotic sea shells, and gorgets (Ellis et al 1990: 116-8).

In southern Ontario the Woodland, like the Archaic period, has been subdivided into three phases, Early, Middle and Late, dating between ca. 1000-900 BC to and AD 1650-1700. This period is marked by the introduction of pottery. The Late Woodland period begins ca. AD800 with the widespread adoption of agriculture.

The Early Woodland people still maintained seasonal routes similar to those from the preceding period. The adoption of pottery seem to indicate an increasing exploitation of plant resources (Williamson 2013: 48). These seasonal rounds were likely focussed around watersheds with families living separately in autumn and winter, coming together in the spring and summer to exploit seasonal resources such as fish spawning. While these larger groups had their own territories, they were not isolated and did not isolate themselves.

Across most of southern Ontario, Quebec and western New York State the people of the Early Woodland shared a similar culture known as "Meadowood". Common artefacts from this time period include: Vinette 1 ceramics, distinctive side-notched "Meadowood" projectile points, and the "Meadowood Cache Blades", trapezoidal gorgets, and bar and expanded bodied pop-eyed birdstones. Also common on Meadowood sites are drills and scrapers made from Meadowood preforms, other gorget types, pendants, copper beads and awls, and fire making kits of iron pyrite. These artefacts are believed to have developed from the preceding Glacial Kame culture of the Late Archaic (Spence et al 1990: 128-9). This could be indicative of the extension or continuance of the Archaic period type lifeways into the Early Woodland in the region like has been hypothesised for other regions of northern Ontario.

Most of what is known about the Meadowood culture stems from cemeteries. Domestic sites often yield little in the way of house plans, often only hearths and pits are recovered. People were buried in individual graves, often coated with imported red ochre with varying quantities and types of grave goods. Long-distance trade items recovered from both cemetery and domestic sites are numerous, but also less so compared to the preceding period (Spence et al 1990: 136).

The Early Woodland Middlesex Complex indicates increasing influence from Adena and Hopewell Complexes in the mid-west United States, what is now Ohio and Indiana. These include both finished artefacts and raw material that originate in this area. Burial mounds also appear on the Ontario landscape, and are also believed to be a result of influence or increasing contact from this region (Spence et al 1990: 138-42).

The Middle Woodland period in southern Ontario has revealed three separate complexes or cultures: the Couture in the southwest, the Saugeen in the northwestern portion of southwestern Ontario, and Point Peninsula in the central and eastern parts of southern Ontario. Owing to the still nomadic nature of these groups, 'borders' are not clearly defined, and within these groups there is still variability. There is also the possibility that there exist other complexes that owing to the lack of research that have so far been classified as belonging to Point Peninsula and Saugeen especially (Spence et al 1990: 143-8).

Common Middle Woodland artefacts include pseudo-scallop shell followed by dentate stamp decorated ceramics, and Vinette 2 ware. Other artefacts recovered from Middle Woodland sites include bone and antler harpoons, antler combs with incised decorations, antler hafted beaver incisors, bone fish hooks, and a wide variety of projectile point forms (Spence et al 1990: 158). The construction of burial mounds continued into the Middle Woodland period.

Settlement patterns indicate a gathering of family groups between the spring and autumn at or near river mouths to fish, then to harvest wild rice, hunt deer and gather nuts. In the winter, the groups would disperse and travel inland to each families' winter camping territory (Spence et al 1990: 164).

In northern Ontario, the Woodland period has been divided into 2 periods, known as Initial and Terminal Woodland. The Initial Woodland period coincides with the Middle Woodland of southern Ontario. Laurel Tradition artefacts define the Initial Woodland period in northern Ontario. Early and Late manifestations of this tradition have been identified, the early phase dating between 200 BC and 500 AD, and the late 500 to 1000 AD. The Laurel Tradition occupies nearly all of the northern parts of the province, save for the very far north, and as far south in Ontario as Lake Nipissing and the French River. The Laurel Tradition spans north and eastern Manitoba, and a small part of Saskatchewan in the west, and extends into northern Quebec to the east, and into northern Minnesota and Wisconsin. Initial Woodland sites are often located along river banks or on the shores of lakes.

Burial mounds were constructed in the Middle/Initial Woodland period throughout Ontario. The best known and most researched group is the Manitou Mounds near Rainy River. The mounds were constructed of relatively clean fill or sod over top of wooden cribbing or scaffold that contained the initial burials (Dawson 1981: 34, Wright 1986: 63-4). Remains of birch bark baskets have been recovered from the mound fill (Dawson 1981: 34, Wright 1986: 34). Subsequent burials, either primary inhumations or secondary burials, interred alone or in a mass burial have been recovered from the mound, and at its base (Wright 1986: 63). Some of the burials were coated with powdered red ochre, and grave goods included such items as lithic bifaces, ceramics, and exotic imports such as a monitor pipe, and an Ohio pipestone sucking tube (Dawson 1981:34, Wright 1986:64). Closer to the project area, a burial ground containing artefacts from the Meadowood Complex was excavated near Killarney on the north shore of Lake Huron (ASI 1994: 8).

Laurel ceramics were produced from either a single lump of clay or by coil manufacture, grit tempered, a smoothed exterior, rims relatively straight with the lip either flattened or rounded (Wright 1967, Wilford Laboratory of Archaeology 2012). There are a variety of decorative techniques utilised on these vessels including a variety of incised, stamped, punctated, embossed, and cord-wrapped stick decorations (Wright 1967, Wilford Laboratory of Archaeology 2012).

Early in the Laurel sequence, projectile points continue to resemble the notched points of the Archaic period (Dawson 1981:3). These are later superceded by stemmed points (Dawson 1980: 55). Side scrapers dominate scraper types in the early phases, and end scrapers assume prominence in the later phases (Dawson 1980: 33). Other typical tools include stone biface blades, abraders, pottery decorating tools, and net sinkers, copper beads, awls, barbs, fragments, nuggets, pendants, projectile points, chisels, and bone awls, needles, knives which are usually manufactured from beaver incisors, pottery decorating tools, and beads (Wright 1967: 152, Dawson 1980:33, 1981: 34).

The Late Woodland period in southern Ontario saw the widespread adoption of agriculture and increasing sendentarisation. This period has numerous cultural and temporal subdivisions within it: commencing ca. AD 600 with the Princess Point complex, and culminating with the Huron, Neutral, Petun, Odawa and other groups encountered by explorers, missionaries and traders.

Settlement size increased in southern Ontario, especially in the later Late Woodland period, with people living in large palisaded villages in locations that may have been chosen with defence at least partly in mind. Ossuary burials become common, where the dead were communally interred in pits along with grave goods.

The Late (Terminal) Woodland in Northern Ontario is composed of numerous ceramic assemblages; Blackduck, Selkirtk Composite, and the Sandy Lake /Psinomani Complex. The last two assemblages are restricted to areas of northwestern Ontario, and unlikely to be recovered in the study region. Blackduck, out of all the northern Ontario Terminal Woodland groups is the most likely to be found in Parry Sound.

Blackduck ceramics are globular, and are more rounded than the other Late Woodland ceramics from northern Ontario, with a more constricted neck, and often have out-flaring rims. They are produced by the paddle and anvil technique, and tempered with grit. Decoration is usually limited to the interior and exterior of the rim, and the exterior neck. Decorative techniques include cord-wrapped stick stamping, “comb” stamping, punctuations of various kinds, and vertical brushing on the exterior rim surface. Distinctive of early Blackduck vessels is bossed decoration, a motif that appeared late in the Laurel sequence (Wilford Laboratory of Archaeology 2010, Wright 1967). Pottery of typical Blackduck manufacture but with Laurel design motifs have been recovered, and these have been dated to very early in the sequence, as early as 700 AD (Dawson 1982:32).

Non-ceramic artefacts considered typical of the Blackduck people include: clay pipes, stone oval and lunate chipped knives; side scrapers; trapezoidal, oval, and thumbnail end scrapers; tubular-shaped drills; steatite pipes; bone awls and needles; unilaterally barbed harpoon; spatulas antler flakers; beaver incisor knives; bear canine ornaments; and native copper fishhooks, gorges, and beads (Gibbon & Anfinson 2008).

Woodland period archaeology in the surrounding regions indicates that rather than be viewed as being part of a large homogeneous "Northern Ontario", it would appear that the Late Woodland occupants of areas such as Muskoka, Haliburton, and Parry Sound Districts had a material culture more related to those from Southern Ontario. Pottery recovered from the Late Woodland Curtin Site (BfGp-2) in Haliburton could be classified as "Iroquoianesque", with more traits connecting it to the Iroquoian Benson Site in Victoria County. Similar pottery displaying both Algonkian and Iroquoian traits was also recovered in the District of Muskoka, near the eastern shore of Georgian Bay at the mouth of the Severn River (Elder 2016).

Similar pottery has been recovered from sites in central and eastern Ontario (Ballantine 2008: 10). Research seems to indicate that sites on the Gull and Burnt River systems in Haliburton, which allow the easiest access to Victoria County possess the greatest amount of chert, while those to the northeast especially have the highest amounts of quartz or quartzite tools (Ballantine 1992: 88).

1.3.2 Post-Contact

Etienne Brule in 1610, is believed to be the first European to journey through the region, followed by Samuel de Champlain, Recollet, and then Jesuit missionaries who used this route journeying to Huronia and beyond. After the dispersal of the Huron in 1649, European travels along the eastern shore of Georgian Bay decreased markedly, and attention shifted to regions to the west. The Huron had been a major source of furs, which they obtained from groups who lived further north, and with this avenue closed, the European traders started to explore and exploit regions further afield.

The first European to spend any great length of time in some form of proximity to the project area was Jean Nicollet. As part of Champlain's plans to strengthen relations between the French and the First Nations, Nicollet lived and traded with the Nipissing between 1620 and 1629 (Marsh 2014). When Quebec fell to the English in 1629, Nicollet left the Nipissing, and lived amongst the Huron until the return of French control in 1633. During his time with the Huron, he was instrumental in thwarting English attempts to establishing trade relations (Hamelin 2017).

There was little in the way of permanent Euro-Canadian habitation in the area, and until the British seized control of New France, the only Europeans in the area were independent, and unlicenced fur-traders operating out of Montreal. The fur traders of New France expected the

First Nations, such as the Nipissing to bring the furs directly to Montreal, and did not make use of trading posts or forts like those that would be established by the Hudson's Bay and Northwest Companies (Roberston et al 1997: 8).

Under the British, trading could be undertaken by any subject, and in 1777 the first licence to trade on Lake Nipissing was granted to Alexander Henry and John Chinn (Robertson et al 1997: 9). In the North Bay area, one of the best known traders was Eustace La Ronde, part of a family of well known traders who operated around Lakes Nipissing, Temiskaming, and Abitibi and the French River from the late 1770's. It is thought the family established a trading post on Lake Nipissing by 1790 (Robertson et al 1997: 11).

Eustace La Ronde had constructed a his trading post / home by 1817 on the shores of Lake Nipissing at the mouth of the La Vase River. Eustace LaRonde's establishment was described as a "snug house", and "a decent ordinary house, not stockaded with a potato ground close to it (Roberston et al 1997: 11)." While this home had been described as being a Northwest Company post, it is likely that the La Rondes acted as agents, and not as employees of the firm, as they seemed to enter into a variety of arrangements with both the Northwest and Hudson's Bay Companies, and often operated in competition to both depending on circumstances (Roberston et al 1997: 11).

No further mention is made of Eustace La Ronde's home after 1821. This was the same year that saw a massive transformation in the fur trade, with the amalgamation of the Northwest and Hudson's Bay Companies. Shortly after the amalgamation, a Hudson's Bay Company post was constructed on Garden Island, on the north side of Lake Nipissing near the mouth of the Sturgeon River. After the merger, operations of the Hudson's Bay Company on Lake Nipissing were run by the half brother of Eustace La Ronde, Toussant de La Ronde, between 1821 and 1824 (Robertson et al 1997: 12).

North Bay as a community had its beginnings as a railroad town. The rail road arrived in the region in 1882, and the amongst the first settlers was John Ferguson, whose nearly 300 acres of land would form North Bay's downtown core (City of North Bay 2018a). Three railroads, The Canadian-Pacific, Canadian National, and Temiskaming Northern Ontario Railroads would eventually meet at the community, making it a major transportation hub, and the "Gateway to the North."

North Bay became a District Divisional Headquarters of the Canadian Pacific in 1901. The CPR complex was located along the waterfront, and included a station, stone roundhouse, roundtable, an 18 stall engine house, and a larger engine shop for jobs that could not be accommodated in the roundhouse, freight, express and flour sheds, carpenter shop, two storey ice houses, booking house, and stockyards. The railyard extended over a kilometre on either side of the station, and could hold 2000 rail cars (Municipal Heritage Committe 2015: 54).

The Divisional Headquarters was moved to Sudbury in 1960, and the ice houses were the first buildings demolished starting in the early 1980's, followed by the express sheds in 1986, and the roundhouse and maintenance shops were torn down in 1988. The only remaining structure from the Divisional Headquarter days is the station itself which now serves as the North Bay Museum (Municipal Heritage Committe 2015: 54).

The railways opened up Northern Ontario to exploration and resource exploitation. Relatively easy access to the resources of the north, lumber, and precious metals especially attracted numerous industries to the area (City of North Bay 2018b). North Bay become a town in 1891, and a city in 1925. North Bay has remained relatively stable economically, it never underwent an extravagant "boom" period like many communities, but it also has never undergone a significant "bust" as many single-resource towns have either. Its role as a supply and relatively diversified industrial centre has helped it avoid such calamities (Karn 2015).

