

Executive Summary

Introduction

The Town of Oakville, as part of its riverine flood risk assessment, commissioned a Town-wide study in 2008. That Study identified numerous watersheds and subwatersheds, and associated locations across the town, which were susceptible to riverine flooding of varying severity. Since the completion of the Town-wide Flood Study, the town has been systematically assessing these flood risk areas to determine the preferred works to minimize and manage the associated flooding concerns. The Sheldon Creek watershed was identified as one of the at-risk watersheds.

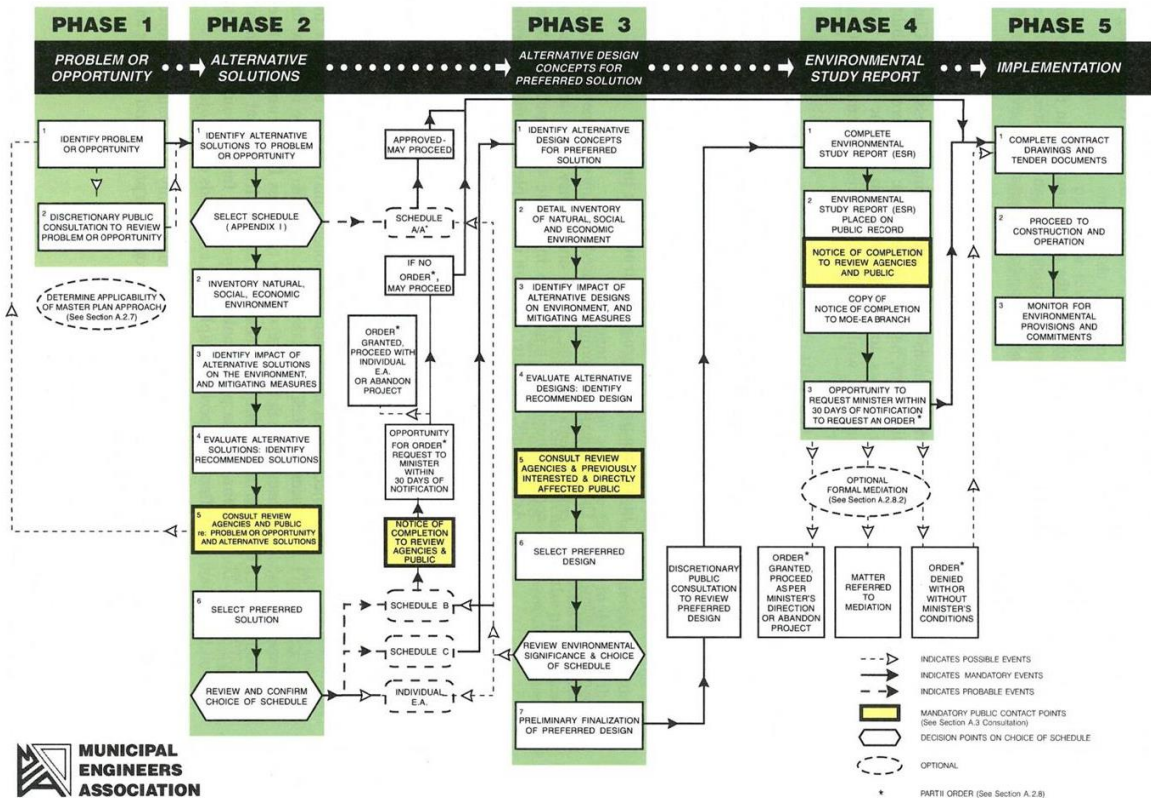
The Sheldon Creek Watershed lies within Conservation Halton's jurisdiction, and measures some 17.1 km² (ref. Figure 1). The lower reaches of the East Sheldon Creek, as well as the lower reaches of the Sheldon Creek Main Branch, are conveyed through the Town of Oakville to its outlet at Lake Ontario, while the upper reaches of the Sheldon Creek extend through the City of Burlington. In recent years (notably following the August 4, 2014 storm which primarily struck Burlington to the west), Town of Oakville staff has noted particular concerns regarding flood risks following severe storms at Rebecca Street and to private properties and public spaces adjacent to the downstream portion of East Sheldon Creek and along the Main Branch, extending to the outlet to Lake Ontario. In response to the recommendations from the Town-wide Flood Study and recent flood observations, the Town of Oakville has initiated this Flood Mitigation Opportunities Study to formalize the understanding of the flooding problems along the Sheldon Creek East Branch and Main Branch through the Town of Oakville, and develop preferred flood mitigation solution(s) focused on reach-specific recommendations to address the flood risk to public safety and property within the subject area.

Study Process

This study has been completed as a Schedule B undertaking of the Municipal Engineers Association (MEA) Class Environmental Assessment Process (ref. Municipal Engineers Association's Municipal Class Environmental Assessment October 2000, as amended in 2007, 2011 & 2015). The Ontario Environmental Assessment Act provides for "...the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation and wise management in Ontario of the environment." The approved MEA Class Environmental Assessment (Class EA) document describes the process that a proponent must follow for a class or group of undertakings in order to satisfy the requirements of the Environmental Assessment Act. Additionally, it represents a method of obtaining an approval under the provincial Environmental Assessment Act and provides alternatives to carrying out individual environmental assessments for each separate undertaking or project within the class.

