Ontario Ministry of Natural Resources

Flood Hazard Identification and Mapping Program (FHIMP)

Program Guide

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INTRODUCTION

This Program Guide provides information about the Canada – Ontario FHIMP, including details that support applying for funding in Ontario. The guide has three parts:

- PART 1: FHIMP PROGRAM AND PROJECT INFORMATION provides an overview of FHIMP, including eligible project categories, program timelines, and available funding. It highlights updates that have been made since FHIMP was first launched, and outlines roles of the provincial and federal governments. This Part contains essential information which must be reviewed ahead of applying for FHIMP project funding in Ontario. It contains details which may impact the eligibility of, and costs to carry out, certain flood mapping activities and must be acknowledged when making an application for funding.

- PART 2: HOW TO FILL OUT A FHIMP PROJECT FUNDING APPLICATION provides information that will support completion of the FHIMP Project Funding Application.

- PART 3: TECHNICAL PROJECT PROCUREMENT PRIMERS provides information which may be considered when preparing requests for bids/proposals to undertake hazard identification and priority setting, data acquisition, and modelling and mapping projects.

Additional questions related to the FHIMP, or the application process may be directed to FHIMPapplications@ontario.ca.

PART 1: FHIMP PROGRAM AND PROJECT INFORMATION

1.1. Program Overview

In January 2022, Natural Resources Canada (NRCan) launched the FHIMP to provide up to 50% matched federal funding to provinces and territories for eligible flood mapping projects. FHIMP has now been extended through March 2028 with up to $15 million in funding available to be matched for activities throughout Ontario.

Eligible projects include those that support:

- flood hazard assessment, priority setting and scoping;
- the acquisition of data used in hydrological and hydraulic modeling;
- the development of flood hazard modelling and mapping;
- the dissemination of flood hazard information;
- **NEW!** erosion hazard studies, if they are included as part of a flood study; and
- **NEW!** regional modelling and mapping (completed at coarse level resolution).

The Ministry of Natural Resources (MNR) is now accepting applications for funding. MNR will enter into agreements with public organizations, including municipalities, Indigenous communities, planning authorities and conservation authorities to conduct flood mapping activities.

There are two application streams, based on when funding is requested for payout:

1) For proposals where funds will be requested for payout prior to February 2025, applications will be accepted until 4:30 pm EST on Friday October 9, 2024.
    - Single-year and multi-year proposals are eligible.
    - Projects with start dates as early as April 1, 2024 may be considered, however projects that are 100% complete are not eligible.
2) For proposals where funds will not be requested for payout until February 2025 or later, applications will be accepted until April 2027 **or** until all provincial FHIMP funding has been allocated.
    - Single-year and multi-year proposals are eligible.
    - Projects may not be approved if they have already been started and will be evaluated on a case-by-case basis.

In all cases, funding is available on a first come, first serve basis. Applications will be reviewed and evaluated based on factors such as:

- Presence or absence of existing mapping;
- Urgency or need for new or updated flood hazard mapping;
- Severity and frequency of new or historical flooding;
- Development pressures or planned development; and
- Financial constraints.

Consideration will also be given to the readiness of projects, recognizing the federal timelines associated with the FHIMP.

1.2. Program Administration

The FHIMP is administered through the coordinated efforts of NRCan, MNR and funding recipients. Environment and Climate Change Canada (ECCC) may also provide support as needed. These efforts are managed through a Project Technical Team (PTT), established for each organization receiving funding, and will include representatives from the province, federal government and funding recipient.

PTTs will meet throughout the project at a schedule to be established based on the projects scope and scale. Provincial and federal representatives provide specific roles on the PTT and in administering FHIMP in Ontario.

MNR provides leadership on the overall administration of the FHIMP in Ontario, coordinates PTT meetings, and manages invoicing review and approval. Projects are administered through Transfer Payment Agreements (TPA) which outlines requirements for the submission of deliverables, and project and financial reporting. Funding will be transferred to recipients through Transfer Payment Ontario (TPON).

The federal government provides technical support in developing project specifics, reviews deliverables, and approves final deliverables for payment.

1.3. Eligible Activities

The following activities are eligible for cost sharing under FHIMP.

1.3.1. Flood Hazard Mapping Prioritization and Scoping

a) Description:

- Assessment of the need for flood hazard mapping across a jurisdiction. These studies review available information, create an inventory of data and assesses potential exposure to flooding at the community level to support the need for flood mapping projects; and
- The results of a prioritization and scoping study provide jurisdictions with

valuable information for long-term flood program planning.

b) Requirements:

- Must increase jurisdiction's understanding of their flood hazard data needs, scope of future activities, identify priority mapping areas, a flood hazard mapping process, or status of their current data and flood hazard map holdings.

