Floodplain Mapping Implementation Plan 2024

Otonabee Region Conservation Authority

2024-08-15

Otonabee CONSERVATION

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Conservation Authority Approval

Board Meeting Date 2024-08-15	Moved by Kevin Duguay Seconded by Don Vassiliadis
Resolution Number 047-24	*Resolved*, That Report 2024-034 titled "Floodplain Mapping Implementation Plan 2024" be received; and *Resolved*, That the Board approves the Floodplain Mapping Implementation Plan as presented; and *Resolved*, That staff be authorized and directed to do all things necessary to give effect to these resolutions. Carried

Executive Summary

In 2015, the Otonabee Conservation Board of Directors approved the Acquisition and Management of a Floodplain Mapping Strategy.

The Floodplain Mapping Implementation Plan (approved in 2022) provides the direction and steps to implement the Strategy.

The Floodplain Mapping Implementation Plan includes a summary of floodplain mapping projects that are underway, an overview of the federal, provincial, and conservation authority guidelines for floodplain mapping, a project prioritization matrix and a proposed project schedule for 2024-2028.

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Introduction

Background

Flooding and natural hazard occurrences have a long history in Ontario. There have been thousands of flooding events in Ontario, the most notable and catastrophic being Hurricane Hazel, in 1954 (see www.hurricanehazel.ca) . Within the Otonabee Region watershed, two storm events that were greater than the 1 in 100-year storm occurred almost back-to-back in 2002 and 2004 in the city of Peterborough, giving watershed residents and municipalities an acute understanding of the significant damage and disruption to the community such hazards can create.

While there are varying approaches to managing natural hazard management, the provincial model for reducing the impacts of natural hazards, and thus reducing the risk of loss of life and minimizing property damage is based on three components:

- **Prevention** through land use planning and the regulation of development;
- **Protection** by applying structural and non-structural measures and acquisition;
- **Emergency Response** by flood forecasting/warning and flood/erosion disaster relief.

Although there are three components of this provincial model, over the long term, prevention is the preferred method of natural hazard management. Accurate flood plain mapping and delineating the extent of riverine flooding then becomes critical in implementing preventative measures related to flooding hazards.

Conservation Ontario (CO) has taken this provincial three-pronged approach and further refined it to the Five Pillars of Emergency Management: prevention, mitigation, preparedness, response and recovery (Conservation Ontario, 2022).

From a planning and development angle, which is the cornerstone of natural hazard prevention found in both models, the interest of Conservation Authorities is primarily two-fold:

1. Regulatory Authority
OTONABEE CONSERVATION is the approval authority for development and/or activity applications submitted for approval under the "Prohibited Activities, Exemptions and Permits" (O.Reg 41/24) and Section 28 of the *Conservation Authorities Act* within OTONABEE CONSERVATION's area of jurisdiction. Development, interference and alteration in areas subject to this regulation require permission from OTONABEE CONSERVATION or is otherwise prohibited. The primary function of this regulation is to limit new development or redevelopment within hazardous lands or sites ***(e.g. areas prone to flooding).***

2. Delegated Responsibilities in Plan Review with Respect to Natural Hazards
OTONABEE CONSERVATION, like all other Conservation Authorities, has been delegated the responsibility to represent the 'provincial interest' as it relates to natural hazards by reviewing and commenting on planning matters within its watershed for conformity with natural hazards

Typical activities associated with each of these pillars are:

- Planning and regulation (prevention)
- Flood control structures, flood proofing, flood forecasting and warning systems (mitigation)
- Flood contingency planning, training, public education (preparedness)
- Monitoring and flood messaging (response) and,
- Recovery programs which assess overall damage and conduct post event audits (recovery)

Floodplain Mapping Updates

Several floodplain mapping studies have been completed in recent years and are summarized in Table 1 below. A map of floodplain studies by date completed is included in Appendix A.