The Work Plan for this study has been developed, based upon the following Phased approach:

- | | |
|----------|---|
| Phase 1: | Problem Definition |
| Phase 2: | Develop and Review Options |
| Phase 3: | Preferred Alternatives Selection and Preliminary Design |
| Phase 4: | Preparation of Environmental Study Report |



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Figure 2 Municipal Class EA Process

The study has focused on the management of flood risks from riverine areas. The intent of the study has not been to update or modify the Regulatory flood condition as administered by Conservation Halton (CH). The formal updating of the Regulatory flood plain rests with CH in partnership with the town; the methods (specific to mapping, modelling (hydrology and hydraulics) and other techniques) applied for this study have intentionally focused on flood risk management with the recognition that future efforts by CH and the town will address formal Regulatory floodplain mapping.

Baseline Assessment

The current land use for the Town of Oakville contributing drainage area to Sheldon Creek is varied. The portion of the subject area south of Rebecca Street is a mix of low density residential with two (2) existing stormwater management (SWM) facilities, parks, and natural areas. The land use of the Sheldon Creek contributing drainage area between Rebecca Street and the CNR rail tracks is business employment with two (2) existing SWM facilities, while the land use between the CNR rail tracks and QEW highway is commercial, industrial, and employment, with two (2) existing SWM facilities. It is also evident that the lands between Rebecca Street and the QEW highway are in a developing and urbanizing state, based on the available aerial imagery and have not been developed to their ultimate condition.

The topography of the subject area is generally sloped from the north west, in the vicinity of Burloak Drive and the QEW highway with an elevation of 125 m (+/-) to the south east at the Sheldon Creek outlet to Lake Ontario with an elevation of 76 m (+/-).

The segment of the Sheldon Creek East Branch along Great Lakes Boulevard is within Creek Path Woods (a.k.a. Burloak Wood) and the lower reach of the Sheldon Creek Main Branch along Shoreline Drive are listed in the Town of Oakville's Official Plan as Woodlands and Significant Wildlife Habitat. No Provincially Significant Wetlands are mapped from the study area, however, Conservation Halton provided Ecological Land Classification mapping which displays swamp and marsh communities in various locations. No Areas of Natural and Scientific Interest (ANSIs) are present in the study area. Also confirmed in the study area is Landbird Migratory Stopover Area Significant Wildlife Habitat (SWH) for Ecoregion 7E. The SWH includes the woodlands at the south end of the study area, including Creek Path Woods/Burloak Woods, Sheldon Creek Trail, and Shell Park. The woodlands have long been recognized as an important stopover site for migrant landbirds, especially in spring and might be the best such site in the greater Hamilton area (Curry 2006). Background review did not confirm the presence of other SWH; however, other SWH likely occurs. Potential SWH could include Bat Maternity Colony, Migratory Butterfly Stopover Areas, or others.

In the Region's Official Plan mapping, the reaches of the Sheldon Creek East Branch downstream of Rebecca Street as well as the reach of the Sheldon Creek Main Branch are located in 'Key Features' which includes Significant Habitat of Endangered and Threatened Species, Significant Wetlands, Significant Coastal Wetlands, Significant Woodlands, Significant Valleylands, Significant Wildlife Habitat, Significant Areas of Natural and Scientific Interest, and Fish Habitat. Great Lakes Boulevard and Wilmot Crescent Nature Areas qualify as Significant Woodlands, among other Key Features. Shoreline Drive also qualifies as Key Features; however, Rebecca Street is not mapped under the Town's Official Plan and therefore may not be Regional Key Features upon further investigation. Additionally, the entirety of the Sheldon Creek corridor within the Town of Oakville is regulated by Conservation Halton under Ontario Regulation 162/06.

Species at risk (SAR) have been identified with a moderate to high potential of occurrence in the study area. Both the Main and East Branches of Sheldon Creek in the study area are classified as warmwater habitats. The habitats are known to be in poor health, with very limited fish diversity.

Flooding Assessment and Problem Definition

Hydrologic analyses have been completed using the HSP-F hydrologic model, which is the most current hydrologic model for the Sheldon Creek Watershed. The HSP-F hydrologic model was originally developed for the 1993 Watershed Master Plan, and has been updated numerous times in support of various hydrologic verifications and drainage studies within the watershed. The HSP-F hydrologic model has been refined within the limits of the study area based upon information provided in various stormwater

management reports, mapping, and GIS data provided for use in this study, as well as the findings from field reconnaissance.

Hydraulic analyses and floodline mapping have been developed to identify sites of potential flooding within the study area (ref. Figure 3). The flood sensitive sites identified from the updated floodline mapping along with the corresponding storm event causing the local flood, have been listed in Table 1.