1.3.2. Elevation Acquisition and Processing

a) Description:

- Acquisition of lidar data or other elevation data where satisfactory data do not already exist, that are used to create high-resolution terrain models which are preferred inputs for flood hazard mapping due to their accuracy and level of detail.

b) Requirements:

- Must be acquired for hydrological, hydraulic or coastal modeling;
- Must be acquired in high-priority areas;
- Must meet the recommended minimum accuracies as outlined in the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023); and
- Must inform the development of new, improved, or renewed flood hazard maps.

1.3.3. Data Collection

a) Description:

- Acquisition, collection or production of data required for flood hazard modelling and mapping where satisfactory data do not already exist; and
- Common data types include topographic data, bathymetric data, field survey data, hydrometric data, high water marks data, detailed meteorological data (e.g., rainfall), detailed land use and land cover data, and historical observations, among others.

b) Requirements:

- Must be acquired for hydrological, hydraulic or coastal modeling;
- Must be acquired in high-priority areas; and

- Must inform the development of new, improved, or renewed flood hazard maps.

1.3.4. Detailed Engineering Quality Flood Mapping

a) Description:

- Production of maps that display the results of detailed engineering hydrologic and hydraulic investigations, showing areas that could be flooded under a variety of scenarios and conditions, as well as associated engineering reports and data;
- Can cover fluvial, lacustrine, and coastal flooding scenarios; and
- Analyses may include assessment of erosion-related hazards and geomorphological processes, including the associated data acquisition activities.

b) Requirements:

- At least three AEP scenarios are required to be modelled: the regulatory event, a lower magnitude event, and a higher magnitude event (AEP 0.5% or more, to account for climate change - see Section 1.7.9. Climate Change Considerations).
- Map products must be suitable for regulatory purposes;
- Must follow provincial and federal flood mapping guidelines and industry best practices. Provincial guidelines take precedence where any conflicts arise; and
- For erosion and geomorphological process assessments: must establish a strong linkage with the flood hazard assessment. Linkages include previous erosion-related events within the study area, feedback from communities through engagement activities, or physical process-related dependencies. Erosion and geomorphologic activities will be assessed and approved for cost-sharing on a project-by-project basis and will consider the value added to the final flood mapping products.

1.3.5. Regional Quality (coarse level resolution) Flood Hazard Mapping

a) Description:

- Production of regional quality flood hazard maps for the purpose of hazard screening and prioritization, public awareness, high-level land use planning and high-level hazard assessment; and
- Regional quality hydrological and hydraulic models involve the use of limited

data on bathymetry and structures, hydrological approximation methods, automated GIS-based methods and medium-resolution data inputs. Project specific methodologies should be developed by qualified practitioners.

b) Requirements:

- Can cover fluvial, lacustrine, and coastal flooding scenarios;
- At least three Annual Exceedance Probabilities (AEP) scenarios are required to be modelled: the regulatory event, a lower magnitude event, and a higher magnitude event (AEP 0.5% or more, to account for climate change); and
- Must follow provincial and federal flood mapping guidelines and industry best practices for the use cases identified (and approved). Provincial guidelines take precedence where any conflicts arise.

1.3.6. Dissemination of Flood Hazard Information

a) Description:

- Engagement and community outreach activities that support development of, or dissemination of finalized flood hazard maps. May include development of web portals, communication campaigns, training in flood map usage, publicity, videos, webinars, workshops, and engagement sessions; and
- Projects funded under FHIMP are encouraged to include engagement with Indigenous communities located within your area of study, or beyond, which may have an interest in flood hazard mapping. Engagement refers to the building of positive relationships, sharing priorities, and cooperative project development.

b) Requirements

- Must improve awareness of, access to, or acceptance of flood hazard information and maps.

1.4. Eligible Costs

All eligible costs must relate directly to FHIMP activities. Eligible costs include, but are not limited to:

- Contractual costs;
- Salaries and benefits - only applicable to new temporary or permanent personnel hired for FHIMP activities, personnel seconded from other

departments that are not typically involved in flood mapping activities and overtime pay, (including that of existing permanent staff);

- Travel expenses, including food and accommodation, consistent with the Ontario government's Travel Meals and Hospitality Directive;
- Material costs (e.g., printing costs, courier or shipping costs, data transfer hard drives);
- Rental costs (e.g., conference room rentals, vehicles, field equipment);
- Engagement costs – reasonable costs directly associated with meetings, open houses, or communications for community engagement purposes, such as local transportation to and from the activity and facility rentals; and
- Purchase of data or data subscriptions (e.g., satellite imagery, geospatial data).