Watershed	Project Status
Byersville Creek	Project is currently underway through support from the City of Peterborough and matching funding from the federal Flood Hazard Identification and Mapping Program (FHIMP). This project uses a novel 2D model approach to better understand complex flood spills. Expected completion date is Q1 2025.
Jackson Creek (Downtown) 2D model	Project is currently underway through support from the City of Peterborough. The project also assesses the impact of flood mitigation measures the City of Peterborough has recently undertaken. Expected completion date is Q1 2025.
Thompson Creek	Completed in 2023 with support from the City of Peterborough.
Rays Creek	Completed in 2022 as part of the Lakefield Tributaries project with funding from the National Disaster Mitigation Program (NDMP) and municipal partners.
Kawartha Lakes	The highest recorded water level contour elevations were mapped using accurate and up to date digital elevation data.
Baxter Creek	Completed in 2022 with funding from the National Disaster Mitigation Program (NDMP) and municipal partners.
Jackson Creek (Upstream of Weir)	Completed in 2022 with funding from the National Disaster Mitigation Program (NDMP) and municipal partners.

Lakefield East Tributary	Completed in 2022 as part of the Lakefield Tributaries project with funding from the National Disaster Mitigation Program (NDMP) and municipal partners.
Ouse River	Completed in 2022 within the village of Norwood with funding from the National Disaster Mitigation Program (NDMP) and municipal partners. Includes updated two-zone mapping for regulatory use.
Curtis Creek	Completed in 2022 with funding from the National Disaster Mitigation Program (NDMP) and municipal partners. Assessed flood mitigation measures the City of Peterborough had recently undertaken and the floodplain was reduced, eliminating the floodplain south of Tivey Street, through East City.
Meade Creek	Completed in 2022 with funding from the National Disaster Mitigation Program (NDMP) and municipal partners.

Floodplain Mapping Framework/Guideline Updates

Federal

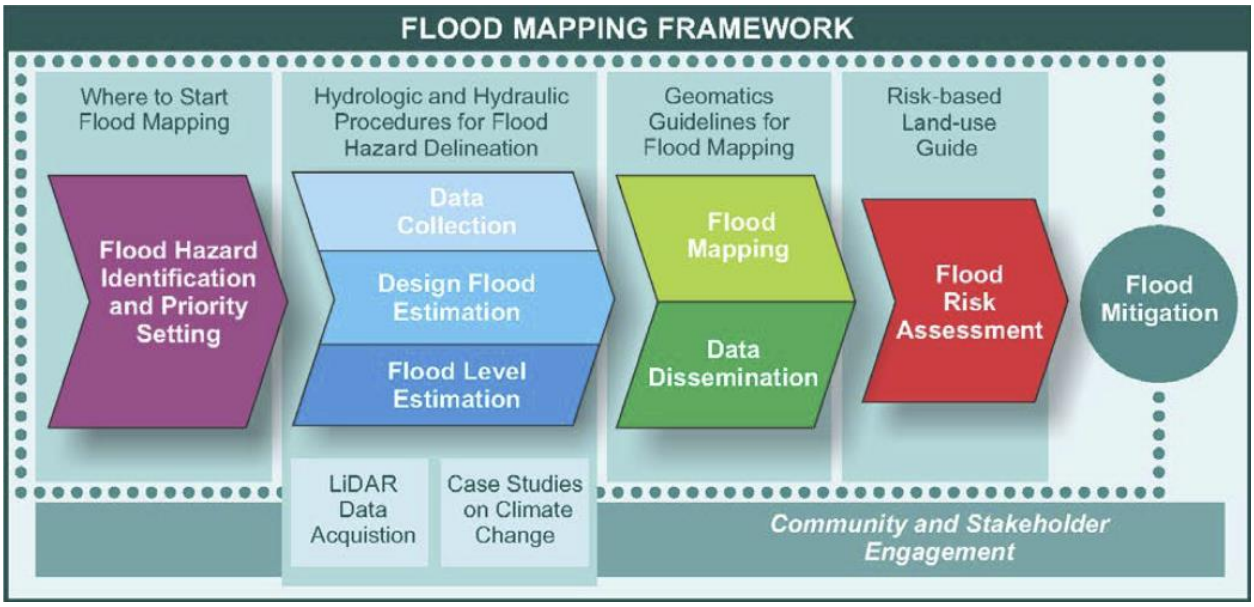
The regulatory framework surrounding floodplain mapping has received considerable updates since 2015. In particular, the federal Flood Mapping Guidelines Series was released and includes seven documents for LiDAR data acquisition, modelling procedures, mapping, flood damage estimation, mitigation, and case studies on climate change in flood mapping. The main documents to consider in floodplain mapping initiatives are:

1. Federal Flood Mapping Framework Version 2.0 (Natural Resources Canada, 2018b)
2. Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Natural Resources Canada, 2019)
3. Case Studies on Climate Change in Floodplain Mapping (Natural Resources Canada, 2018a)

It is a requirement that federally funded floodplain mapping projects adhere to these guidance documents.