Table 1 Summary of Existing Conditions Spill Locations and the Storm Events		
Reach	Spill/Flooding Location	Storm Events
East Sheldon Creek	Burloak Drive crossing, spilling southward	August 4, 2014 and Regional Storm events
East Sheldon Creek	Rebecca Street, spill on the south side of the channel into Suncor Site and overtopping Rebecca Street	10 - 100 year frequency storms, August 4, 2014 storm, and Regional Storm events
East Sheldon Creek	Great Lakes Boulevard, southward spill on the east side of channel	August 4, 2014 and Regional Storm events
Main Sheldon Creek	Burloak Drive crossing, spilling southward	August 4, 2014 and Regional Storm events
Main Sheldon Creek	South side of channel to Wilmot Crescent	Regional Storm event
Main Sheldon Creek	Flooding of properties on the north side of the channel downstream of Lakeshore Road	100 year frequency storm, August 4, 2014 storm, and Regional Storm events

The results of the hydraulic analyses have identified four (4) flood risk and spill areas, during at least one of the formative events evaluated, at Rebecca Street, Great Lakes Boulevard, Wilmot Crescent, and downstream of Lakeshore Road at Shoreline Drive. The flooding locations at Rebecca Street, Great Lakes Boulevard, and Shoreline Drive have been verified by incidental observations made by Town of Oakville staff during the storm of August 4, 2014. Additionally, two (2) spill locations have been identified on Burloak Drive at crossings on the East Sheldon Creek and the Main Sheldon Creek. The spill at Burloak Drive and overtopping of the bridge traversing the Main Sheldon Creek was previously identified in the Town-Wide Flood Study Town of Oakville (Philips Engineering Ltd. April 2008) and continues to be identified as a flood prone site during infrequent storm events. This site has not been advanced for further study at this time as the spill does not contribute to flooding within the Town of Oakville and the structure is not owned by the town.

The floodline mapping generated for the study area has been overlaid on aerial imagery with a property parcel shapefile to determine the number of properties at risk of flooding during the three formative storm events assessed for this study. Flood risk for properties has been categorized as **major** flood risk and **minor** per the criteria presented in Table 2.

Table 2 Criteria for Defining Flood Risk of Private Properties	
Flood Risk	Criteria
Major	<ul style="list-style-type: none"> • Floodlines encroach onto more than one side of the property • Flood risk to the structure • The flood risk has been verified during the August 4, 2014, storm event
Minor	<ul style="list-style-type: none"> • Flood risk to one side property • No flood risk to the structure • The flood risk has not been validated during the August 4, 2014, storm event

One (1) of the three (3) criteria noted in Table 2 would need to be met to be identified as a major flood risk, otherwise the property would be assigned a minor flood risk. The results of the floodline mapping have been reviewed to determine the number of properties with a major or minor risk of flooding at the four (4) spill or flooding locations. The results are presented in Tables 3 and 4.

Table 3 Cumulative Number of Properties Identified with Major Flood Risk During Less Frequent Storm Events					
Storm Event	Rebecca Street	Great Lakes Boulevard	Wilmot Crescent	Downstream of Lakeshore Road	Summation
100 Year Frequency Storm Event	0	0	0	5	5
August 4, 2014 Storm Event	0	9	0	8	17
Regional Storm Event	0	17	6	8	31

The results in Table 3 indicate that up to thirty-one (31) private properties have been identified with major flood risk under existing conditions, at the four (4) identified locations within the study area during a Regional Storm event. This study will provide flood mitigation measures to address the major flood risk to these properties. While buildings have not been identified as being at risk at the Rebecca Street spill site in Table 3.11, the spill is anticipated to impact buildings and properties near the storm sewer inlet at Chalmers Street, opposite Village Wood Park.

Table 4 Cumulative Number of Properties Identified with Minor Flood Risk During Less Frequent Storm Events					
Storm Event	Rebecca Street	Great Lakes Boulevard	Wilmot Crescent	Downstream of Lakeshore Road	Summation
100 Year Frequency Storm Event	0	0	0	3	3
August 4, 2014 Storm Event	0	0	1	4	5
Regional Storm Event	0	7	19	10	36

Up to thirty-six (36) private properties have been identified with minor flood risk during the Regional Storm event as shown in Table 4. The water surface elevation during the Regional Storm event would be sufficient to encroach onto those private properties, however, is not anticipated to impact the structures on those properties. The noted properties with minor flood risk have been identified for the town to continue to monitor and address as required as part of future studies.

Through the results presented in this study and from the awareness of flooding incidents in the subject area by Town of Oakville staff, there is potential for flooding at four (4) locations of both private and public property within the Town of Oakville in the Sheldon Creek Watershed during less frequent storm events. The potential for flooding at the identified locations is due to several factors, most notably a lack of channel or floodplain capacity, undersized channels and culverts, and legacy developments constructed at susceptible locations adjacent to the Sheldon Creek channel.