1.3.3 Study Area Specific History

Widdifield Township was surveyed in 1883, the year after the arrival of the railroad (Centre for Community and Oral History 2010). After being open for settlement for longer than a decade, in 1897 the township had a population exceeding 250, and North Bay itself had population of 2500 (North Bay Board o f Trade 1897: 32, Union Publishing Co. 1897: A50). The Department of Crown Land's Patent Plan of Widdifield Township indicates that the part of the study area was part of the City of North Bay.

Lot 20, Concession D was the first area cleared for settlement in North Bay, by the town's first resident, Jon Ferguson in August 1882. The Lot became the main part of the town (Gard 1909: 18). Union Publishing Company's 1897-8 Directory which included the District of Nipissing, shows Alex McDonald as owning at least part of Lot 20, Concession D (Union Publishing Co 1897: 391). An "A. McDonald" is listed as being amongst the earliest pioneer settlers in North Bay in an early 20th Century history of the city (Gard 1909: 3). While McDonald is shown as a freeholder on the Lot under investigation, the project area itself became part of the rail systems that arrived starting in the 1880's. The Canadian Pacific Railway line ran to the west of the project area. While most of the CPR's buildings were located to the northwest of the project area, the stockyards for the railway were located just to the west along Chippewa Creek (VintagePostcards.org 2014) .

To encourage settlement in the northeastern parts of Ontario, especially in the agricultural Clay Belts, the Province of Ontario created the Temiskaming and Northern Ontario Railway in 1900, with North Bay as the railroad's southern terminus. The Temiskaming and Northern Ontario Railway (TNO, now Ontario Northland) line ran through the project area ending at the company's head office approximately 300 metres to the north at the corner of Regina and Oak Streets. Just to the southeast of the project area, two spur lines ran from the TNO mainline to the

Standard Planing Mills Ltd's factory complex.

1.3.4 Maps

Early maps do not depict Lake Nipissing or the project area in any great detail, or even accuracy. Duval's map of 1653 depicts Lake Nipissing as more circular than it is currently depicted. He places the Jesuit Mission of St. Espirit on the east end of Lake Nipissing. Alexander Sherrif's map of 1831 shows Lake Nipissing with greater accuracy, though he has misplaced either the Sturgeon River, or the location of the Hudson's Bay Post on the north shore of the lake (**Figures 1 & 2**).

The 1894 Department of Crown Lands Map of Widdifield Township, has a very faint and indecipherable name written on Lot 20 Concession D (**Maps 3, & 4**). Rail lines are shown travelling through the project area after converging to the southeast.

A 1905 plan of the Town of North Bay by L.O. Clarke, Town Engineer shows the project area before the arrival of the Temiskaming and Northern Ontario railway yards. Toronto Street on the map is today Oak Street. This map shows the changes caused to the immediate surroundings of the project area after the arrival of the TNO head office and yards (**Maps 5 & 6**, Clarke 1905).

An undated, but presumably after 1908 and the completion of the TNO head office building, a map of North Bay by McAuslan and Anderson depicts the changes to the area brought about by the construction of the TNO rail complex. The project area and surroundings are all occupied by TNO lands, and Chippewa Creek's course has been straightened, the cartographer indicating its previous course with dotted lines (**Maps 7 & 8**, McAuslan & Anderson nd).

The 1915 Goad's Fire Insurance maps of North Bay do not indicate any structures within the project area, the nearest buildings belong to the Standard Planing Mills Ltd to the southeast. The Temiskaming and Northern Ontario rail lines run through the project area, stopping at the TNO's siding to the northwest (**Map 9**, Goad 1915: 9 & 13).

1.3.5 Summary of Historical Context

The Nipissing-North Bay region was used as a major transportation corridor, used first by explorers, then missionaries, and fur traders. Under French control, the First Nations were expected to transport their furs directly to the merchants in Montreal, and licence to trap and trade in the interior were strictly controlled, though there were some independent traders who ventured inland. Under the British, any citizen could obtain a licence to trade, and the earliest ones for the Nipissing area were granted in 1777.

One of the locally best known traders was Eustace LaRonde, who was operating on Lake

Nipissing by the late 18th Century. He was a member of a fur trading family that operated from the shores of Georgian Bay, to the Ottawa River, north to Lake Abitibi. By 1817 Eustace had constructed a home / trading post on Lake Nipissing at the mouth of the La Vase River. The amalgamation of the Hudson's Bay and Northwest Companies in 1821 changed the trading landscape, and that same year, Eustace LaRonde's trading post disappears from history. In that year the Hudson's Bay Company constructed a trading post on the north side of Lake Nipissing, at the mouth of the Sturgeon River, and Lake Nipissing operations were under the control of Eustace's half brother.

The railroad arrived in 1882, giving the impetus for the founding of North Bay. Three railroads would eventually intersect in the town, and it became a transit hub for goods and people travelling between the northern and southern parts of the province. North Bay became a shipping centre, as well as an industrial town processing the raw materials and metals shipped from further north. It became a town in 1891 and a city in 1925.

Lot 20, Concession D was the focus of initial development of North Bay. The arrival of the railroads, the Temiskaming and Northern Ontario in particular, whose rail yards and associated buildings demolished much of the earlier structures near and within the project area.

1.4 Archaeological Context

1.4.1 Current Conditions

The project area measures approximately 30 metres northeast-southwest along the course of Chippewa Creek, by 18 metres north-south, and is located approximately 66 metres southwest of the intersection of Oak and Main Streets, and 370 metres from the current mouth of Chippewa Creek in the City of North Bay. It is comprised of Chippewa Creek and its banks, a pedestrian bridge scheduled for replacement or refurbishment, and an abandoned railway bridge (**Figures 3-12**). The banks are overgrown with weeds and a few small trees and bushes, and slope steeply or nearly vertically to the creek where the bridge abutments have not been built into the sides of the watercourse (**Figures 3-7**).

The project area links Oak Street sidewalks to the Kinsmen Way Trail which borders the project area on the south side (**Figures 13-15**). A parking lot belonging to an apartment complex forms the border on the northwest, and a parking lot and private home/business is located on the southeast corner. Chippewa Creek has been straightened when its modern course is compared with earlier maps.

1.4.2 Physiography

The project area is located within the Algonquin Highlands physiographic region. Most of this region is underlain by the Precambrian rocks of the Canadian Shield which consists of uneven ground, outcrops of bare rock, rounded rock knobs and ridges up to 150 metres high (Chapman and Putnam 1984: 211). In between the areas of surface rock bogs and swamps often occur, with other areas containing moulded till plains that are suitable for agriculture. Depending on soil conditions, there is maple, birch, pines, fir and hemlock trees where the soil is deeper, while spruce and cedar occupy the wet areas (Chapman and Putnam 1984: 211).

Soils in this region are relatively shallow, sandy, stony and acidic (Chapman and Putnam 1984: 211). Within the project area, soils are classified as Rockland and Monteagle Sandy loam. Rockland soils are comprised of thin soils over top of Pre-Cambrian rock. Monteagle Sandy loam is a very stony sandy loam of Pre-Cambrian origin with good drainage, most commonly found in areas of moderately to strongly rolling topography.

1.4.3 Previous Archaeological Assessments

No previous archaeological assessments have taken place within 50 metres of the current project boundaries.

1.4.4 Registered Archaeological Sites and Heritage Structures

A request of the MTCS data base yielded one site within 2 kilometres of the project area. Site CbGu-44, located on the shore of Delaney Lake to the northeast of the project area had no further information save its Borden Number.

The former headquarters of the Temiskaming and Northern Ontario Railway are located approximately 300 metres northwest of the project area. The building was transformed into a telecommunications centre after Ontario Northland constructed a new head office building (Municipal Heritage Committee 2015: 26). It was sold in 2018 to a private buyer (Aube 2018). A Provincial Plaque celebrating the creation of the railway is located near the front door of the building.

Just over a kilometre to the northwest is the Canadian Pacific Train Station. Replacing two earlier CPR stations, the existing structure was built in 1903, when North Bay was a major hub for the CPR (Municipal Heritage Committee 2015:9). It now serves as North Bay’s museum.

2.0 Field Methods

Stage 1 assessment included a site inspection, with no ground being disturbed, nor collection of archaeological resources if any were encountered. Aside from the review of the available literature to discern archaeological potential and previous historic land use, the assessment hoped to determine the areas which may have been too badly disturbed to still potential contain cultural values. This information was used to determine what survey strategies would be appropriate for a Stage 2 assessment, should it be required.

Located in the District of Nipissing, the project area qualifies for Sections 1.3.3: Alternatives for potential evaluation in special conditions: Canadian Shield, and 2.1.5: Alternative Strategies for special survey conditions: Test pit survey in northern Ontario and on Canadian Shield terrain. Section 2.1.5 does not require test pitting beyond 50m of a modern watercourse. If there are features of high potential other than a modern water source, such as glacial shore lines, test pits are to be dug at 5 metre intervals up to 50 metres from the feature of high potential, and at 10 metre intervals from 50 to 150 metres. No assessment is required beyond 150 metres (Standard 2.1.5.2, MTCS 2011: 35).

The site inspection systematically covered the entirety of the project area on October 18th 2018, and was sufficient to identify any archaeological potential. As per Section 1.2.2 of the Standards and Guidelines for Consultant Archaeologists, conditions permitted good visibility of land features during the site inspection. The temperature during on the day of the site inspection was between 3°C, sunny, with intermittent cloud. No restrictions were placed on the fieldwork. All photographs and reference points were recorded using a WAAS enabled Magellan eXplorist 610 GPS, using the NAD 83 datum.

Approximately 40% of the property composed of a narrow band of creek bank, 30% is Chippewa Creek, 20% is composed of the rail and pedestrian bridges, and 10% pavement, either parking lot, community trails, or sidewalks (**Map 10**). The creek course has been altered, and the banks disturbed through a century of development. The pedestrian bridge is currently closed to traffic, and the rail bridge has been separated from the existing rails to the south by the paved Kinsmen path, and to the north, the rail lines have been ripped up, and the apartment complex and parking lot separate it from the TNO head office building.

3.0 Analysis and Conclusions

3.1 Features Indicating Archaeological Potential

A number of factors are employed in determining archaeological potential. Criteria for pre-contact archaeological potential is focussed on physiographic variables that include distance from the nearest source of water; the nature of that source; distinguishing features in the landscape (e.g., ridges, knolls, eskers, wetlands); the types of soils found within the area of the assessment and resource availability. Also considered are known archaeological sites within or the vicinity of the study area.

Chippewa Creek bisects the study area flowing in a roughly northeast to southwest direction, and

Lake Nipissing is over 300 metres to the west. Chippewa Creek's course, however appears to have been canalised or straightened between the project area and Lake Nipissing. There are no sites within the project area, however, there is 1 site registered within 2 kilometres.

Land registry records , assessment rolls, census, historic maps and aerial photographs as well as a property inspection all assist in determining historical archaeological potential. Additionally, the proximity of historic transportation corridors such as roads, rail and water courses also affect the historic archaeological potential.

Lot 20, Concession D was the original area cleared by the first settler in North Bay, and became part of the downtown core of the community. Gazetteers from the decade after the founding of North Bay indicate an A. Mc Donald living on Lot 20, Concession D, and an "A. McDonald" was listed as an original settler in an early 20th Century history of North Bay. By the early 20th Century however, much of the earlier development in and around the study area had been demolished for the construction of the Temiskaming and Northern Ontario Railway headquarters and railyard to the northwest of the project area.

3.2 Conclusions

The area assessed has been disturbed and contains no further archaeological concerns.

4.0 Recommendations

Based on the results of the Stage 1 Archaeological Assessments it is recommended that:

1) All areas of the Chippewa Creek- Oak Street Channel Repair Project be cleared of any further archaeological concerns.

5.0 Advice on Compliance with Legislation

This report is filed with the Ministry of Culture as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c. 0.18. The report is reviewed to ensure that is complies with the standards and guidelines that are issued by the Ministry, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matter relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism and Culture, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Section 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such a time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the Ontario Heritage Act.

Should previously unknown or deeply buried archaeological resources by uncovered during development, they may be a new archaeological site and therefore subject to Section 48 (1) of the Ontario Heritage Act. The Proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologists to carry out archaeological fieldwork, in compliance with Section 48 (1) of the Ontario Heritage Act.

The Cemeteries Act, R.S.O. 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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7.0 Images

Figure 1: Detail of Duval's map of 1653 showing Lake Nipissing (7).

Figure 2: Segment of Sherrif's Map of 1831 showing Lake Nipissing.

Figure 3: Chippewa Creek from Project Area. Facing West.

Figure 4: Pedestrian Bridge. Facing Northeast.

Figure 5: Railway Bridge. Facing West.

Figure 6: Chippewa Creek Oak Street Repair Project Area, North Bank. Facing West.

Figure 7: Chippewa Creek- Oak Street Repair Project Area, North Bank Project Area, Disturbed. Facing West.

Figure 8: Chippewa Creek Oak Street Repair North Bank Project Area between Bridges. Facing Northwest.

Figure 9: Chippewa Creek Oak Street Repair, Project Area South Bank. Facing Southwest.