Federal Flood Mapping Framework

The federal Flood Mapping Framework lays out the history and importance of floodplain mapping in Canada and how the series of documents will be used to create an effective framework for identifying, assessing, and mitigating flood risks (Figure 1 below).



Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation

The federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation provides a high-level methodology and principles for effective flood hazard delineation. Generally, these guidelines include more modern modelling approaches such as 2D modelling.

Case Studies on Climate Change in Floodplain Mapping

Canadian climate change case studies have been incorporated into the floodplain mapping process. The document is not prescriptive but provides useful approaches for accounting for climate change under various conditions. The two predominant themes in case studies are sea level rise and increasing precipitation due to increasing annual average temperatures. For Otonabee Conservation climate change considerations shall focus on the potential impacts of increased precipitation.

Provincial

No significant updates have been made to provincial regulations or guidelines for floodplain mapping since 2015. The Ministry of Natural Resources (MNR) is administering the Federal Flood Hazard Identification and Mapping Program (FHIMP) within Ontario and has indicated that the province will support 2D modelling with certain technical stipulations, although this support is not currently reflected in provincial guidelines.

The most current guidance on floodplain mapping from the provincial government remains the River & Stream Systems: Flooding Hazard Limit Technical Guide (MNR, 2002).

Conservation Authorities

Under our mandatory programs and services legislation (O. Reg 686/21) Otonabee Conservation is required to study, delineate and map natural hazards in our watershed. On April 1, 2024, changes to the *Conservation Authorities Act* and Ontario Regulation 41/24 came into effect across the province. This regulation requires Otonabee Conservation to use the Regional Timmins storm event as the event standard for floodplain mapping. The mapping is required to be available to the public and updated on an annual basis.

Strategy

Project Priorities

Prioritization Matrix

In the past, primary watercourses within the Otonabee Conservation watershed were analysed with respect to their existing hydrologic and hydraulic models, topographic mapping, and hazard level. Many floodplain studies require an update/replacement, particularly studies that are greater than twenty years old. A prioritization ranking system was used to ensure accurate and current floodplain mapping are completed in a timely fashion.

The greatest need for new floodplain mapping is dependent on the quality and usability of the existing information, or the lack thereof, and the risk consequences associated with flooding on a particular watercourse. To aid in the evaluation, each watercourse was given a weighted score based on the factors listed below. Note that each watercourse was scored based on models and mapping that have been previously adopted by the board.

Hydrology, hydraulics, and mapping were each given a score of 1 to 4. These values were defined as:

- Current and accurate – 1 point:
    - Created 2017 and after
    - Available electronically, in a current digital model
    - Uses Lidar-derived terrain model
- Out-dated and electronic format – 2 points:
    - Created before 2017
    - Available electronically
    - Produced in out-dated software
- Out-dated and hardcopy only – 3 points:
    - Created before 2004
    - Available in hardcopy only
- None available – 4 points:
    - No model available

Hazard level was also given a score of 1 to 4. The scoring is based on the hazard level assigned to a particular reach. Hazard levels were previously defined for existing study areas within the inventory sections of this report, where no study exists, the hazard level was estimated. The hazard scores are defined as follows:

- High – ≥ 80% of the reach, by length, classified as high hazard (4 points)
- Medium – ≥ 80% of the reach, by length, classified as medium or high hazard (3 points)
- Low – 40 - 79% of the reach, by length, classified as medium or high hazard (2 points)
- Very Low – >60% of the reach, by length classified as low hazard (1 point)

All of the components were combined using the formula:

Score = (Hydrology + Hydraulics + Mapping) * Hazard Level

Final scores were used to determine the priority of floodplain mapping for each of the watercourses, with higher scores indicating a higher priority. Other factors such as study cost, difficulty and development pressures are not factored into this assessment.