Long List of Alternatives

The following long list of alternatives has been developed for the mitigation of flooding at the at-risk properties:

- i. Do Nothing
- ii. Culvert/Bridge upgrades
- iii. Eliminate/Reduce potential culvert blockages
- iv. Floodplain/Channel improvements
- v. Flood proofing buildings
- vi. Flow diversion
- vii. Online storage
- viii. Offline storage (convey flow to existing SWM facilities)
- ix. Roadway longitudinal profile modification
- x. Vegetation management plan
- xi. Non-Structural Alternatives
 - o Creek maintenance plan
 - o Emergency preparedness
 - o Flood forecasting/warning
 - o Land acquisition

- Regulation
- xii. Combinations

The long list of alternatives has been screened at a high-level based upon feasibility and anticipated effectiveness, to develop a short list of alternatives for further consideration. The alternative screening has considered the site-specific conditions at each of the four locations, to advance a short list of alternatives accordingly. The following alternatives have been screened from further consideration:

The short list of alternatives is presented in Table 5 and has been advanced for further consideration corresponding to the flood sensitive locations:

Table 5 Short List Alternatives Advanced for Further Consideration					
Alternative #	Alternative	Rebecca Street	Great Lakes Boulevard	Wilmot Crescent	Downstream of Lakeshore Road
i	Do nothing	X	X	X	X
iv	Floodplain/Channel improvements	X	X	X	X
v	Flood proof buildings	X	X	X	X
vi	Flow diversion	X			
ix	Roadway longitudinal profile modification	X			
xi	Non-Structural	X	X	X	X
xii	Combinations	X			X

Short List of Alternatives

The short list of alternatives has been assessed at each flood risk site using the following evaluation categories: functional, environmental, social, and economic, with the following respective criteria and factors:

Functional

Effectiveness of the alternative to provide flood relief: The alternative has been assessed based on the potential of flood or spill mitigation whether it be through containing the flow within the bankfull limits of the channel or preventing flow conveyance to public or private property.

Ease of implementation: The alternative has been assessed based on the level of difficulty to implement. Obstacles to implementing the alternative include land acquisition, construction access to the site, coordination with other stake holders, and impacts to utilities. It is the town's preference to implement selected structural alternatives within public property or within the town's management authority. This will ensure that the town can maintain those alternatives to provide long term functionality for flood mitigation. While not considered an obstacle, the permitting required from the regulatory bodies has been noted for this factor.

Environmental

Impacts to aquatic systems: A high level assessment of the impacts to aquatic systems has been undertaken based on the anticipated impacts to aquatic systems. Alternatives that would be

implemented outside the bankfull limits of the channel have been assumed to not negatively impact the aquatic systems hence would be favoured over alternatives that are within the bankfull environment (notwithstanding the potential for enhancement/restoration works).

Impacts to terrestrial systems: A high level assessment of the impacts to terrestrial systems has been undertaken based on the anticipated impacts to the area terrestrial features. The presence of woodlots or wildlife has been noted based on a review of the available data, in addition to the desk review of the ecological constraints related to flood mitigation works as well as the potential need for follow-up studies, such as an ecological land classification (ELC) study. Alternatives that would be implemented outside the limits of any identified terrestrial features would be favoured over alternatives that would encroach on those terrestrial features.

Social

Impacts to private property: An assessment has been performed of the anticipated impacts to private property due to the implementation of an alternative. Consultation with private property owners may be required should the alternative require implementation on privately owned land.

Impacts to recreational activities: The alternatives have been assessed for their anticipated impacts to existing or potential recreational activities. The potential impacts considered include access to sidewalks or trail systems, and the quality of the sidewalks or trail systems.

Impacts to public safety: The anticipated impacts to public safety have been assessed for each alternative. Alternatives which improve public safety have been considered more favourable than those that either provide no change to the impact to public safety or a reduction to public safety.

Economic

Capital costs: The capital costs of an alternative have been assessed based on Class D (Conceptual) cost estimates.

Operations and maintenance costs: The projected operations and maintenance costs of an alternative have been assessed based on high level cost estimates.

Each of the shortlisted alternatives have been qualitatively evaluated based upon the preceding criteria and factors and assessed according whether the impact of the alternative has been considered “positive”, “neutral/positive”, “neutral”, “neutral/negative”, or “negative”. The results of this assessment have been summarized in Table 6.

Table 6 Summary of the Net Overall Rankings for the Assessed Alternatives at the Flood Sensitive Sites							
Flood Mitigation Site	Do Nothing	Floodplain/Channel Improvements (Berm)	Flood Proofing Buildings	Flow Diversion	Roadway Longitudinal Profile Modification	Non-Structural	Combinations
Rebecca Street	-1	-0.5	-0.5	-1	-1.5	+1	-0.5
Great Lakes Boulevard	-1	+1	-0.5	N/A	N/A	-0.5	N/A
Wilmot Crescent	-1	+1.5	-0.5	N/A	N/A	-0.5	N/A
Downstream of Lakeshore Road	-1	-2.5	0	N/A	N/A	-0.5	0

Preferred Alternative

A preferred alternative has been selected for each of the four (4) flood susceptible sites and has been summarized in Table 7 based on the evaluation in the preceding tables. The preferred alternatives are also shown in Figures 5, 6, and 7 for three (3) of the four (4) sites.