1.5. Ineligible Costs

Ineligible costs include but are not limited to:

- Hospitality, meeting food and beverages, alcoholic beverages and entertainment;
- Administrative costs which are not directly related to a specific FHIMP project;
- Salaries and benefits of existing employees;
- Capital costs (depreciable property, such as tangible capital assets (physical infrastructure, vehicles, computers, IT equipment, permanent hydrometric stations, etc.) as well as non-depreciable assets (land).

  Note: an exception to ineligible capital costs is the purchase of small equipment for temporary flow and water level monitoring (e.g., data loggers and associated supplies/hardware for their temporary installation in the field). Such equipment should account for no more than $2,000.00 per project, be less expensive to buy than to rent, and be used to maximize its lifecycle).

- Costs associated with the development of agreements, proposals and applications; and
- Costs reimbursed by any other federal program.

1.6. Program Requirements

In order to meet both provincial and federal agreement requirements, successful

applicants must:

- Have all project deliverables completed no later than December 2027;
- Agree to share with the governments of Ontario and of Canada any project deliverables, data, flood maps or other information learned as a result of the project;
- Make flood hazard maps, data, and data-derived products publicly available online, in accordance with the Open Government License – Ontario and Open Government License – Canada. Where the organization does not have the means to do so, federal government methodologies may be used;
- Agree that no other funding has been, or will be, received by another federal program for the project. Any new sources of federal funding must be disclosed immediately;
- Enter into an agreement with the MNR that will further outline requirements related to the release of deliverables, technical requirements, and reporting;
- Be responsible for covering at least 50% of the project costs, agreed to be cost-shared and incurred;
- Be required to demonstrate that they have the support of local municipal/planning authorities, indicating alignment with overall land use planning in the jurisdiction. This can be provided via Council resolution or similar planning authority letter and must be provided prior to entering into agreement with MNR. It is recommended that applicants work with their planning authority early in the project planning process to ensure projects meet the needs and interests of the jurisdiction;
- Ensure that products created are consistent with the policies in the current Provincial Policy Statement and the policies and performance standards outlined in MNR's natural hazard technical guides. Maps created must be suitable for use in a regulatory regime;
- Where appropriate, engage with local Indigenous communities, building positive working relationships, sharing priorities, and creating cooperative project development;
- Agree that NRCan and Ontario may release information regarding the project such as: its title, the names of successful applicants, and the level of NRCan funding and other support;
- Agree to publicly recognize the contribution of the federal and provincial governments in all project public announcements, press releases, publicity, and publicly available products (including flood hazard maps);

- NRCan’s support is to be acknowledged using the "Canada" wordmark, and, where space allows, the credit line "This project is funded [in part] by the Government of Canada”;

- The province’s support is to be acknowledged using the Ontario logo, and where space allows, the credit line “This project was made possible in part by the Province of Ontario”;

- Agree to participate in a Project Technical Team with provincial and federal staff to discuss project status and deliverables; and

- Be required to have/create a Transfer Payment Ontario account, to facilitate project payment(s).

1.7. Technical Requirements

The following specifications are associated with each type of eligible activity listed in Section 1.3. Eligible Activities.

1.7.1. Geospatial Data Specifications

All geospatial data delivered for this project should meet the following specifications:

1.7.1.1. Geospatial Reference Systems

Geometric reference systems should use NAD83(CSRS) and height reference system (vertical datum) should be CGVD2013.

1.7.1.2. Geospatial File Formats

All gridded raster files should be provided in the GeoTIFF format. Vector files should be provided in an Esri Shapefile, Esri File Geodatabase or Geopackage format.

Geospatial data made available using other current Open Geospatial Consortium (OGC) geospatial data standards may be considered.

1.7.1.3. Geospatial Geometry Validity

All geospatial vectors must be geometrically valid according to Open Geospatial Consortium (OGC) standards as defined in OpenGIS Implementation Specification for Geographic information (#06-103r4). These standards include, but are not limited to, the requirements that geometry be non-empty, topologically closed, and be free of self-intersecting paths or discontinuous parts.

1.7.2. LiDAR Specifications

The LiDAR point cloud data shall be tiled in 1 km x 1 km tiles and provided in LAZ format. The point cloud should meet the following technical specifications:

- Minimum aggregate nominal pulse density >= 8.0 pls/m^2.

The point cloud data should meet the following accuracy benchmarks:

- Non-Vegetated Vertical Accuracy (NVA): 95% Confidence level <= 9,8 cm; and
- Vegetated Vertical Accuracy (VVA): 95th percentile <= 14,7 cm.

Point cloud data should be classified according to the following minimum standard categories:

Class Value	Class Description
1	Processed, but unclassified
2	Ground
6	Building
7	Low noise
9	Water
17	Bridge deck
18	High noise

Two dimensional closed polygons should be created for 'low confidence areas' where bare earth elevation values may not meet the overall data accuracy requirements. See the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023) for additional information.