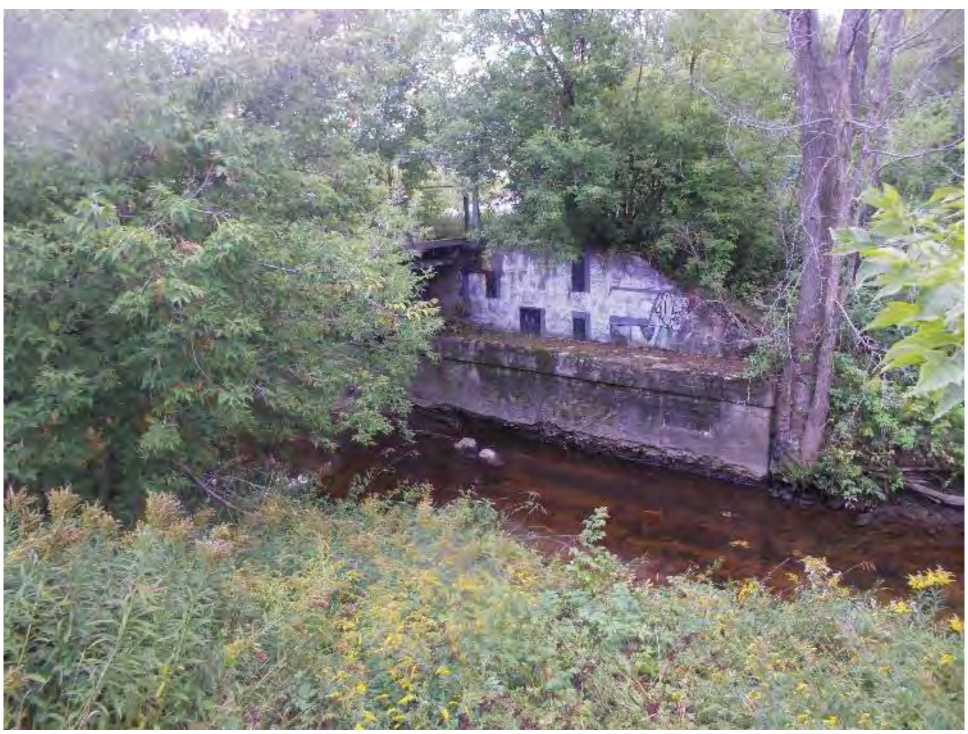


Figure 10: Railway Bridge Abutment, South Bank. Facing Southeast.

Figure 11: Pedestrian Bridge South Bank Bridge Abutment. Facing Southwest.

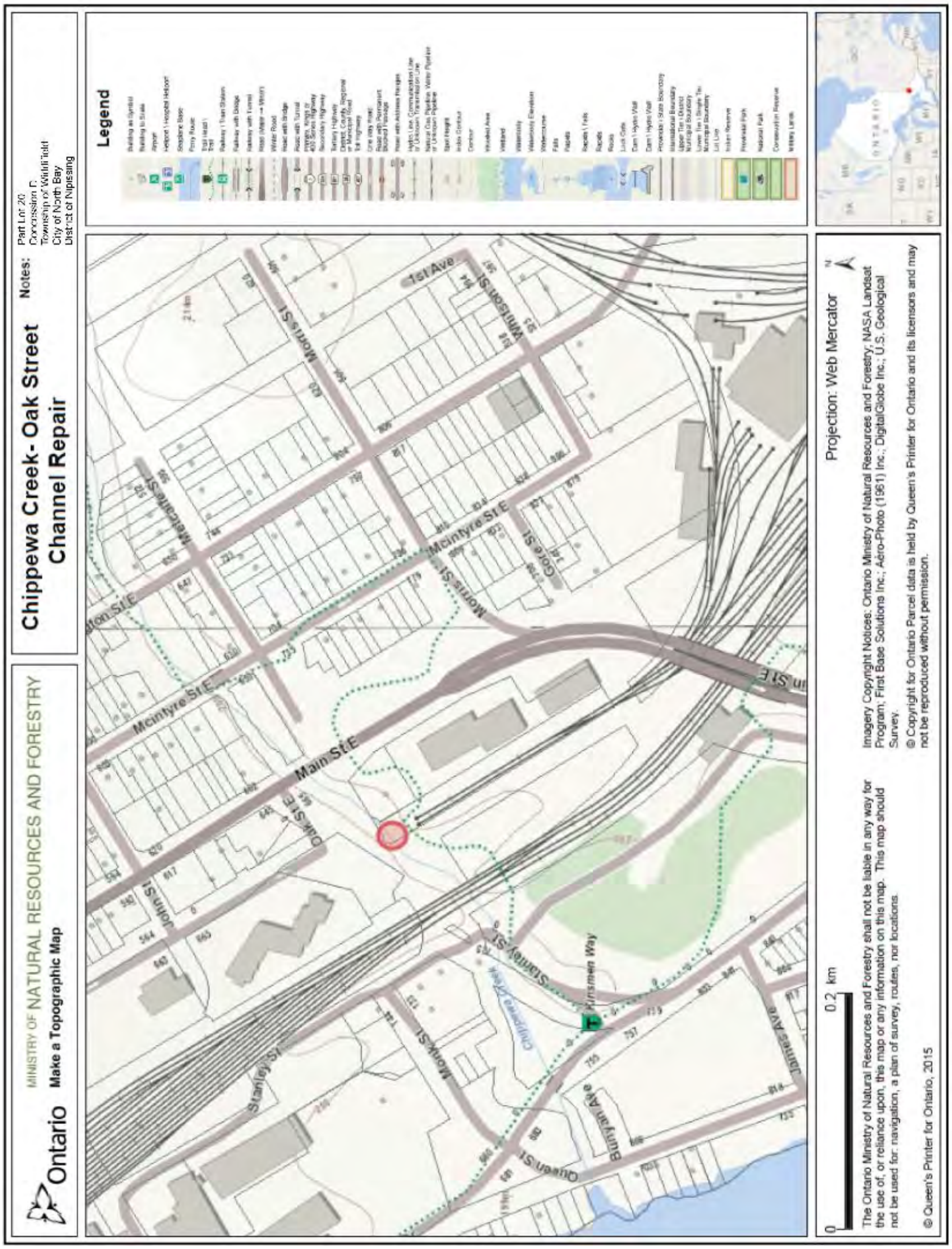
Figure 12: Chippewa Creek Oak Street Repair. South Bank Project Area. Note Exposed Concrete under the Ground Cover. Facing North.

Figure 13: Chippewa Creek Oak Street Repair Project Area from Oak Street Access. Facing Southwest.

Figure 14: Chippewa Creek Oak Street Repair, Southern Project Area Border. Facing West.

Figure 15: Chippewa Creek Oak Street Repair Southern Border from Kinsmen Trail. Facing Northeast.

9.0 Maps

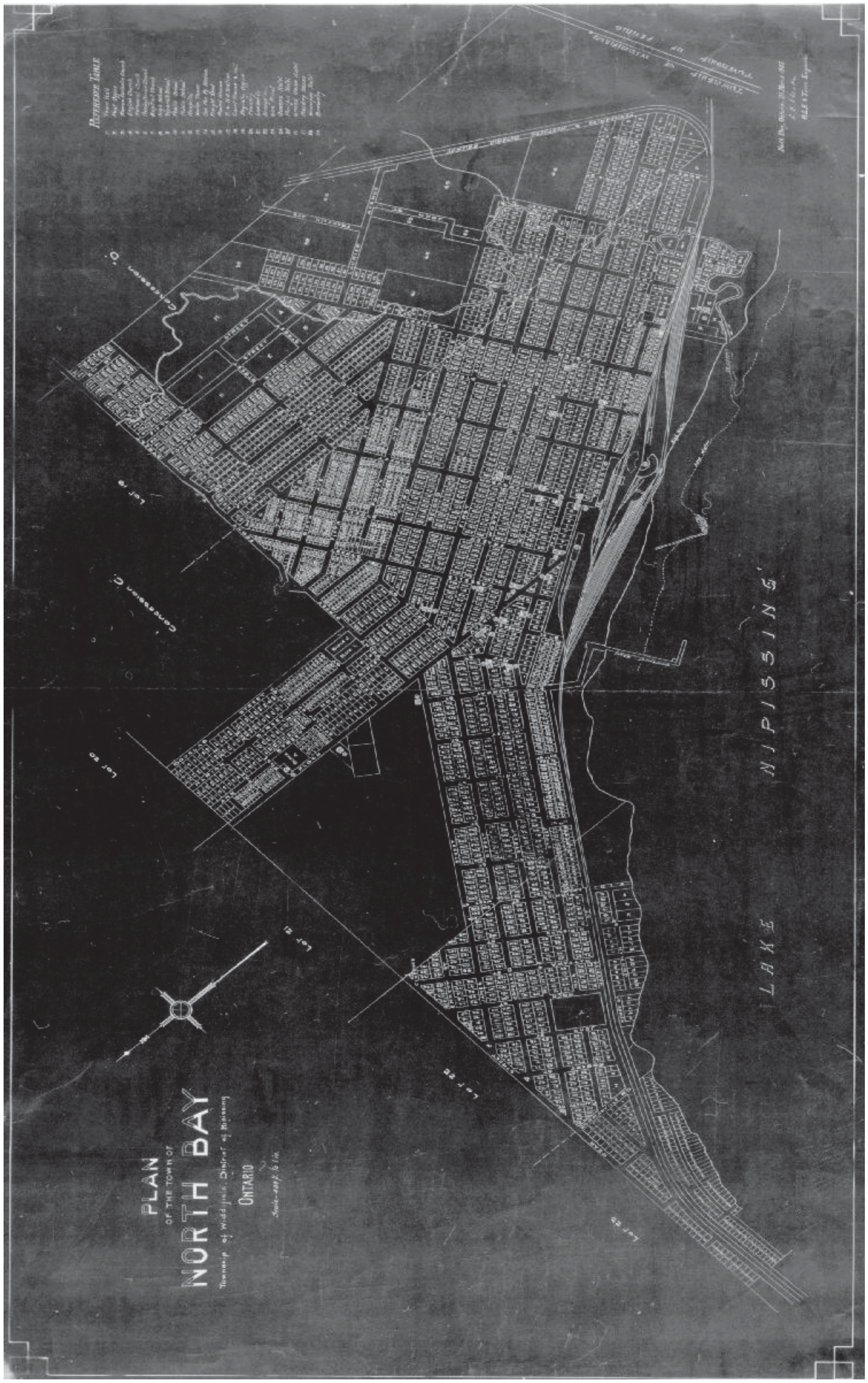


Map 1: Chippewa Creek- Oak Street Channel Repair Project Area Location.

Map 2: Chippewa Creek- Oak Street Channel Repair Development Map.

Map 3: Department of Crown Lands Patent Plan of Widdifield Township.

Map 4: Segment of Patent Plan of Widdifield Township. Project Area Outlined in Red.

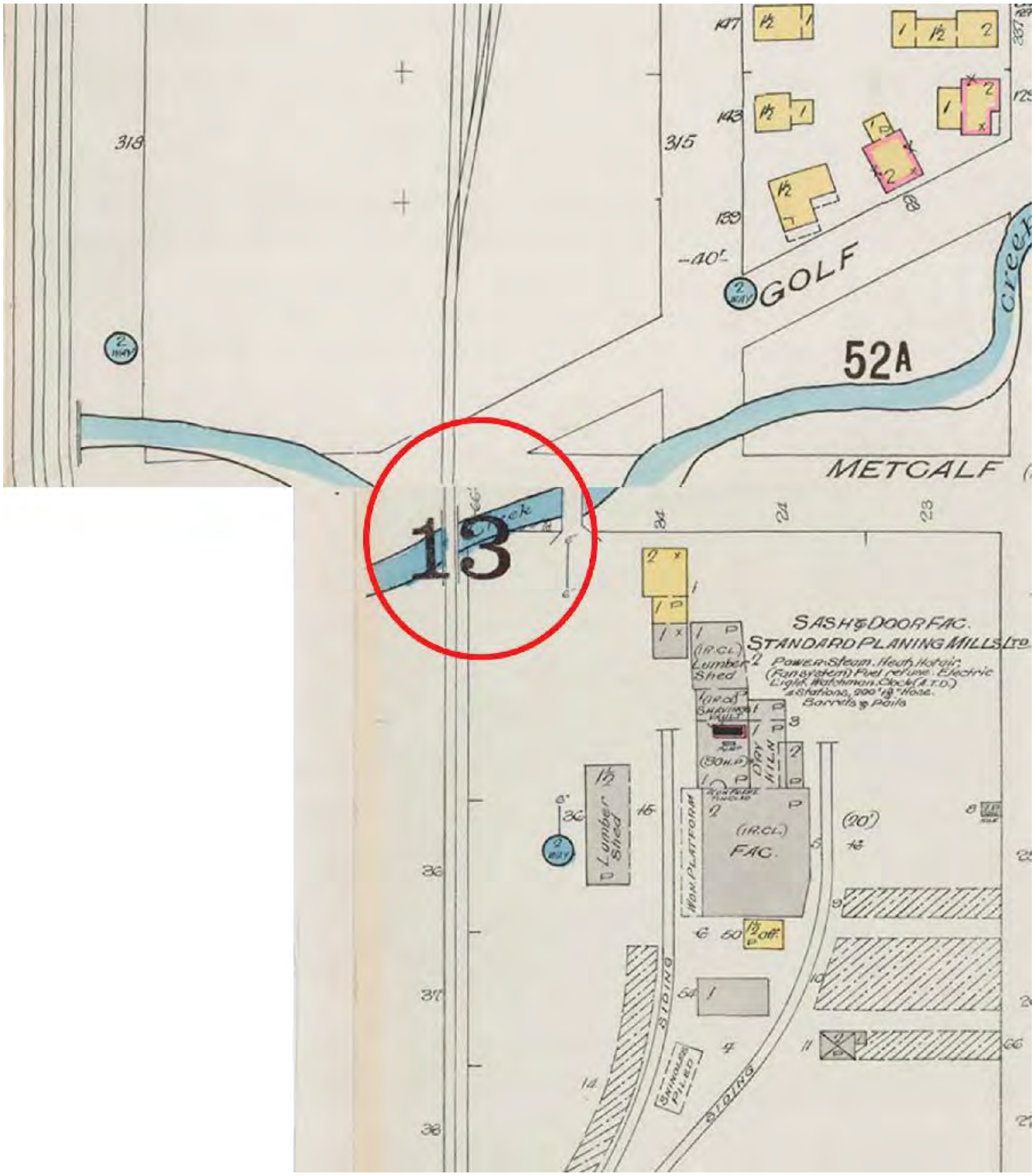


Map 5: 1905 Plan of the Town of North Bay.