Site	Preferred Alternative	Level of Service	Estimated Total Cost (\$)	Unitary Cost (\$/Building at Risk)
Rebecca Street	Emergency preparedness in the form of monitoring the depth of flow at the sag in the Rebecca Street ROW and mobilizing town staff to limit pedestrian and vehicular traffic in the ROW during a significant precipitation event	All storm events up to and including the Regional Storm event	N/A	N/A
Great Lakes Boulevard	Floodplain/Channel Improvements in the form of a two (2) berms, adjacent to Great Lakes Boulevard	All storm events up to and including the Regional Storm event	\$90,000	\$4,600
Wilmot Crescent	Floodplain/Channel Improvements in the form of a berm commencing at Burloak Drive and extending through Spruce Park to Wilmot Park	All storm events up to and including the Regional Storm event	\$222,000	\$31,714
Downstream of Lakeshore Road	Combination of Non-Structural alternative in the form of emergency preparedness for the identified residential properties on Shoreline Drive and Shelburne Place followed by the implementation of flood proofing buildings	August 4, 2014 and Regional Storm events	N/A	N/A

Next Steps and Implementation

The preferred alternatives for mitigating the flood risk at the four (4) identified sites, as presented herein, can be advanced to the next stages of planning and design including: data collection, ecological field surveys, topographic surveys, seeking approvals during consultation with property owners and stake holders, and permit approvals from Conservation Halton. The ecological field surveys should determine which species of wildlife are present at the respective sites to establish appropriate construction timing to limit the impact to the wildlife.

Topographic survey data should be obtained of the sites for the design of the preferred alternatives. Topographic survey sections of the channel at and near the four (4) flood sensitive sites or spill locations should be used to update the HEC-RAS modelling during the next stage of planning and design to better understand the extent of major and minor flood risk while validating the recommendations of this study.

Berm slopes should be made as flat as feasible (4:1) if sufficient space is available, to be determined at the detailed design stage, to facilitate maintenance and pedestrian or vehicular access, where needed. Consideration should be given to flood walls or combinations of berms/walls where space limitations warrant this need.

The recommended works involving the implementation of flood mitigation berms would require approval from Conservation Halton due to the location of the works within the regulated floodplain.

Additionally, the representatives at the Suncor Site and the identified residential properties should be informed of the flood risks and the recommendation to develop emergency preparedness plans to mitigate the impact during flooding events.

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LEGEND

- MUNICIPAL BOUNDARY
- ROAD CENTRELINE
- WATERCOURSE
- CONTOUR (2m)
- WATERSHED BOUNDARY
- SUBJECT AREA

Town of
Oakville

City of
Burlington

BRONTE
TRIBUTARY
WATERSHED

MAIN
SHELDON CREEK
WATERSHED

EAST
SHELDON CREEK
WATERSHED

MINOR
SYSTEM
CONTRIBUTING
AREA

Lake Ontario

FLOOD MITIGATION
OPPORTUNITIES STUDY
SHELDON CREEK
TOWN OF OAKVILLE

SUBJECT AREA
PLAN

wood.

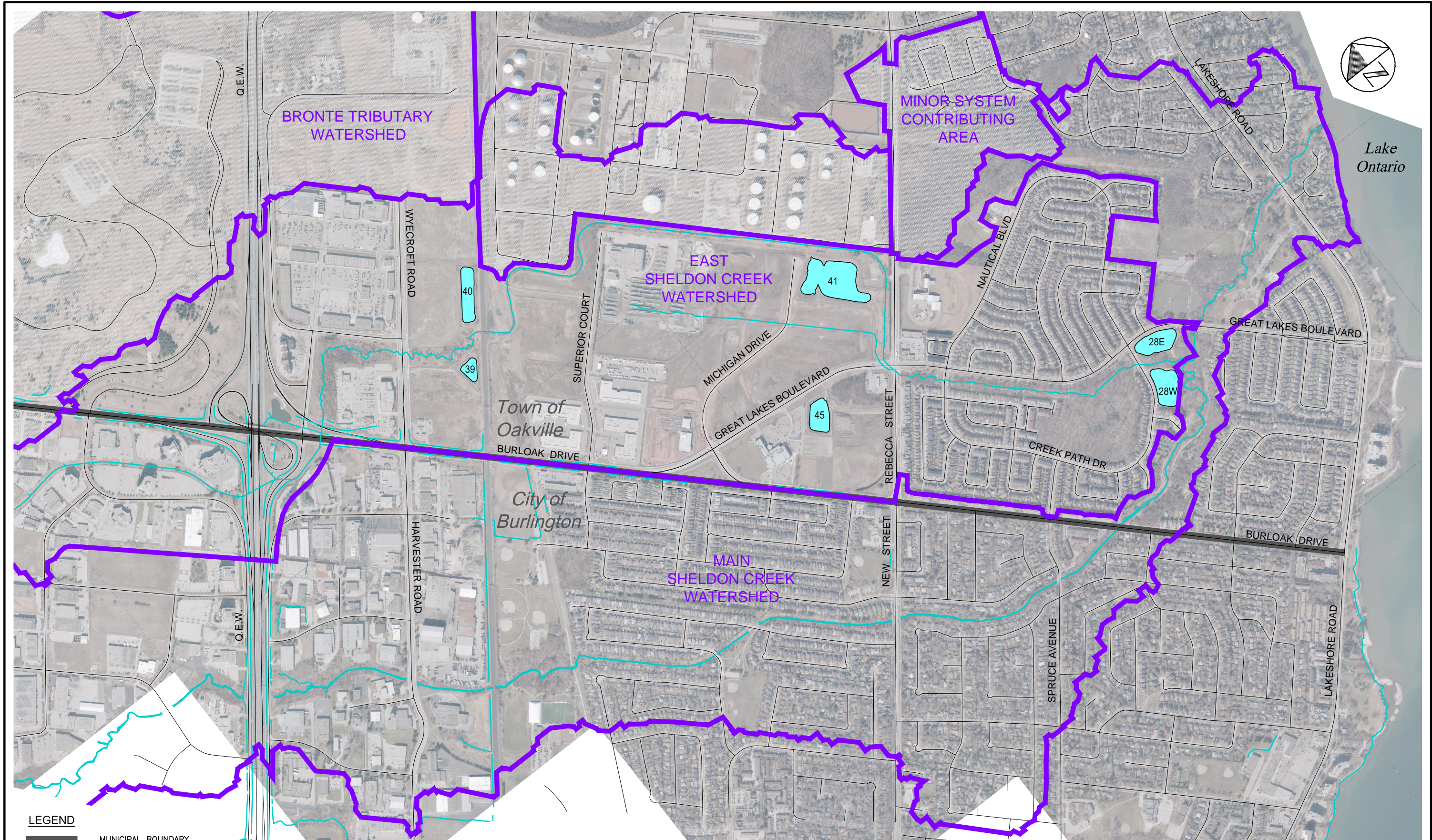
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Figure No.
1