1.7.3. Provincial and Federal Technical Guidance

The standards provided within provincial natural hazard technical guidance should inform the methodologies used when planning and undertaking technical work. The Federal Flood Mapping Guidelines Series may be used as additional information sources, as appropriate, but not serve as primary guidance.

To ensure flood hazard maps can be used for regulatory purposes, where any conflicts arise, the province's technical guidance, standards and policies take precedence over the Federal Flood Mapping Guidelines Series.

1.7.3.1. Provincial Technical Guidance:

The following provincial technical guidance should be referenced when undertaking flood mapping activities, as appropriate:

- Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023);
- Technical Guide – River & Stream Systems: Erosion Hazard Limit (MNR, 2002a);
- Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b);
- Technical Guide for Great Lakes – St. Lawrence River Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001); and
- Technical Guide for Large Inland Lakes (MNR, 1996).

For copies of provincial technical guidance, email FHIMPapplications@ontario.ca.

1.7.3.2. Federal Technical Guidance:

The following federal technical guidance may be used as reference, as appropriate:

- Federal Flood Mapping Framework (Version 2.0) (NRCan, 2018c);
- Federal Airborne LiDAR Data Acquisition Guideline (Version 3.1) (NRCan, 2022);
- Bibliography of Best Practices and References for Flood Mitigation (Version 2.0) (NRCan, 2018a);
- Case Studies on Climate Change in Floodplain Mapping (Volume 1.0) (NRCan, 2018b);
- Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023);
- Federal Geomatics Guidelines for Flood Mapping (Version 1.0) (NRCan, 2019); and
- Federal Flood Damage Estimation Guidelines for Buildings and Infrastructure (Version 1.0) (NRCan, 2021).

1.7.4. CFM Compliance Form(s)

The Canada Flood Map Inventory (CFM) Compliance Form facilitates the conversion of flood mapping data products to CFM database standards. Each project involving the creation of a flood hazard map will be accompanied by its own form. The CFM Compliance Form is provided by NRCan.

1.7.5. Topographic Analysis

The most relevant and recent topographic information, including but not limited to Digital Elevation Models (DEM) and Digital Terrain Models (DTM), should be applied in all stages of the flood mapping process. Accuracies for these datasets should follow the recommendations set out in the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023).

1.7.6. Bathymetric Analysis

If applicable, professional surveyors and technicians shall be employed for the collection of bathymetric data. A survey report detailing methods and results of bathymetric survey shall be provided, along with the processed bathymetric data. Bathymetric surveys should be conducted to obtain relevant and required information as outlined in the Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (NRCan, 2023), Section 3.41 and Appendix 3 of the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023) should also be consulted in relation to the use and collection of bathymetric survey information.

1.7.7. Data Collection

If applicable, professional surveyors and technicians shall be employed for the collection of field data or supervision of field data collection. This data may include, without being limited to, structures and crossings surveys, hydrometric surveys (flow or water level measurements), high water marks surveys or detailed meteorological data measurements.

Field investigations should be conducted to obtain relevant and required information as outlined in the relevant provincial technical guidance documents, including, but not limited to the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023). The Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (NRCan, 2023), may also be used to support data collection, when used in conjunction with Ontario's technical guidance.

If types of data other than surveys are collected or developed to support flood hazard modelling and mapping, a report should be produced describing the methodology, analysis, and findings. The report will be accompanied by any associated data produced. Examples of other types of data include, without being limited to, project-specific aerial photographs or satellite imagery, detailed land use and land cover layers or historical observations.

It is recommended that a field program or methodology memo be submitted to and approved by the Project Technical Team before conducting field investigations. For other types of data collection, a methodology document is also required for approval.

1.7.8. Hydrologic and Hydraulic Analysis

Industry standard practices and modelling software should be used to conduct hydrologic and hydraulic analysis in accordance with the Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b) for riverine systems, the Technical Guide for Great Lakes – St. Lawrence River Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001), as well as the Technical Guide for Large Inland Lakes (MNR, 1996). The Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (NRCan, 2023), may also be consulted, as appropriate.

Documentation for all steps of analysis and results must be provided along with rationale for model selection and analysis methodology.

The following AEPs are recommended for modelling purposes: 2%, 1%, 0.5%, 0.2%, and 0.1%., however they will not all be mapped in the final study deliverables (see Section 1.7.10. Minimum Mapped Annual Exceedance Probabilities If not reflected in this list of AEPs, an additional climate change scenario is required (see Section 1.7.9. Climate Change Considerations).