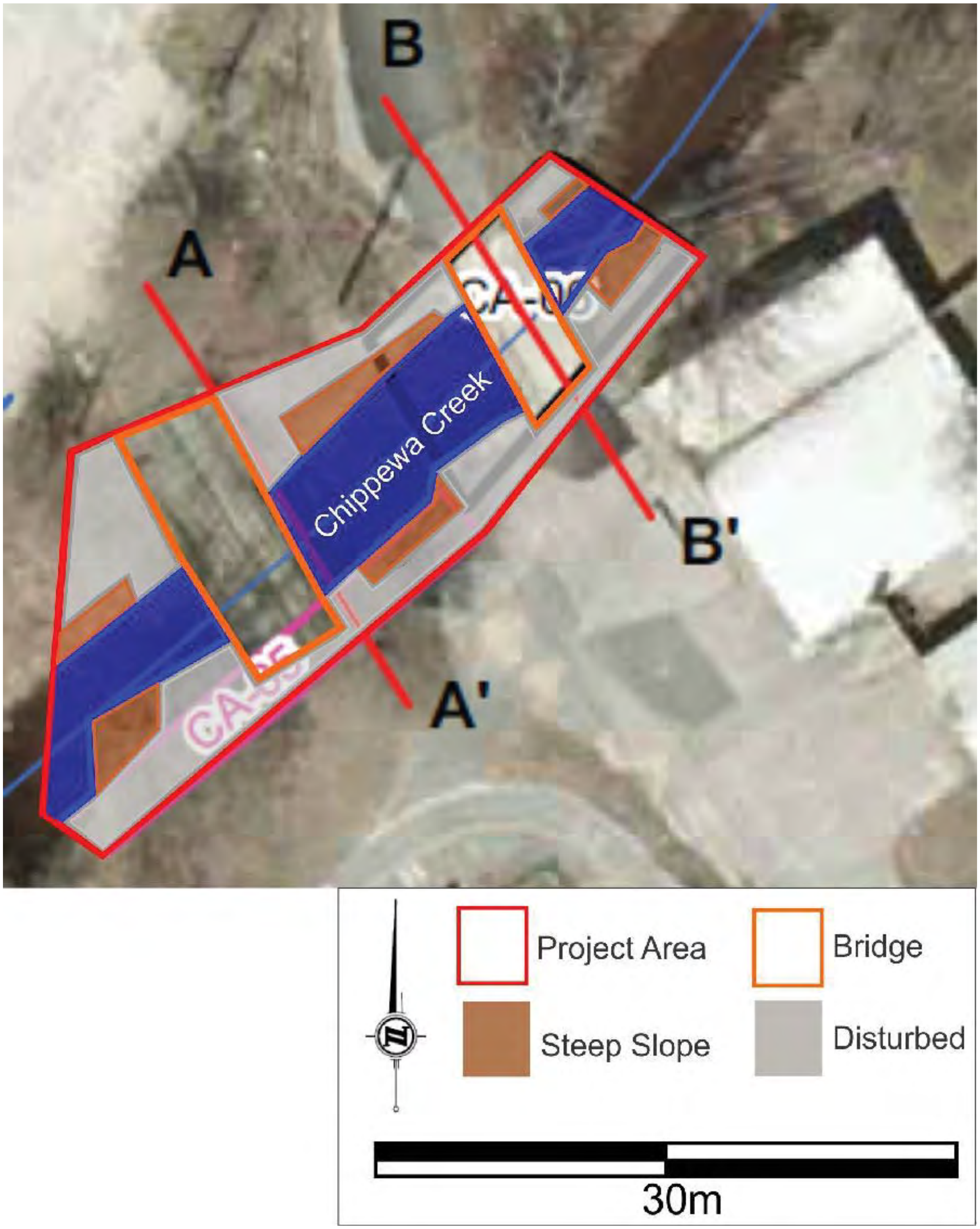
Map 6: Segment of 1905 Plan of Town of North Bay. Project Area Outlined in Red.

Map 7: Portion of McAuslin and Anderson's Map of North Bay.

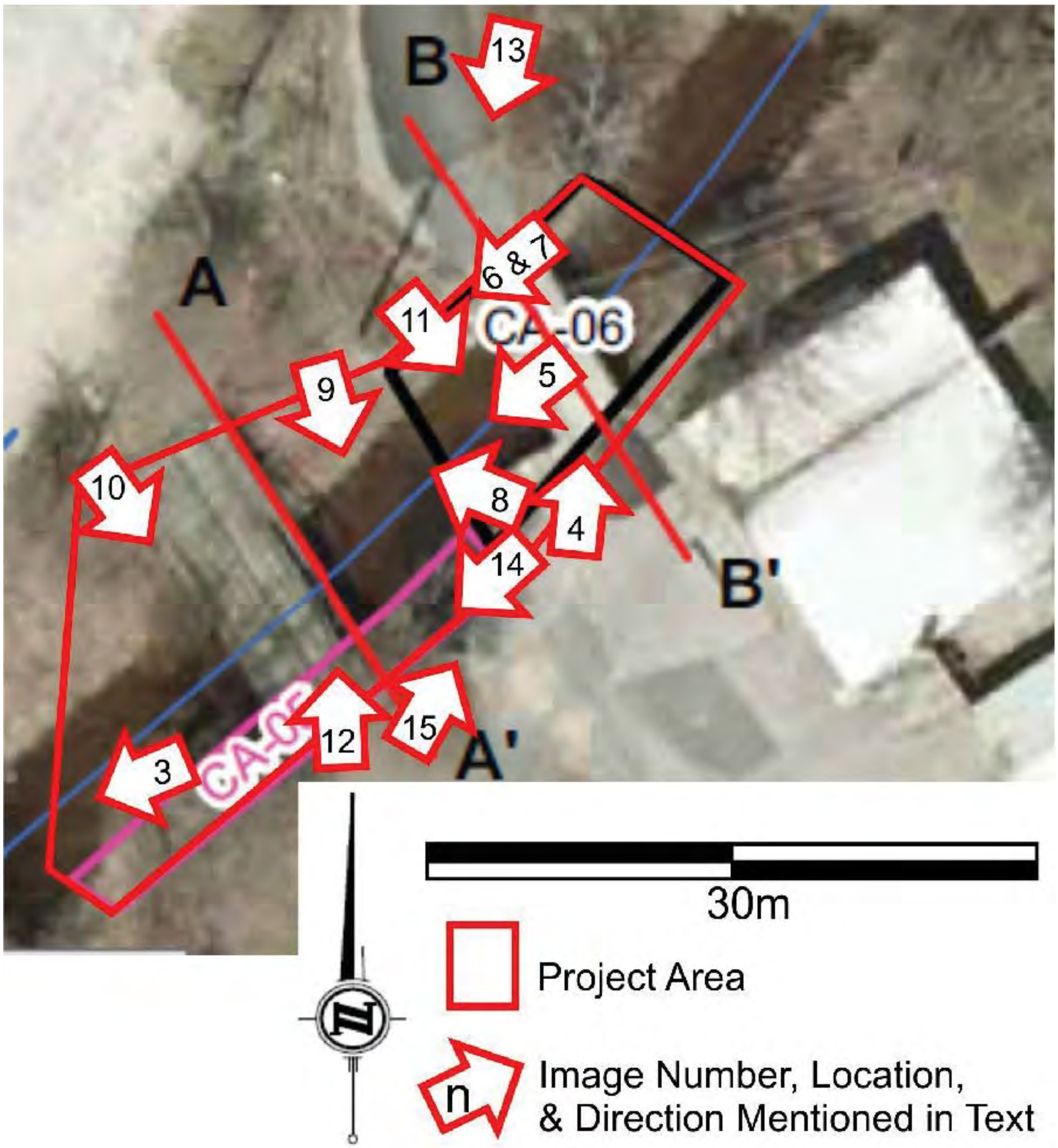
Map 8: Segment of McAuslin and Anderson Map. Project Area Outlined in Red.



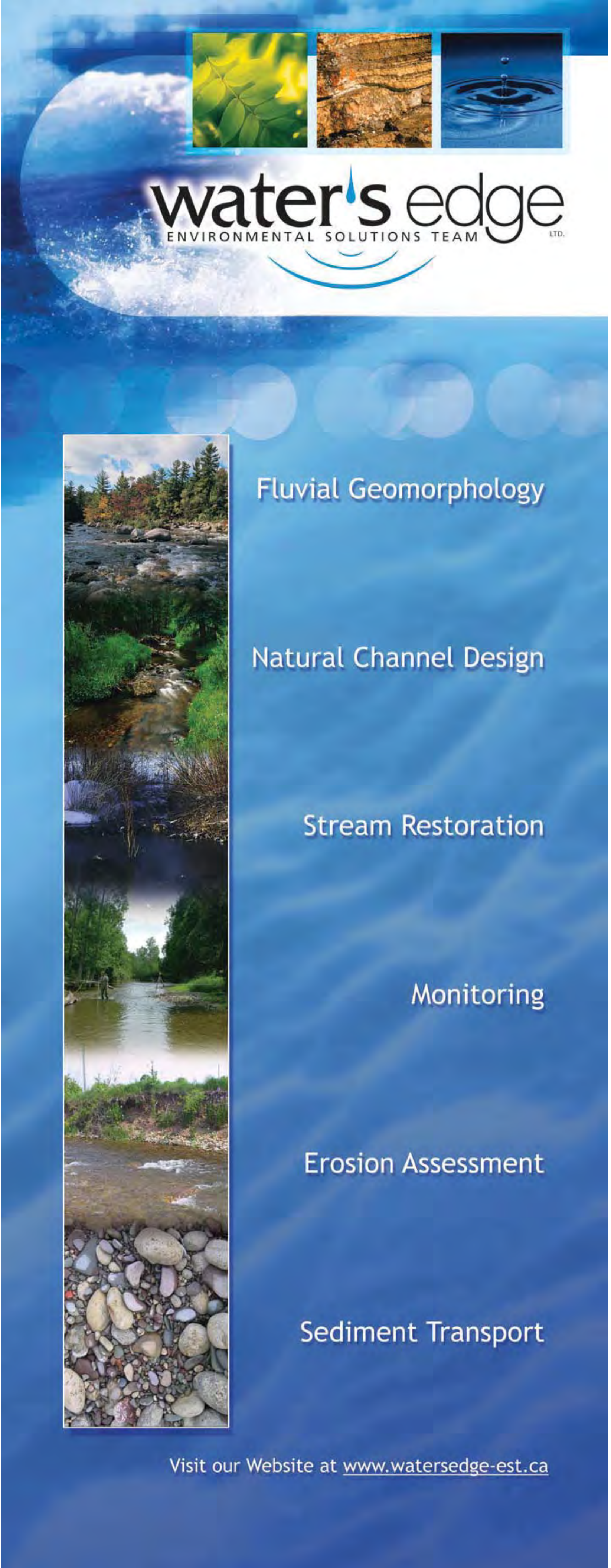
Map 9: Goad's 1915 Fire Insurance Map of North Bay, Composite of Pages 9 & 13. Project Area Outlined in Red.



Map 10: Chippewa Creek- Oak Street Channel Repair Project Area. Results of the Stage 1 Site Inspection. No further Archaeological Assessment is required.



Map 11: Image Number, Location, and Direction Mentioned in Text.