Watershed/Watercourse	Hydrology	Hydraulics	Mapping	Hazard Level	Score
Trent River	4	4	4	3	**36**
Bears Creek	3	3	3	4	**36**
Fleming Creek	4	4	4	2	**24**
Otonabee River - Lakefield to 5th Line Smith/Douro 9th Line	3	3	3	2	**18**
Otonabee River - 5th Line Smith/Douro 9th Line to Whitfield Rd	3	3	3	2	**18**
Cavan Creek - Downstream of Highway 7	3	3	3	2	**18**
Riverview Creek	3	3	3	2	**18**
Rays Creek	1	1	1	4	**12**
Ouse River – Norwood	1	1	1	4	**12**
Cavan Creek - Upstream of Highway 7	4	4	4	1	**12**
Indian River - All other reaches	4	4	4	1	**12**
Squirrel Creek	4	4	4	1	**12**
Byersville Creek *	1	1	1	4	**12**
Jackson Creek - City of Peterborough*	1	1	1	4	**12**
Ouse River - Outside Norwood	3	3	3	1	**9**
Otonabee River - Whitfield Rd to Rice Lake	3	3	3	1	**9**
Lakefield East Tributary	1	1	1	3	**9**
Indian River - Hope to Lang	3	3	3	1	**9**
Indian River - Gilchrist to Warsaw	3	3	3	1	**9**
Thompson Creek	1	1	1	3	**9**
Curtis Creek	1	1	1	2	**6**
Jackson Creek - Outside of Peterborough	1	1	1	2	**6**
Meade Creek	1	1	1	2	**6**
Baxter Creek	1	1	1	2	**6**
Kawartha Lakes			1	4	**4**

*Re-ranked as completed for 2024

The results of the prioritization matrix clearly indicate a number of priority projects that ranked very high due to the age and/or absence of digital models and mapping and/or risk levels within floodplain areas.

Technical Approach

Clear methodologies and reporting requirements are needed to ensure that floodplain mapping studies follow applicable technical guidelines and can be easily peer reviewed. The descriptions of the technical approach and data used needs to be sufficient such that the results of the study can be duplicated by a qualified engineer.

Flood management is regulated by provincial, territorial, and municipal levels of government, which often have different technical requirements. The federal government has developed the federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Natural Resources Canada, 2019) to provide a summary of current technical practices used by qualified professionals in Canada. While provincial regulations and guidelines supersede the federal documents, the federal documents are a good reference for aspects of floodplain mapping not included in provincial guidelines, such as 2D hydraulic modelling.

All floodplain mapping must be consistent with the River & Stream Systems: Flooding Hazard Limit Technical Guide (MNR, 2002) as the mapping is adopted as regulatory floodplain maps and implemented into Official Plans and/or Zoning By-Laws.

The Technical Guidelines for Flood Hazard Mapping (Environmental Water Resources Group Ltd., 2017) were developed to provide a prescriptive methodology for floodplain mapping projects while being consistent with provincial guidelines. This document will be referenced for model development and reporting requirements. The reporting requirements in the document are more comprehensive than provincial guidelines and represents an increase in the level of effort.

Finally, all regulatory floodplain mapping projects will have reports and floodplain maps signed and stamped by a licensed Professional Engineer in the province of Ontario.

Climate Change Adaptation

Recent climate change reports have reported Canada's climate is warming twice as fast as the global average (McNeil, 2019). A key part of quantifying flood risks for long-term planning is understanding the conditions that lead to flooding and how those conditions will change over time. Temperature and precipitation are climate change variables that affect intensity, duration and frequency of precipitation events which increase flood risk.

Otonabee Conservation developed a Climate Change Strategy in 2019 to guide climate change mitigation and adaptation approaches locally. Where updating and identifying regulatory flood hazards within the watershed to the current standard is extremely important, Otonabee Conservation stives to assess the possible impacts of climate change by integrating further flood risk analysis into the mapping process. This will ensure that Otonabee Conservation is meeting the goals of the Climate Change Strategy to quantify the future impacts of climate change on floodplain mapping and assist in hazard management with respect local land use planning.