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LEGEND

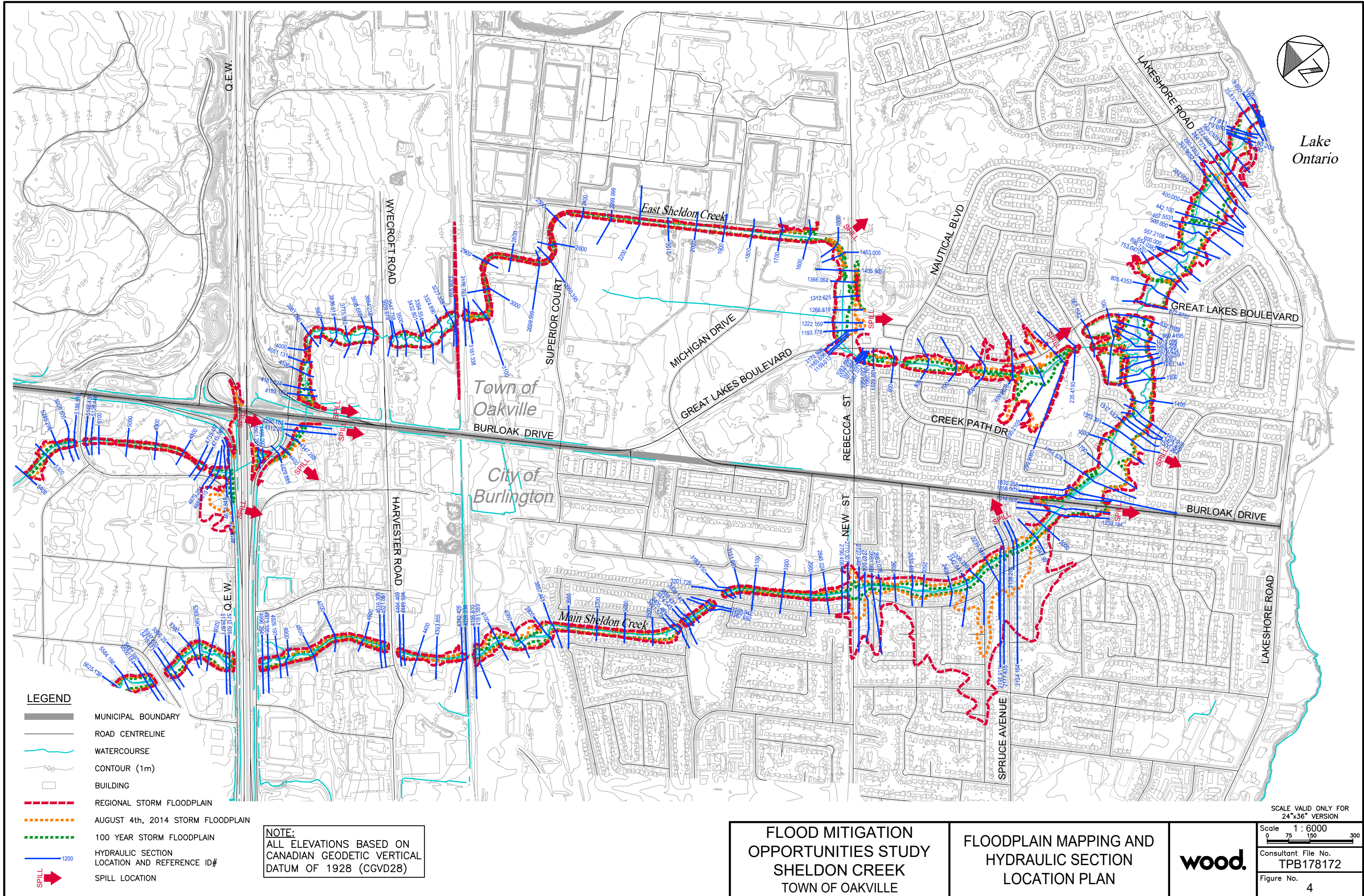
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- ROAD CENTRELINE
- WATERCOURSE
- WATERSHED BOUNDARY
- SWM FACILITY AND TOWN REFERENCE ID#