APPENDIX D:

HEC-RAS Summary Tables

Existing Conditions

River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
99.64	1.5yr	10.58	195.58	197.07		197.14	0.002143	1.22	8.7	9.19	0.4
99.64	5yr	20.06	195.58	197.65		197.75	0.001937	1.36	14.71	12.05	0.39
99.64	10yr	25.1	195.58	197.93		198.03	0.001791	1.36	18.46	14.41	0.38
99.64	20yr	30.83	195.58	198.24		198.33	0.001478	1.33	23.17	16.19	0.36
99.64	50yr	35.21	195.58	198.47		198.55	0.001254	1.31	27.42	23.12	0.33
99.64	100yr	40.59	195.58	198.78		198.86	0.000921	1.24	34.83	23.74	0.29
90.24	1.5yr	10.58	195.49	197.05		197.12	0.001847	1.16	9.11	9.06	0.37
90.24	5yr	20.06	195.49	197.64		197.73	0.001664	1.34	14.96	10.92	0.37
90.24	10yr	25.1	195.49	197.91		198.01	0.00154	1.39	18.11	11.8	0.36
90.24	20yr	30.83	195.49	198.21		198.31	0.001403	1.42	21.77	12.74	0.35
90.24	50yr	35.21	195.49	198.43		198.54	0.001276	1.43	24.95	19	0.33
90.24	100yr	40.59	195.49	198.75		198.84	0.001023	1.39	30.98	19.34	0.3
79.66	1.5yr	10.58	195.54	197.04		197.09	0.001563	1.05	10.12	10.77	0.34
79.66	5yr	20.06	195.54	197.63		197.7	0.001246	1.17	17.17	12.86	0.32
79.66	10yr	25.1	195.54	197.91		197.98	0.001119	1.2	20.89	13.75	0.31
79.66	20yr	30.83	195.54	198.21		198.29	0.001001	1.22	25.17	14.71	0.3
79.66	50yr	35.21	195.54	198.43		198.51	0.000908	1.23	28.77	20.31	0.29
79.66	100yr	40.59	195.54	198.75		198.82	0.000717	1.2	36.08	23.94	0.26
68.26	1.5yr	10.58	195.64	197		197.07	0.001731	1.17	9.05	8.29	0.36
68.26	5yr	20.06	195.64	197.58		197.68	0.001817	1.38	14.51	10.74	0.38
68.26	10yr	25.1	195.64	197.86		197.96	0.001692	1.42	17.68	11.93	0.37
68.26	20yr	30.83	195.64	198.16		198.27	0.001523	1.43	21.49	13.2	0.36
68.26	50yr	35.21	195.64	198.39		198.49	0.001378	1.43	24.6	15.21	0.35
68.26	100yr	40.59	195.64	198.71		198.81	0.001025	1.38	31.22	22.49	0.31
57.08	1.5yr	10.58	195.65	196.88	196.48	197.02	0.003111	1.69	6.26	7.71	0.51
57.08	5yr	20.06	195.65	197.34	196.85	197.6	0.003486	2.26	8.88	8.48	0.58
57.08	10yr	25.1	195.65	197.56	197.03	197.87	0.003543	2.48	10.11	8.76	0.59
57.08	20yr	30.83	195.65	197.79	197.21	198.16	0.003538	2.69	11.44	9.08	0.61
57.08	50yr	35.21	195.65	197.97	197.35	198.38	0.003485	2.83	12.45	9.43	0.61
57.08	100yr	40.59	195.65	198.27	197.51	198.69	0.003003	2.86	14.17	11	0.58
52.74		Bridge									
48.39	1.5yr	10.58	195.5	196.86		196.97	0.002361	1.49	7.12	6.51	0.44
48.39	5yr	20.06	195.5	197.32		197.53	0.002725	2	10.01	6.65	0.5
48.39	10yr	25.1	195.5	197.54		197.79	0.00279	2.21	11.37	6.72	0.52
48.39	20yr	30.83	195.5	197.78		198.07	0.002796	2.4	12.86	9.11	0.53
48.39	50yr	35.21	195.5	197.96		198.28	0.002759	2.52	13.98	11.1	0.54
48.39	100yr	40.59	195.5	198.27		198.6	0.002376	2.55	15.93	13.2	0.51
37.6	1.5yr	10.58	195.49	196.86	196.24	196.93	0.001328	1.18	8.96	9.32	0.34
37.6	5yr	20.06	195.49	197.34	196.55	197.47	0.001593	1.61	12.46	10.67	0.39
37.6	10yr	25.1	195.49	197.56	196.7	197.72	0.001647	1.78	14.11	12.01	0.41
37.6	20yr	30.83	195.49	197.81	196.86	198	0.001664	1.94	15.91	12.47	0.42
37.6	50yr	35.21	195.49	197.99	196.97	198.21	0.001651	2.04	17.27	13.58	0.42
37.6	100yr	40.59	195.49	198.31	197.1	198.5	0.003574	1.95	20.81	14.33	0.52
32.62		Bridge									
27.64	1.5yr	10.58	195.64	196.69		196.87	0.005094	1.9	5.58	6.96	0.64
27.64	5yr	20.06	195.64	197.02		197.37	0.006532	2.64	7.61	9.15	0.76
27.64	10yr	25.1	195.64	197.16		197.61	0.007091	2.96	8.49	9.78	0.81
27.64	20yr	30.83	195.64	197.28	197.15	197.85	0.008089	3.34	9.23	10.22	0.87
27.64	50yr	35.21	195.64	197.34	197.27	198.03	0.009295	3.67	9.59	10.52	0.94
27.64	100yr	40.59	195.64	197.42	197.42	198.25	0.010408	4.02	10.09	11.09	1.01
19.89	1.5yr	10.58	195.6	196.56		196.8	0.009975	2.2	4.82	6.39	0.81
19.89	5yr	20.06	195.6	196.96	196.83	197.31	0.010466	2.63	7.62	7.91	0.86

19.89	10yr	25.1	195.6	197.12	197.01	197.52	0.010774	2.81	8.94	8.6	0.88
19.89	20yr	30.83	195.6	197.26	197.18	197.72	0.011394	3.01	10.23	9.23	0.91
19.89	50yr	35.21	195.6	197.34	197.29	197.86	0.012453	3.22	10.93	9.56	0.96
19.89	100yr	40.59	195.6	197.42	197.42	198.03	0.013521	3.44	11.8	9.95	1.01
11.12	1.5yr	10.58	195.3	196.57		196.69	0.004081	1.53	6.92	8.48	0.54
11.12	5yr	20.06	195.3	196.99		197.16	0.004449	1.82	11.03	11.15	0.58
11.12	10yr	25.1	195.3	197.16		197.35	0.004584	1.92	13.09	12.52	0.6
11.12	20yr	30.83	195.3	197.33		197.54	0.004515	2.03	15.18	13.11	0.6
11.12	50yr	35.21	195.3	197.42		197.65	0.004722	2.15	16.39	13.44	0.62
11.12	100yr	40.59	195.3	197.52		197.78	0.005008	2.29	17.74	13.8	0.64
0	1.5yr	10.58	195.31	196.41	196.27	196.6	0.008006	1.93	5.48	7.79	0.74
0	5yr	20.06	195.31	196.81	196.6	197.07	0.008005	2.25	8.91	10.01	0.76
0	10yr	25.1	195.31	196.98	196.77	197.26	0.007995	2.35	10.69	11.31	0.77
0	20yr	30.83	195.31	197.16	196.93	197.45	0.008008	2.37	12.99	13.65	0.78
0	50yr	35.21	195.31	197.26	197.05	197.57	0.008001	2.45	14.37	14.39	0.78
0	100yr	40.59	195.31	197.36	197.18	197.69	0.00801	2.57	15.81	14.73	0.79

Proposed Conditions (Option 4b)

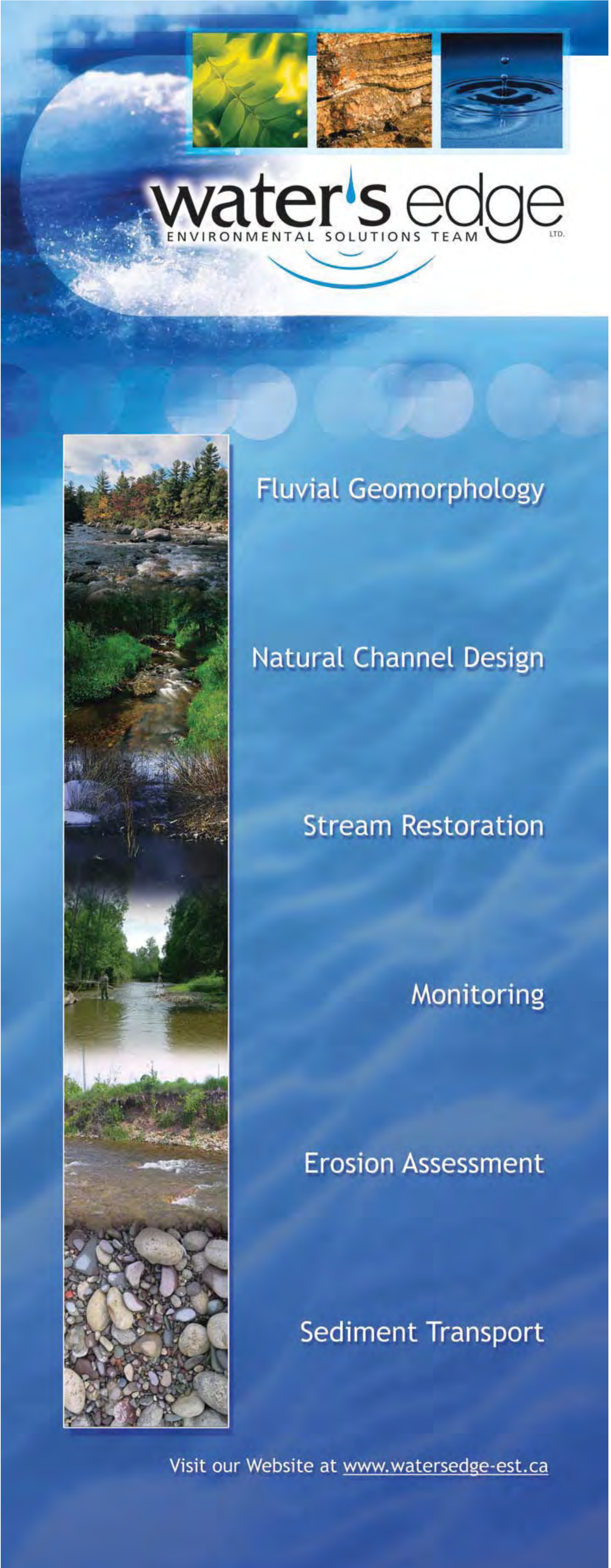
River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
99.64	1.5yr	10.58	195.58	196.98		197.07	0.002812	1.34	7.91	8.9	0.45
99.64	5yr	20.06	195.58	197.49		197.61	0.002577	1.56	12.87	10.65	0.45
99.64	10yr	25.1	195.58	197.7		197.84	0.002794	1.64	15.3	12.53	0.47
99.64	20yr	30.83	195.58	197.93		198.07	0.002726	1.68	18.39	14.37	0.47
99.64	50yr	35.21	195.58	198.1		198.24	0.002544	1.69	20.89	15.38	0.46
99.64	100yr	40.59	195.58	198.29		198.44	0.002343	1.69	23.95	16.47	0.45
90.24	1.5yr	10.58	195.49	196.96		197.04	0.002414	1.28	8.28	8.76	0.42
90.24	5yr	20.06	195.49	197.47		197.58	0.002378	1.53	13.15	10.38	0.43
90.24	10yr	25.1	195.49	197.68		197.81	0.002405	1.63	15.4	11.05	0.44
90.24	20yr	30.83	195.49	197.89		198.05	0.002405	1.72	17.88	11.74	0.45
90.24	50yr	35.21	195.49	198.05		198.21	0.002383	1.78	19.77	12.23	0.45
90.24	100yr	40.59	195.49	198.23		198.41	0.002354	1.84	22.03	12.81	0.45
79.66	1.5yr	10.58	195.54	196.94		197.01	0.00211	1.16	9.08	10.32	0.4
79.66	5yr	20.06	195.54	197.46		197.55	0.001841	1.34	14.98	12.31	0.39
79.66	10yr	25.1	195.54	197.67		197.77	0.001798	1.42	17.67	12.99	0.39
79.66	20yr	30.83	195.54	197.89		198.01	0.001754	1.5	20.61	13.69	0.39
79.66	50yr	35.21	195.54	198.05		198.17	0.001716	1.54	22.83	14.19	0.39
79.66	100yr	40.59	195.54	198.23		198.36	0.001676	1.59	25.48	14.78	0.39
68.26	1.5yr	10.58	195.64	196.91		196.98	0.002086	1.21	8.72	9.04	0.39
68.26	5yr	20.06	195.64	197.41		197.52	0.002172	1.47	13.67	10.85	0.42
68.26	10yr	25.1	195.64	197.62		197.74	0.002228	1.57	16.01	11.7	0.43
68.26	20yr	30.83	195.64	197.84		197.97	0.002227	1.65	18.64	12.54	0.43
68.26	50yr	35.21	195.64	197.99		198.14	0.002198	1.7	20.67	13.16	0.43
68.26	100yr	40.59	195.64	198.18		198.33	0.002157	1.75	23.13	13.86	0.43
57.08	1.5yr	10.58	195.65	196.89	196.31	196.96	0.001683	1.13	9.71	10.09	0.34
57.08	5yr	20.06	195.65	197.39	196.62	197.5	0.001807	1.45	14.98	11.09	0.37
57.08	10yr	25.1	195.65	197.59	196.76	197.72	0.001874	1.6	17.3	11.65	0.38
57.08	20yr	30.83	195.65	197.8	196.91	197.95	0.001955	1.75	19.72	12.17	0.4
57.08	50yr	35.21	195.65	197.94	197.01	198.11	0.001996	1.86	21.52	12.6	0.4
57.08	100yr	40.59	195.65	198.11	197.13	198.3	0.002044	1.98	23.68	13.33	0.41
52.74		Bridge									
48.39	1.5yr	10.58	195.5	196.87		196.94	0.001764	1.18	9.32	9.33	0.35
48.39	5yr	20.06	195.5	197.36		197.48	0.002054	1.55	14.13	10.46	0.38
48.39	10yr	25.1	195.5	197.55		197.7	0.002231	1.71	16.23	10.92	0.4
48.39	20yr	30.83	195.5	197.75		197.92	0.002431	1.89	18.41	11.42	0.42
48.39	50yr	35.21	195.5	197.89		198.08	0.002555	2	20.04	11.81	0.43