1.7.9. Climate Change Considerations

A standard approach to estimating flood zone variability attributable to climate change must be applied to hydrologic and hydraulic analysis in accordance with Provincial Policy Statement (PPS) policy 3.1.3, the Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (NRCan, 2023), and the Case Studies on Climate Change in Floodplain Mapping (NRCan, 2018b).

As per requirements under the FHIMP, at a minimum, peak flows are to be computed for the flood event standard (i.e., Regulatory Event), the 25-year, 50-year, and 100-year flood, as well as a climate informed flood flow that exceeds the Regulatory Event.

For the FHIMP extension program, climate change shall be considered, relative to the magnitude of the flood event standard (i.e., Regulatory Flood Event) applied in the area/jurisdiction of study. This may involve computation of one or two flood events greater than the flood event standard, depending on the relative magnitude of its flow to the 200-year and 350-year flood events. Alternatively, where computations and graphical evidence substantiate that a jurisdiction's flood event standard (i.e., Regulatory Flood Event) exceeds the 1:350-year flood event (0.29% AEP), no additional mapping will be required as a proxy for climate change.

Any increase in the magnitude and associated extent of flooding that occurs by applying the FHIMP climate change factor, is solely for information purposes to satisfy requirements under the FHIMP, to derive a flood flow/level greater than the flood event

standards/Regulatory flood event as a proxy for climate change. This information is not intended to be used for generating Regulatory flood-lines and associated mapping in Ontario.

The climate change flood event review process is outlined in Figure 1.1. Decision process diagram for climate change requirements under FHIMP in Ontario. Key computations and mapping requirements are identified for items a) through d) informed by the magnitude/return period of the flood event standard for the area of interest. The process is as follows:

a) Where the flood event standard (i.e., Regulatory Event) is exclusively the 100-year flood (1% AEP), as well as in circumstances where the 100-year flood produces the greatest flood magnitude in Zone 1 and Zone 3, over the Regional flood (i.e., Hurricane Hazel or Timmins) storm events (see Section 1.7.10. Minimum Mapped Annual Exceedance Probabilities) and the Flood Hazard Criteria Zones of Ontario found in the Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b). Additional computations are required to derive flood flows equivalent to the 200-year flood event (0.5% AEP) and the 350-year (0.29% AEP). The extent of the flooding hazard limit shall be mapped for both the 200-year and 350-year flood, as a proxy scenario for climate change. This also applies to the Technical Guide for Great Lakes – St. Lawrence River Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001) and Technical Guide for Large Inland Lakes (MNR, 1996), as appropriate.

b) For all flood event standards that exceed the 100-year flood (1% AEP), the return period for the magnitude of the flood event standard shall be estimated/computed and documented including presentation of the graphical information (e.g., return-time plots, flood frequency curves) used to estimate the return period. This includes an evidence-based interpretation of the data analyses including a description of the statistical distribution(s) (e.g., Generalized Extreme Value (GEV), Three-Parameter Lognormal (3PLN)) of best fit, and any limitations of the analyses noted when deriving the best estimate of the return period/recurrence interval. All data from this step, including supporting graphical information shall be included in the hydrology report.

c) When the magnitude of the flood event standard (as calculated in Step b) is found to be less than the 200-year flood (0.5% AEP) and greater than the 100-year flood (1% AEP), the 200-year and 350-year flood (0.29%) flow magnitudes shall be estimated and mapped as a proxy scenario for climate change.

d) When the magnitude of the flood event standard (as calculated in step b) is less than the 350-year (0.29%) flood, but greater than the 200-year flood (0.5% AEP), the 350-year flood (0.29% AEP) shall be applied and mapped as the climate change proxy scenario event.

- Where the 350-year flood (0.29% AEP) is exceeded by the flood event standard, no additional mapping is required, however this shall be substantiated and confirmed in writing within Step b.