FLOOD MITIGATION
OPPORTUNITIES STUDY
SHELDON CREEK
TOWN OF OAKVILLE

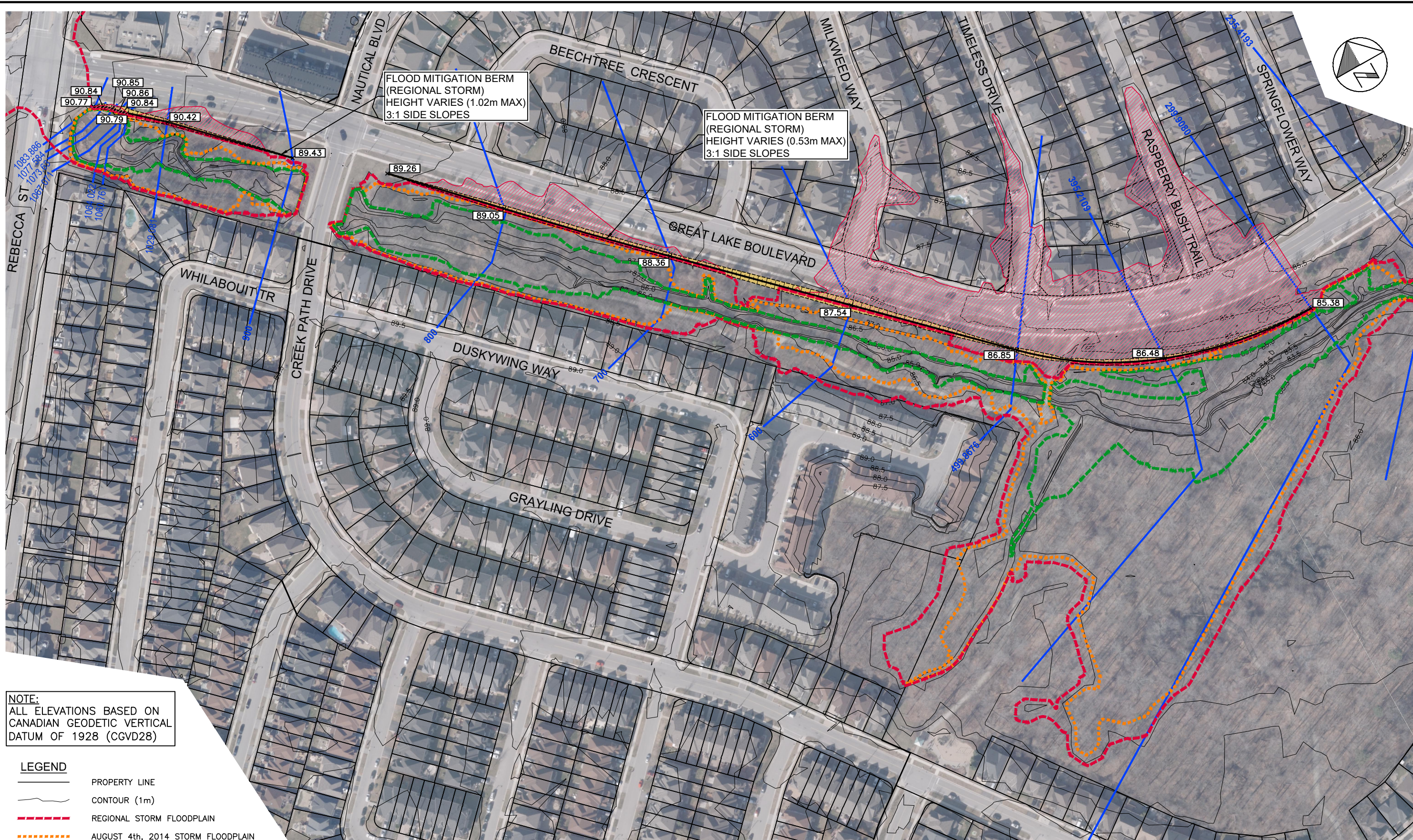
EXISTING
LAND USE PLAN
(2015 AERIAL PHOTOGRAPHY)

wood.