48.39	100yr	40.59	195.5	198.05		198.27	0.002676	2.14	21.97	12.34	0.45
37.6	1.5yr	10.58	195.49	196.86		196.92	0.0014	1.07	10.18	9.89	0.31
37.6	5yr	20.06	195.49	197.35		197.45	0.001657	1.42	15.23	10.94	0.35
37.6	10yr	25.1	195.49	197.54		197.67	0.001809	1.58	17.43	11.37	0.37
37.6	20yr	30.83	195.49	197.74		197.89	0.00198	1.74	19.68	11.79	0.39
37.6	50yr	35.21	195.49	197.88		198.05	0.002087	1.85	21.36	12.09	0.4
37.6	100yr	40.59	195.49	198.04		198.23	0.002208	1.98	23.33	12.45	0.41
27.64	1.5yr	10.58	195.64	196.79		196.89	0.003148	1.39	7.63	8.82	0.46
27.64	5yr	20.06	195.64	197.26		197.41	0.003039	1.73	11.99	9.79	0.47
27.64	10yr	25.1	195.64	197.44		197.62	0.003196	1.91	13.82	10.16	0.49
27.64	20yr	30.83	195.64	197.62		197.84	0.003415	2.1	15.68	10.53	0.5
27.64	50yr	35.21	195.64	197.75		198	0.003546	2.22	17.06	10.8	0.52
27.64	100yr	40.59	195.64	197.9		198.17	0.003702	2.36	18.67	11.1	0.53
19.89	1.5yr	10.58	195.6	196.56		196.8	0.009975	2.2	4.82	6.39	0.81
19.89	5yr	20.06	195.6	196.96	196.83	197.31	0.010464	2.63	7.62	7.91	0.86
19.89	10yr	25.1	195.6	197.12	197.01	197.52	0.01077	2.81	8.94	8.6	0.88
19.89	20yr	30.83	195.6	197.26	197.18	197.72	0.01139	3.01	10.23	9.23	0.91
19.89	50yr	35.21	195.6	197.34	197.29	197.86	0.012446	3.22	10.94	9.56	0.96
19.89	100yr	40.59	195.6	197.42	197.42	198.03	0.013521	3.44	11.8	9.95	1.01
11.12	1.5yr	10.58	195.3	196.57		196.69	0.004081	1.53	6.92	8.48	0.54
11.12	5yr	20.06	195.3	196.99		197.16	0.004448	1.82	11.03	11.15	0.58
11.12	10yr	25.1	195.3	197.16		197.35	0.004582	1.92	13.09	12.52	0.6
11.12	20yr	30.83	195.3	197.33		197.54	0.004513	2.03	15.18	13.11	0.6
11.12	50yr	35.21	195.3	197.42		197.65	0.004719	2.15	16.4	13.44	0.62
11.12	100yr	40.59	195.3	197.52		197.78	0.005007	2.29	17.74	13.8	0.64
0	1.5yr	10.58	195.31	196.41	196.27	196.6	0.008006	1.93	5.48	7.79	0.74
0	5yr	20.06	195.31	196.81	196.6	197.07	0.008005	2.25	8.91	10.01	0.76
0	10yr	25.1	195.31	196.98	196.77	197.26	0.007995	2.35	10.69	11.31	0.77
0	20yr	30.83	195.31	197.16	196.93	197.45	0.008008	2.37	12.99	13.65	0.78
0	50yr	35.21	195.31	197.26	197.05	197.57	0.008001	2.45	14.37	14.39	0.78
0	100yr	40.59	195.31	197.36	197.18	197.69	0.00801	2.57	15.81	14.73	0.79

Additional Option from ONTC

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
99.64	1.5yr	10.58	195.58	196.98		197.07	0.002812	1.34	7.91	8.9	0.45
99.64	5yr	20.06	195.58	197.49		197.61	0.002577	1.56	12.87	10.65	0.45
99.64	10yr	25.1	195.58	197.7		197.84	0.002794	1.64	15.3	12.53	0.47
99.64	20yr	30.83	195.58	197.93		198.07	0.002726	1.68	18.39	14.37	0.47
99.64	50yr	35.21	195.58	198.1		198.24	0.002544	1.69	20.89	15.38	0.46
99.64	100yr	40.59	195.58	198.29		198.44	0.002343	1.69	23.95	16.47	0.45
90.24	1.5yr	10.58	195.49	196.96		197.04	0.002414	1.28	8.28	8.76	0.42
90.24	5yr	20.06	195.49	197.47		197.58	0.002378	1.53	13.15	10.38	0.43
90.24	10yr	25.1	195.49	197.68		197.81	0.002405	1.63	15.4	11.05	0.44
90.24	20yr	30.83	195.49	197.89		198.05	0.002405	1.72	17.88	11.74	0.45
90.24	50yr	35.21	195.49	198.05		198.21	0.002383	1.78	19.77	12.23	0.45
90.24	100yr	40.59	195.49	198.23		198.41	0.002354	1.84	22.03	12.81	0.45
79.66	1.5yr	10.58	195.54	196.94		197.01	0.00211	1.16	9.08	10.32	0.4
79.66	5yr	20.06	195.54	197.46		197.55	0.001841	1.34	14.98	12.31	0.39
79.66	10yr	25.1	195.54	197.67		197.77	0.001798	1.42	17.67	12.99	0.39
79.66	20yr	30.83	195.54	197.89		198.01	0.001754	1.5	20.61	13.69	0.39
79.66	50yr	35.21	195.54	198.05		198.17	0.001716	1.54	22.83	14.19	0.39
79.66	100yr	40.59	195.54	198.23		198.36	0.001676	1.59	25.48	14.78	0.39
68.26	1.5yr	10.58	195.64	196.91		196.98	0.002086	1.21	8.72	9.04	0.39
68.26	5yr	20.06	195.64	197.41		197.52	0.002172	1.47	13.67	10.85	0.42
68.26	10yr	25.1	195.64	197.62		197.74	0.002228	1.57	16.01	11.7	0.43

68.26	20yr	30.83	195.64	197.84		197.97	0.002227	1.65	18.64	12.54	0.43
68.26	50yr	35.21	195.64	197.99		198.14	0.002198	1.7	20.67	13.16	0.43
68.26	100yr	40.59	195.64	198.18		198.33	0.002157	1.75	23.13	13.86	0.43
57.08	1.5yr	10.58	195.65	196.89	196.31	196.96	0.001683	1.13	9.71	10.09	0.34
57.08	5yr	20.06	195.65	197.39	196.62	197.5	0.001807	1.45	14.98	11.09	0.37
57.08	10yr	25.1	195.65	197.59	196.76	197.72	0.001874	1.6	17.3	11.65	0.38
57.08	20yr	30.83	195.65	197.8	196.91	197.95	0.001955	1.75	19.72	12.17	0.4
57.08	50yr	35.21	195.65	197.94	197.01	198.11	0.001996	1.86	21.52	12.6	0.4
57.08	100yr	40.59	195.65	198.11	197.13	198.3	0.002044	1.98	23.68	13.33	0.41
52.74		Bridge									
48.39	1.5yr	10.58	195.5	196.87		196.94	0.001764	1.18	9.32	9.33	0.35
48.39	5yr	20.06	195.5	197.36		197.48	0.002054	1.55	14.13	10.46	0.38
48.39	10yr	25.1	195.5	197.55		197.7	0.002231	1.71	16.23	10.92	0.4
48.39	20yr	30.83	195.5	197.75		197.92	0.002431	1.89	18.41	11.42	0.42
48.39	50yr	35.21	195.5	197.89		198.08	0.002555	2	20.04	11.81	0.43
48.39	100yr	40.59	195.5	198.05		198.27	0.002676	2.14	21.97	12.34	0.45
37.6	1.5yr	10.58	195.49	196.86		196.92	0.0014	1.07	10.18	9.89	0.31
37.6	5yr	20.06	195.49	197.35		197.45	0.001657	1.42	15.23	10.94	0.35
37.6	10yr	25.1	195.49	197.54		197.67	0.001809	1.58	17.43	11.37	0.37
37.6	20yr	30.83	195.49	197.74		197.89	0.00198	1.74	19.68	11.79	0.39
37.6	50yr	35.21	195.49	197.88		198.05	0.002087	1.85	21.36	12.09	0.4
37.6	100yr	40.59	195.49	198.04		198.23	0.002208	1.98	23.33	12.45	0.41
27.64	1.5yr	10.58	195.64	196.79		196.89	0.003148	1.39	7.63	8.82	0.46
27.64	5yr	20.06	195.64	197.26		197.41	0.003039	1.73	11.99	9.79	0.47
27.64	10yr	25.1	195.64	197.44		197.62	0.003196	1.91	13.82	10.16	0.49
27.64	20yr	30.83	195.64	197.62		197.84	0.003415	2.1	15.68	10.53	0.5
27.64	50yr	35.21	195.64	197.75		198	0.003546	2.22	17.06	10.8	0.52
27.64	100yr	40.59	195.64	197.9		198.17	0.003702	2.36	18.67	11.1	0.53
19.89	1.5yr	10.58	195.6	196.56		196.8	0.009975	2.2	4.82	6.39	0.81
19.89	5yr	20.06	195.6	196.96	196.83	197.31	0.010464	2.63	7.62	7.91	0.86
19.89	10yr	25.1	195.6	197.12	197.01	197.52	0.01077	2.81	8.94	8.6	0.88
19.89	20yr	30.83	195.6	197.26	197.18	197.72	0.01139	3.01	10.23	9.23	0.91
19.89	50yr	35.21	195.6	197.34	197.29	197.86	0.012446	3.22	10.94	9.56	0.96
19.89	100yr	40.59	195.6	197.42	197.42	198.03	0.013521	3.44	11.8	9.95	1.01
11.12	1.5yr	10.58	195.3	196.57		196.69	0.004081	1.53	6.92	8.48	0.54
11.12	5yr	20.06	195.3	196.99		197.16	0.004448	1.82	11.03	11.15	0.58
11.12	10yr	25.1	195.3	197.16		197.35	0.004582	1.92	13.09	12.52	0.6
11.12	20yr	30.83	195.3	197.33		197.54	0.004513	2.03	15.18	13.11	0.6
11.12	50yr	35.21	195.3	197.42		197.65	0.004719	2.15	16.4	13.44	0.62
11.12	100yr	40.59	195.3	197.52		197.78	0.005007	2.29	17.74	13.8	0.64
0	1.5yr	10.58	195.31	196.41	196.27	196.6	0.008006	1.93	5.48	7.79	0.74
0	5yr	20.06	195.31	196.81	196.6	197.07	0.008005	2.25	8.91	10.01	0.76
0	10yr	25.1	195.31	196.98	196.77	197.26	0.007995	2.35	10.69	11.31	0.77
0	20yr	30.83	195.31	197.16	196.93	197.45	0.008008	2.37	12.99	13.65	0.78
0	50yr	35.21	195.31	197.26	197.05	197.57	0.008001	2.45	14.37	14.39	0.78
0	100yr	40.59	195.31	197.36	197.18	197.69	0.00801	2.57	15.81	14.73	0.79



APPENDIX E:

Preliminary Design Drawings of Preferred Alternative

EXISTING CONDITIONS & REMOVALS

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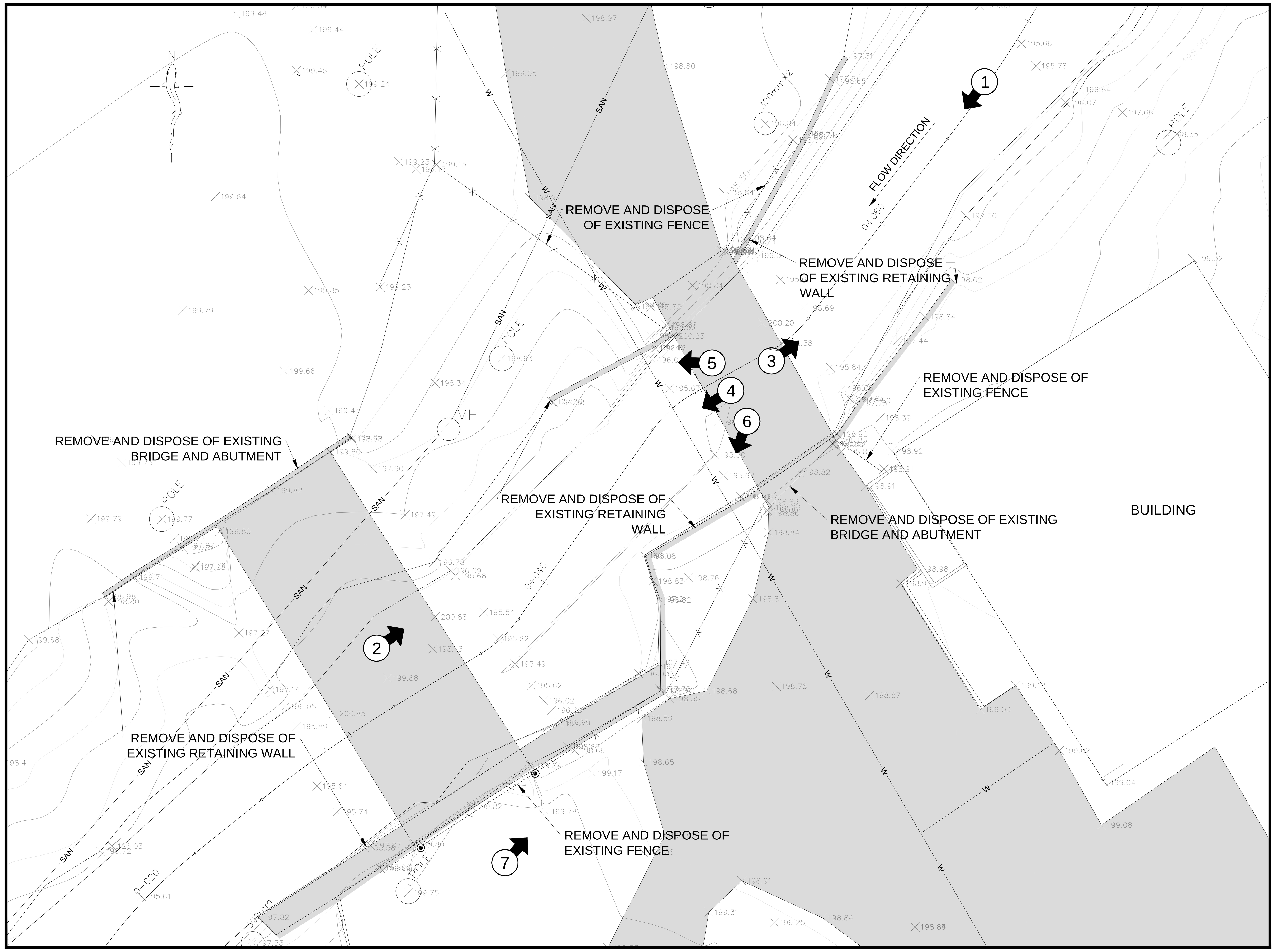