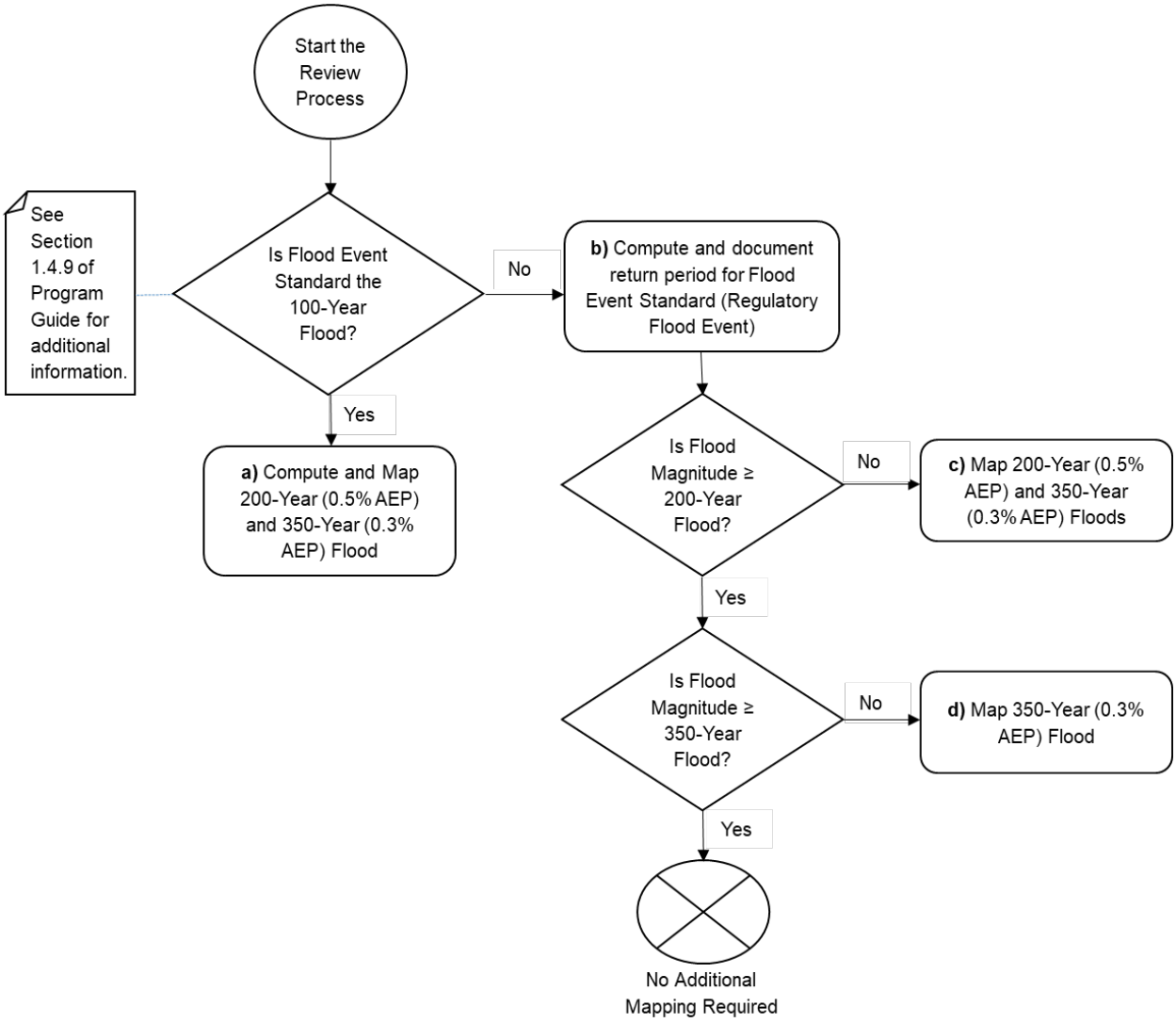

Figure 1.1. Decision process diagram for climate change requirements under FHIMP in Ontario.

To reiterate, this information and the climate change process outlined above, **is not** intended to be used for generating Regulatory flood-lines and associated mapping in Ontario.

It is advisable to consult the Project Technical Team if an approach that differs from those outlined herein is being advanced.

All analyses and decisions shall be documented in the hydrology report.

1.7.10. Minimum Mapped Annual Exceedance Probabilities

It is understood that the hydrologic and hydraulic analysis provide results for a range of AEPs, however they will not necessarily all be mapped in the final study deliverables. A minimum of three scenarios are required for mapping.

Flood Hazard Criteria Zones of Ontario are defined in the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b):

Zone 1: Flood produced by Hurricane Hazel Storm or the 100 Year Flood, whichever is greater;

Zone 2: The 100 Year Flood; and

Zone 3: Flood produced by the Timmins Storm, or the 100 Year Flood, whichever is greater.

As per FHIMP objectives, it is typically required that a minimum of three flood events with varying magnitudes be mapped to better inform flood risk assessment and management at the local level. In general, the regulatory flood would be mapped according to the Flood Hazard Criteria Zones of Ontario, as well as a flood event with a magnitude lower than the regulatory flood, and a minimum of one flood event with a magnitude higher than the regulatory flood.

Since climate change considerations are not yet included in provincial flood mapping technical guidelines, the flood event(s) of higher magnitude will serve as a proxy scenario for climate change. The higher magnitude event(s) should be equal to or higher than a 200 Year Flood (0.5% AEP). The approach and resulting climate proxy to be applied is dependent on the magnitude and associated return period of the flood event standard (Regulatory Event) in the area of interest. See Section 1.7.9. Climate Change Considerations for more details.