One of the goals of Otonabee Conservations Climate Change Strategy is to collaborate with municipalities to establish new Intensity-Duration-Frequency (IDF) curves that reflect future climate change impacts. A tool was developed by the University of Western Ontario (UWO) that applies various climate models and scenarios to Environment and Climate Change Canada precipitation datasets to estimate changes to local IDF curves from 2015-2100 (Simonovic et al., 2015). The IDF curves are used in hydrologic modelling to determine the magnitude of return period storms (i.e. 50-year, 100-year storm, etc.). Using the tool from UWO will facilitate the integration of future precipitation regimes associated with climate change into modelling and floodplain mapping without the need for specialized climate experts. Similar tools can also be considered for future studies.

In addition to accounting for climate change in design storms, attention will be paid to extreme events that are larger than the 100-year storm event. The Timmins Storm is the Regional Storm within the Otonabee Conservation watershed, which occurred in 1961 before significant changes to the climate and precipitation regimes were observed. Under present and future climate change scenarios, a storm of the same return period would be significantly larger. More uncertainty is present when predicting the magnitude of extreme events. Factors such as rising ocean temperatures could allow hurricanes to make landfall further north and hit Ontario with increasing intensity. Larger storms could also develop within the Great Lakes due to rising temperatures, such as the unusual extra-tropical cyclone that formed on Lake Huron in 1996.

The MNR has stated the regulatory floodplain should be defined as the larger of the 100-year storm, the Regional Storm, or a larger event observed locally. However, Ontario Regulation 41/24 (April 1, 2024) now requires that the flood event standard be the Timmins Regional Storm for regulated areas mapping.

The federal Flood Mapping Framework, and the recent Flood Hazard Identification and Mapping funding program (FHIMP) recommend that storms larger than the Regional Storm are modelled, such as the 500-year and 1000-year storms. To ensure that future flood magnitudes are represented for both frequent and extreme storm events, climate models will be implemented into return period storms to assist with planning and infrastructure sizing. The range of return period storms modelled will be expanded to include up to the 1000-year storm and larger local storms, such as the 2004 storm. This framework will ensure that flood risk is accurately quantified over a wide range of storm magnitudes to assist in assessing the future impacts of climate change within our watershed.

Funding Opportunities

Funding for floodplain mapping has not been available from the province since the end of the Flood Damage Reduction Program (FDRP) in 1996.

In recent years, federal funding programs for floodplain mapping have allowed Otonabee Conservation to complete studies that have improved and updated floodplain mapping in key areas. This included the eight important mapping updates through the NDMP program and additional updates on Byersville Creek under the FHIMP program. Both programs allow local agencies to partner and commit funding support to apply under the 50-50 cost sharing framework.

Natural Resources Canada (NRCan) has recently announced (October 2023) an extension to the Flood Hazard Identification and Mapping Program (FHIMP) through to March 2028.

The intention would be to apply to the Flood Hazard Identification and Mapping Program for funds to complete the Byersville Creek floodplain mapping and priorities on the updated project schedule.

Authority staff will work collaboratively with municipalities and ensure all the parties are supportive of the work and timelines in order to move forward.

Updated Project Schedule 2024-2028

Despite separate scores for different reaches within the same watercourse, sometimes it is more cost effective to complete the entire watercourse within one study.

Based on the prioritization matrix, the following projects are scheduled to be completed between 2024 and 2028. These timelines correspond with the expected FHIMP grant application window.

Project
Trent River Floodplain Mapping
Bears Creek Floodplain Mapping
Riverview Creek Floodplain Mapping
Otonabee River Floodplain Mapping
Cavan Creek Floodplain Mapping
Fleming Creek Floodplain Mapping
Indian River Floodplain Mapping
Ouse River (Lower Reaches) Floodplain Mapping

References

Conservation Ontario. (2022). *Flood & Erosion Management: Conservation Authorities protect people and property from flooding*. https://conservationontario.ca/conservation-authorities/flood-erosion-management

Conservation Ontario (2017). *Metadata Inventory of Existing Conservation Authority Flood Mapping*. https://conservationontario.ca/resources?tx_fefiles_files%5Baction%5D=download&tx_fefiles_files%5Bcontroller%5D=File&tx_fefiles_files%5Bfile%5D=461&cHash=b33c67efa7a8df1b0d71300172527686

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Appendix A: Map of Floodplain Studies by Date Completed