7

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LEGEND:

SAN	SANITARY SEWER
ST	STORM SEWER
W	WATERMAIN
X	EXISTING FENCE
MH	MAINTENANCE HOLE
POLE	UTILITY POLE
100mm	EXISTING TREE AND DIAMETER

No.	DATE	BY	REVISIONS

APPROVALS

MUNICIPAL

MANAGER OF DEVELOPMENT, ENVIRONMENTAL & TRANSPORTATION ENGINEERING

DATE

REGIONAL

COMMISSIONER OF PUBLIC WORKS

DIRECTOR OF DESIGN & CONSTRUCTION

FIELD NOTES:

SCALE: AS NOTED

DATE: January 23, 2019

CONSULTANT

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

NORTH BAY-MATTAWA CONSERVATION AUTHORITY

CHIPPEWA CREEK OAK ST CHANNEL REPAIR CLASS EA

EXISTING CONDITIONS / REMOVALS

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CHECKED: EG	MUNICIPAL DRAWING NO.: WE 18053-01

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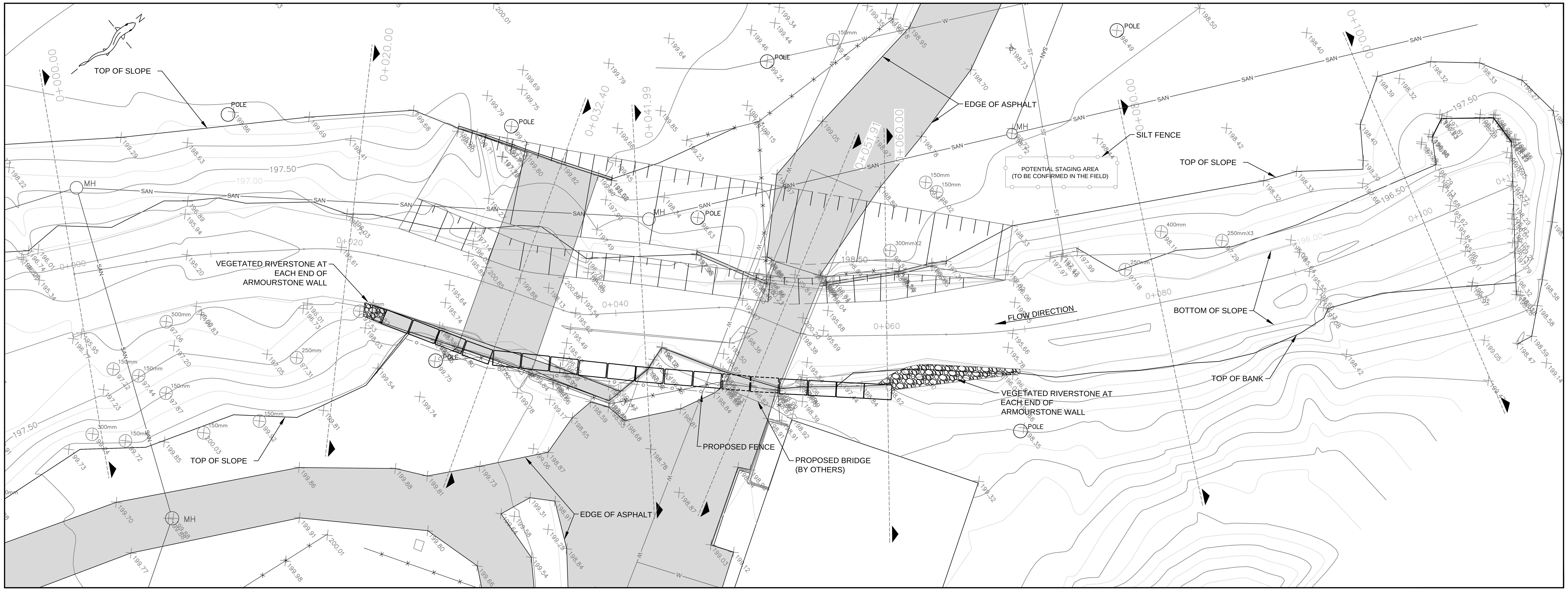

PROFILE
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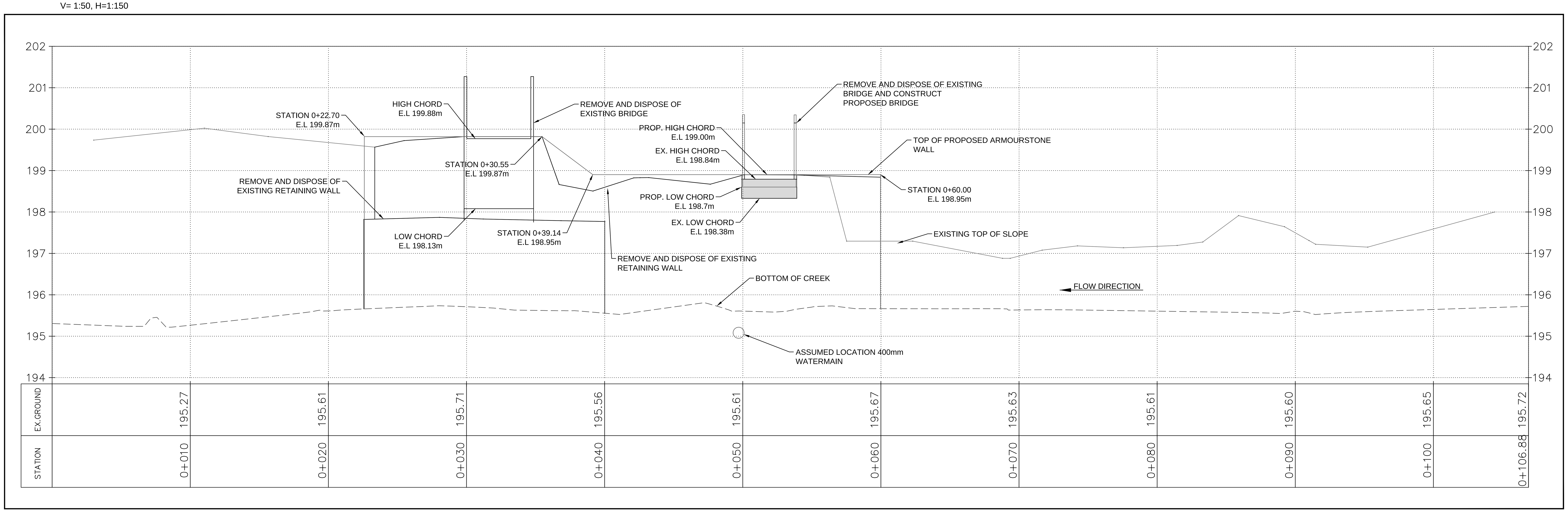

EX.GROUND	195.27	195.61	195.71	195.56	195.61	195.67	195.63	195.61	195.60	195.65	195.72
STATION	0+010	0+020	0+030	0+040	0+050	0+060	0+070	0+080	0+090	0+100	0+106.88

LEGEND:

SAN	SANITARY SEWER
ST	STORM SEWER
W	WATERMAIN
X	EXISTING FENCE
O	PROPOSED FENCE
	PROPOSED SLOPE
	PROPOSED ARMOURSTONE
MH	MAINTENANCE HOLE
POLE	UTILITY POLE
100mm	EXISTING TREE AND DIAMETER

No.	DATE	BY	REVISIONS

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CHIPPEWA CREEK OAK ST
CHANNEL REPAIR
CLASS EA

PLAN & PROFILE

DESIGN: JS

CAD FILENAME: PP1

CHECKED: EG

MUNICIPAL DRAWING NO.: WE 18053-02

CROSS-SECTIONS
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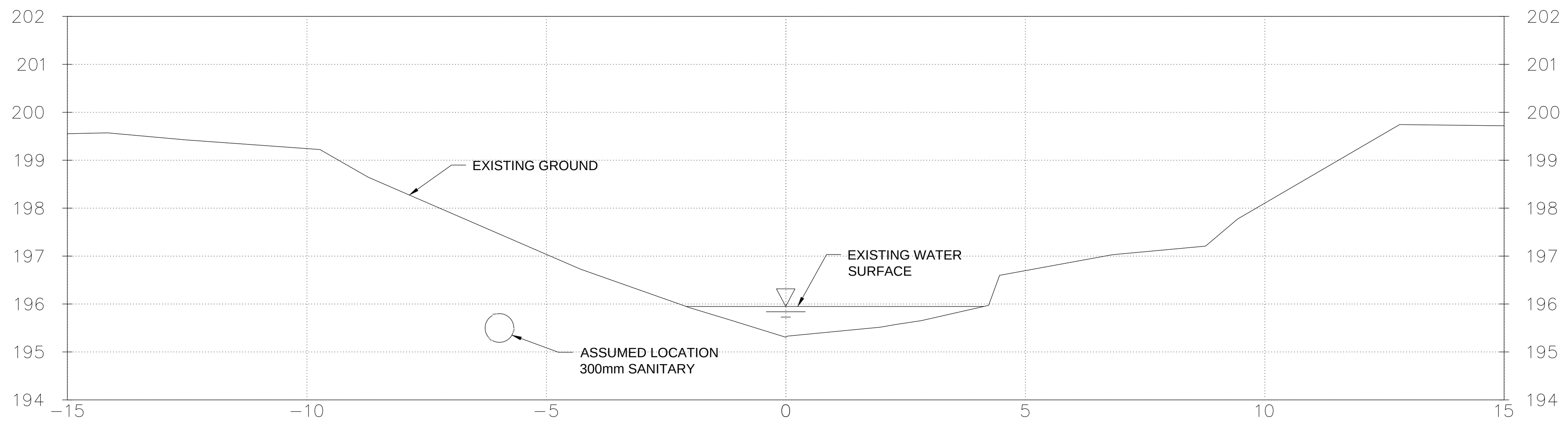

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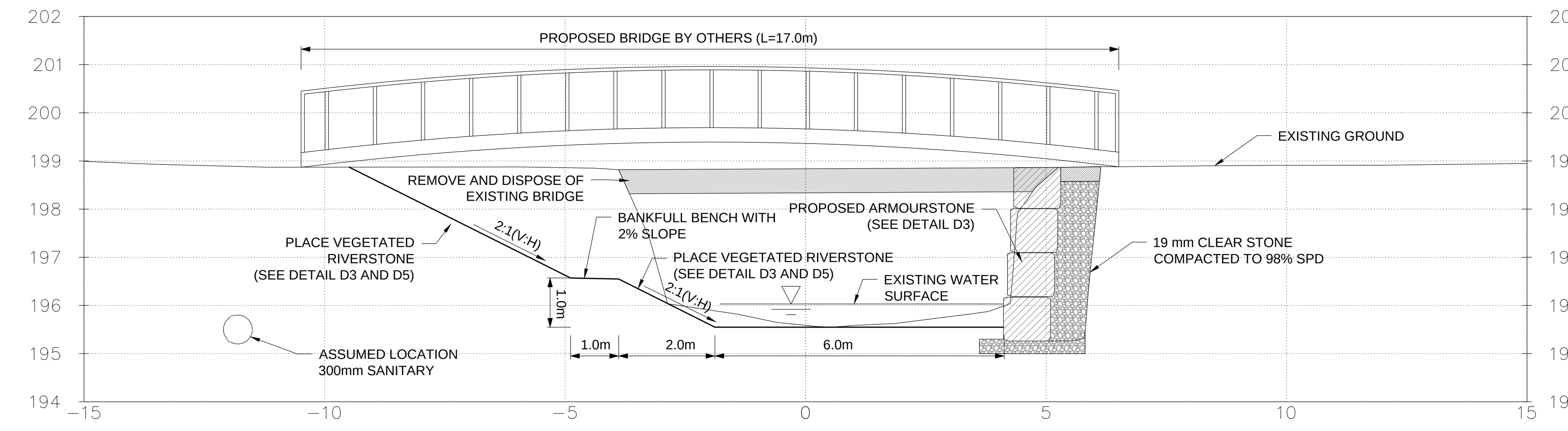

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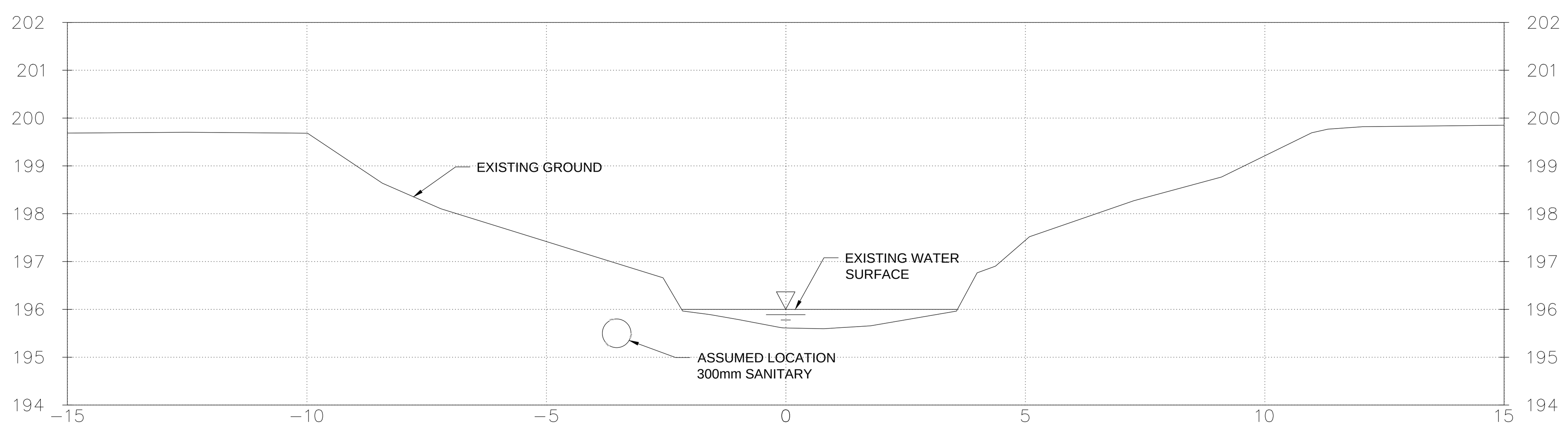