1.7.11. Erosion Hazard Analysis

Provincial erosion hazard guidance that integrates industry standard practices and professional engineering and geoscientist judgement shall be used to conduct the required erosion hazard analysis.

Requirements for erosion hazard analysis are defined in provincial technical guides:

I. Technical Guide - River and Stream Systems: Erosion Hazard Limit (MNR, 2002a);

II. Technical Guide for Great Lakes – St. Lawrence River Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001); and

III. Technical Guide for Large Inland Lakes (MNR, 1996).

When technical requirements specific to an analysis are not covered in existing guidelines at the federal or provincial/territorial level, alternative requirements may be proposed with adequate rationale, for approval by the Project Technical Team.

1.7.12. Geospatial Flood Features

The following features shall be provided as georeferenced vectors:

- Study area; and
- Flood hazard areas subdivided into:
  - Direct inundation areas; and
  - For two-zone flood plains: floodway and flood fringe sub-polygons.

Furthermore, any geospatial vectors either required for, or produced by hydrological or hydraulic modelling, should be included. Application or consideration of these attributes produced by hydrological or hydraulic modelling shall be consistent with policies and performance standards outlined in Ontario's natural hazard technical guides.

These can include, but are not limited to:

- Reach lengths;
- Channel and overbank centre lines;
- Bank stations and bank lines;
- Ineffective flow areas, 2D areas and relevant mesh features such as break-lines or refinement regions;
- Hydraulic and flood control structures (bridges, culverts, weirs, dikes/levees, among others);
- Model cross sections and/or bathymetry used, with all computed flood frequency levels contained as attributes; and
- Final Digital Elevation Models (DEMs) used in the hydraulic modelling or mapping phase, if applicable.

The following features should be provided as georeferenced raster format:

- Water surface elevation;
- Flood depth;
- Flood velocity; and

- Other applicable deliverables (such as depth x velocity results).

Additional recommendations can be found in the Technical Bulletin for Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023).

1.7.13. Detailed Engineering Quality Flood Hazard Maps, Engineering Reports and Data

Where detailed engineering flood hazard maps, engineering reports and data are being created, they must be suitable for regulatory applications by their provincial and local governments.

Engineering reports must include at minimum:

- Information on hydrology and hydraulic setting;
- Data inputs;
- Assessment approach, assumptions and rationale;
- Details of assessment and results, including model validation and calibration; and
- Discussion on estimated level of quality and limitations.

The engineering report should allow third parties to reproduce the modelling study including its results, without the need to refer to other material. If interim reports or memorandums are not separately issued, all associated information should be included in the final engineering report.

Final engineering reports and maps, including interim reports or memorandums if issued separately, should be signed and sealed by a qualified professional. A “qualified professional” means someone who possesses the specialized knowledge and experience required to conduct hydrologic and hydraulic analyses to support flood mapping, licensed under the Canadian provincial or territorial engineering regulator for the study site.

1.7.14. Regional Quality Flood Hazard Maps, Engineering Reports and Data

Where regional flood hazard maps, engineering reports and data are to be created, they must be deemed suitable for use cases approved by the Project Technical Team.

Engineering reports must include at minimum:

- Information on hydrology and hydraulic setting;
- Data inputs;

- Assessment approach, assumptions and rationale;
- Details of assessment and results, including model validation and calibration; and
- Discussion on estimated level of quality and limitations.

The engineering report should allow third parties to reproduce the modelling study including its results, without the need to refer to other material. If interim reports or memorandums are not separately issued, all associated information should be included in the final engineering report.

Final engineering reports and maps, including interim reports or memorandums if issued separately, should be signed and sealed by a qualified professional. A “qualified professional” signifies someone who possesses the specialized knowledge and experience required to conduct hydrologic and hydraulic analyses to support flood mapping, licensed under the Canadian provincial or territorial engineering regulator for the study site.

1.7.15. Erosion Hazard Maps, Engineering Reports and Data

Erosion hazard maps, engineering reports and data created must be suitable for regulation. These deliverables include assessment of erosion-related hazards and geomorphological processes completed as part of a flood hazard study.

Engineering reports must include at minimum:

- Information on erosion hazard setting;
- Data inputs;
- Assessment approach, assumptions and rationale;
- Details of assessment and results, including model validation and calibration; and
- Discussion on estimated level of quality and limitations.

The engineering report should allow third parties to reproduce the modelling study including its results, without the need to refer to other material. If interim reports or memorandums are not separately issued, all associated information should be included in the final engineering report.

Final engineering reports and maps, including interim reports or memorandums if issued separately, should be signed and sealed by a qualified professional. A “qualified professional” signifies someone who possesses the specialized knowledge and experience required to conduct erosion or geomorphological hazard analyses to support flood mapping, licensed under the Professional Engineers of Ontario and/or Professional

Geoscientists of Ontario.