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Figure No.
3



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NOTE:
ALL ELEVATIONS BASED ON
CANADIAN GEODETIC VERTICAL
DATUM OF 1928 (CGVD28)

LEGEND

- PROPERTY LINE
- CONTOUR (1m)
- REGIONAL STORM FLOODPLAIN
- AUGUST 4th, 2014 STORM FLOODPLAIN
- 100 YEAR STORM FLOODPLAIN
- HYDRAULIC SECTION LOCATION AND REFERENCE ID#
- PROPOSED ELEVATION
- AREA PROTECTED VIA THE PROPOSED BERM

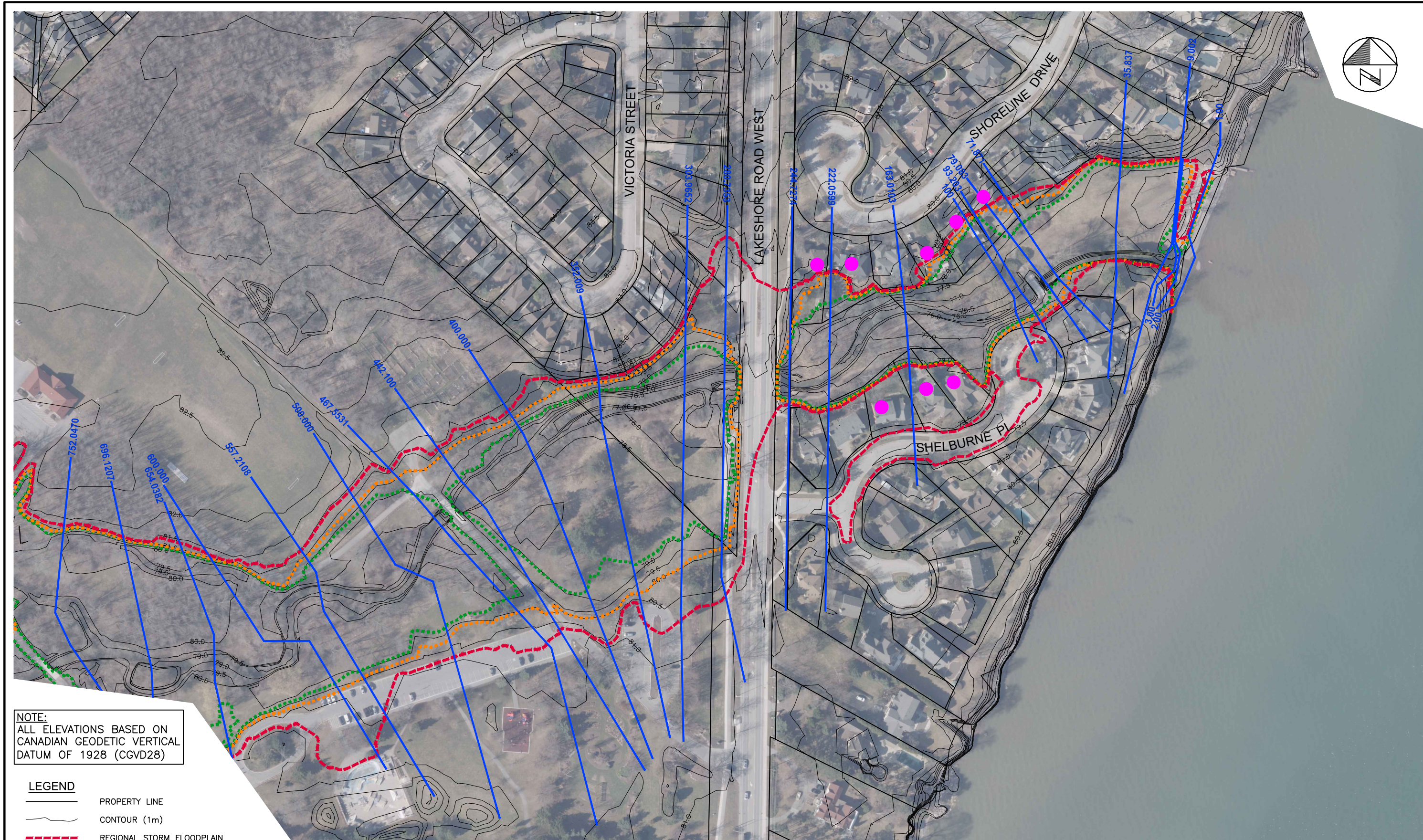
FLOOD MITIGATION
OPPORTUNITIES STUDY
SHELDON CREEK
TOWN OF OAKVILLE

FLOOD MITIGATION
PREFERRED ALTERNATIVE
GREAT LAKES BOULEVARD

wood.

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Figure No.
5

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NOTE:
ALL ELEVATIONS BASED ON
CANADIAN GEODETIC VERTICAL
DATUM OF 1928 (CGVD28)

- LEGEND**
- PROPERTY LINE
 - CONTOUR (1m)
 - REGIONAL STORM FLOODPLAIN
 - AUGUST 4th, 2014 STORM FLOODPLAIN
 - 100 YEAR STORM FLOODPLAIN
 - HYDRAULIC SECTION LOCATION AND REFERENCE ID#
 - NON-STRUCTURAL ALTERNATIVES

FLOOD MITIGATION
OPPORTUNITIES STUDY
SHELDON CREEK
TOWN OF OAKVILLE

FLOOD MITIGATION
PREFERRED ALTERNATIVE
DOWNSTREAM OF
LAKESHORE ROAD WEST

wood.

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Figure No.
7