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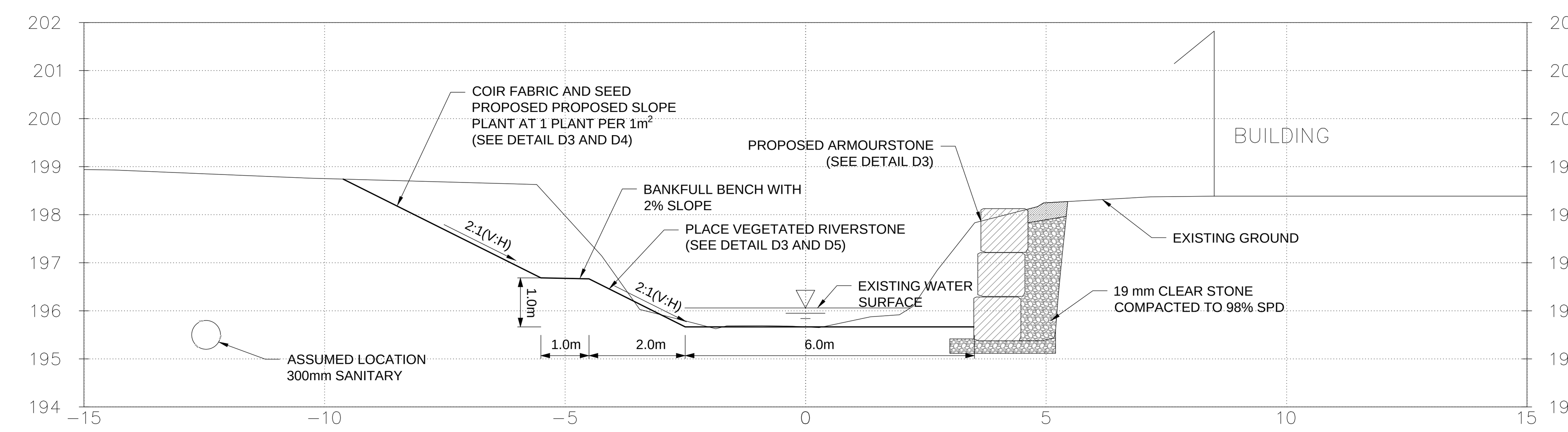

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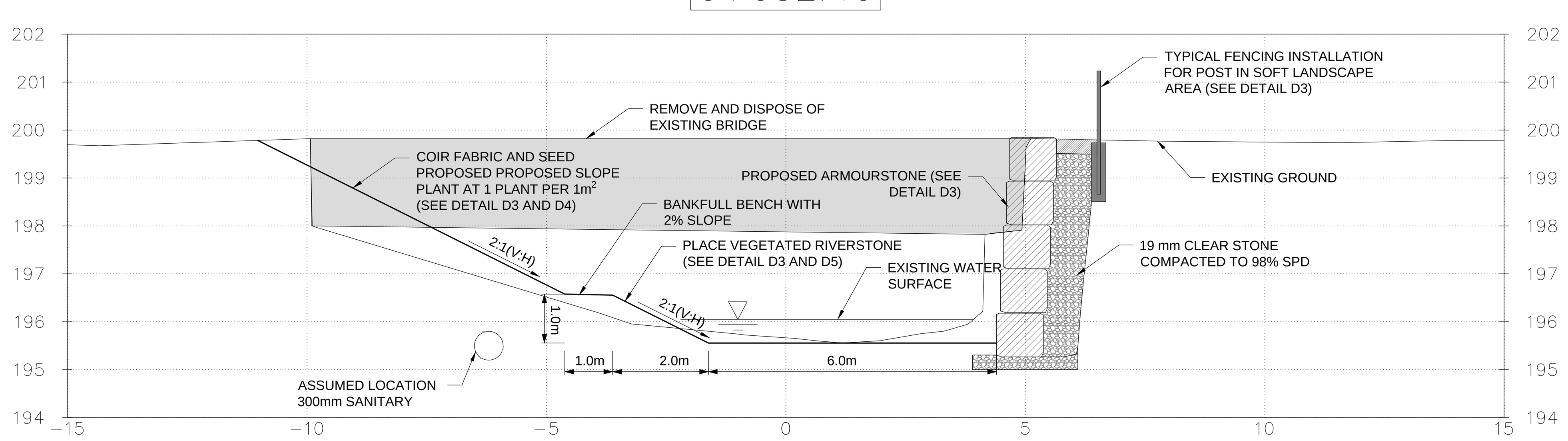

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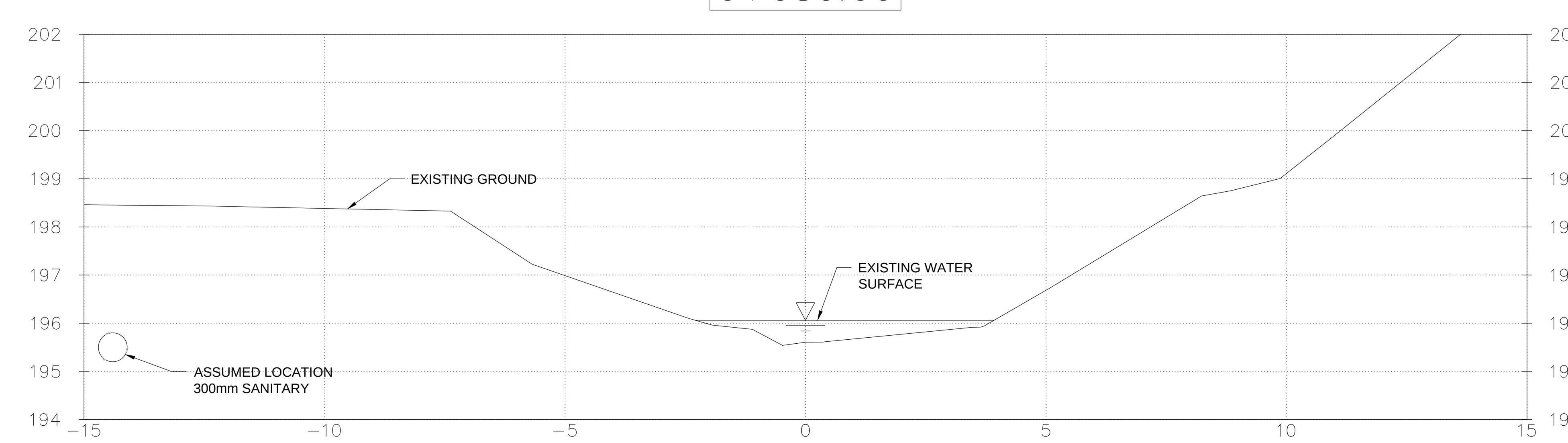

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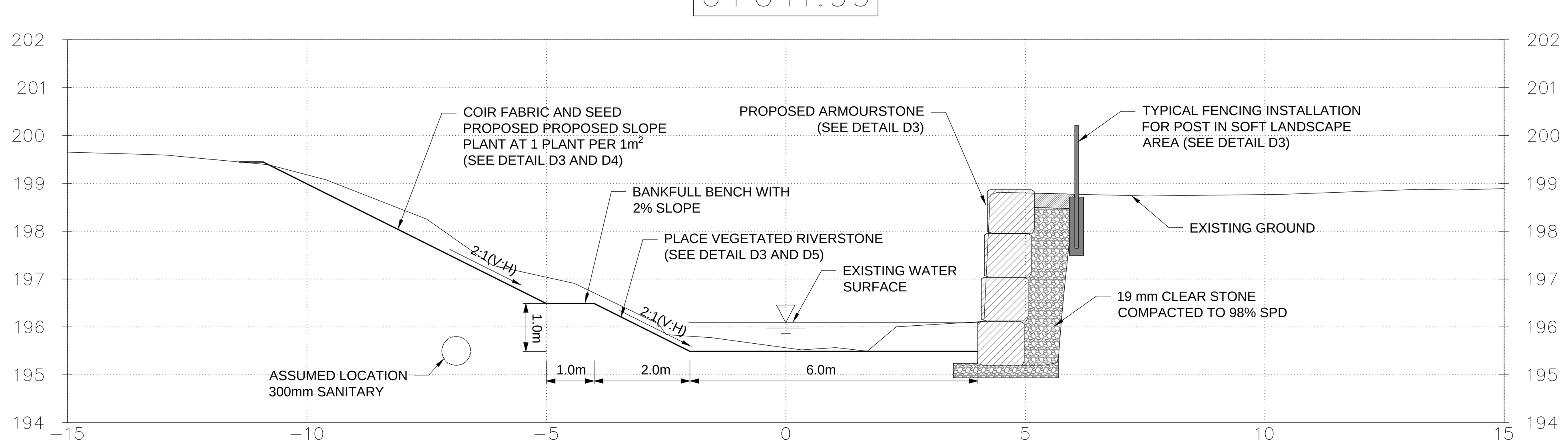

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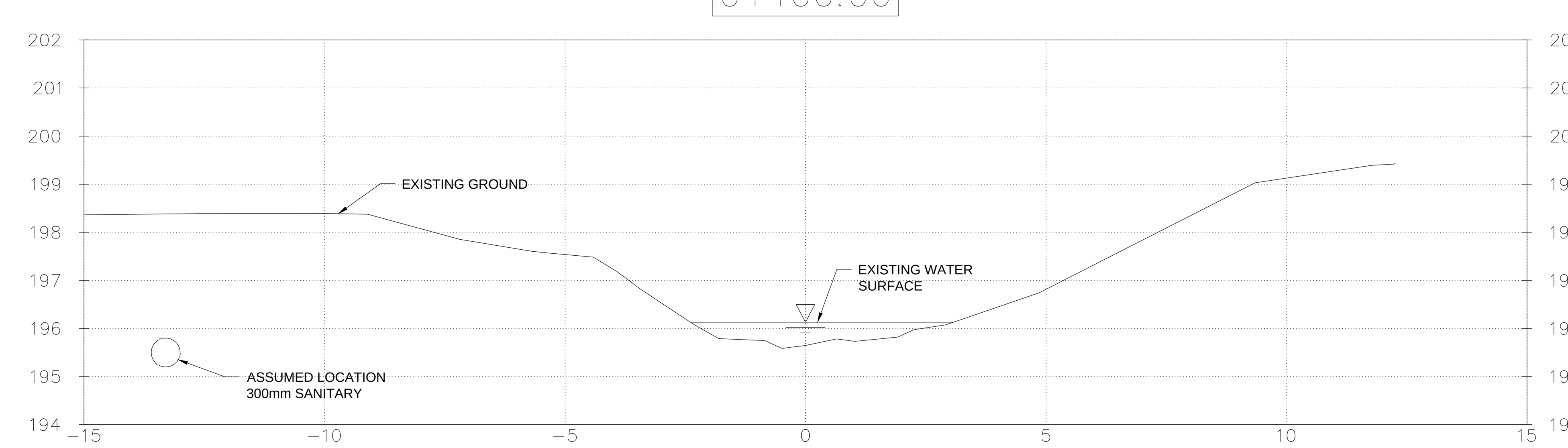

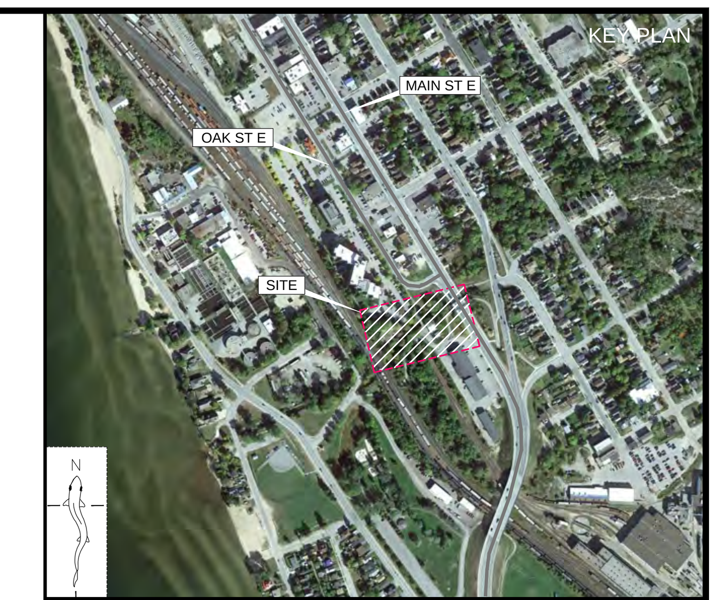

LEGEND:

No.	DATE	BY	REVISIONS

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FIELD NOTES:

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DATE: January 23, 2019

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CHANNEL REPAIR
CLASS EA

CROSS-SECTIONS

DESIGN: JS

CAD FILENAME: XS1

CHECKED: EG

MUNICIPAL DRAWING NO.: WE 18053-03