Erosion hazard deliverables may be integrated with other flood hazard mapping deliverables or provided separately.

1.7.16. Other Activities

For other types of activities not included above, specific technical requirements must be clearly documented in collaboration with the Project Technical Team.

PART 2: HOW TO FILL OUT A FHIMP PROJECT FUNDING APPLICATION

This part provides details on how to successfully complete the FHIMP Project Funding Application form.

2.1. Section 1: Application Contact Information

Questions (Q) 1 through 8: Provide applicant contact information as outlined.

Q9. Review all project eligibility, program and technical requirement information in PART 1: FHIMP PROGRAM AND PROJECT INFORMATION and check the box that you agree to participate in the program as outlined.

2.2. Section 2: Project Summary

Q10. Project Title: Title applicable to the project. Please consider using a descriptive qualifier, for example, Flood Mapping Study – Blue River.

Q11. Project Start Date: Indicate the date that project work will commence.

Note: For applications with deliverables that will be completed prior to February 2025, project start dates as early as April 1, 2024 may be considered, however projects that are 100% complete are not eligible. These applications must be submitted no later than Sept 13, 2024 at 4:30pm EST.

After Sept 13/24, project applications may not be approved if they have already been started and will be evaluated on a case-by-case basis.

Q12. Project End Date: Indicate the date that your project is anticipated to be complete and final deliverables will be submitted to MNR.

Note: The last date that final deliverables can be submitted for a project is December 1, 2027. We encourage you to ensure that your project will be complete in advance of this final deliverable date, to avoid unforeseen circumstances.

Q13. Estimated Project Cost: Provide the estimated total project cost from all funding sources, including appliable taxes.

Q14. Estimated FHIMP portion of cost: Up to 50% of eligible project costs and applicable taxes may be provided by the FHIMP. Please indicate the amount of funding you are requesting according to this cost-share.

2.3. Section 3: Project Details

Q15. Project Description: Provide an outline of your project, including details regarding how this project will directly lead to the creation of flood hazard maps, increase access to flood hazard maps, or improve the quality of existing flood hazard maps in Ontario. Where applicable, please also describe the methodology/methodologies that will be used in this project.

Q16. Description of the geographic area(s): Outline the project area(s) including the names of local communities, e.g. A, B, C, and part of D, as applicable.

Application should also include a georeferenced vector file indicating the geographic extent of a project, when applicable. For flood hazard mapping activities, the geographic extent is to be provided under the form of polylines representing the hydrographic features to be covered by flood mapping (e.g., centerline for river reaches, and coastline, among others).

Q17. Estimated project area(s) in square kilometres. Provide the area to be covered by the study.

Q18. Estimated population living in the area of study: Provide an estimated number of people impacted by the project results. This could be number of people living in the watershed or community(s) if study information is not available. Please indicate the metric used.

Q19. Number and names of lakes to be studied: Provide the number of lakes and their names that will be studied in this project. An estimate may be provided if the number is large and unknown. Please indicate if number is actual or estimated.

Q20. Number and names of rivers to be studied: Provide the number of rivers and their names that will be studied in this project. An estimate may be provided if the number is large and unknown. Please indicate if number is actual or estimated.

Q21. Project Category: Choose the project category(s) that apply to your project from the list of eligible project categories provided. You may check as many boxes as applicable for your project.

Q22. Project Status: Choose the current stage of your project at the time of application from the list provided (check one box).

Q23. Status of flood hazard mapping in the project area: From the options provided, choose the option that most closely reflects the current status of your flood hazard mapping project (check one box).

Q24. Identify stakeholders connected to this project and their current/potential level of engagement: Identify any stakeholders you plan to engage through your project.

Q25. If applicable, identify partners involved in the project and describe their level of involvement. Include how partners will be engaged in the project, for example, staffing, equipment, data, institutional experience. Include any financial support.

Q26. Please identify any Indigenous communities located within your area of study, or beyond, which may have an interest in this work, as well as any proposed engagement with these communities: Projects funded under FHIMP are encouraged to include engagement with Indigenous communities who have an interest in flood hazard mapping. Engagement refers to the building of positive relationships, sharing priorities, and cooperative project development. Provide an overview of how you plan to engage Indigenous communities in your project.

Q27. FHIMP funded projects are prioritized based on areas of highest need and/or urgency. Describe, in detail, the need and/or urgency for this project: Provide an overview of why the project is a priority. This could include area specific information related to vulnerable populations, lack of mapping, lack of data, community requests, presence of critical infrastructure, age of existing mapping, known inaccuracies in current mapping, impacts of climate change, or similar relevant information.

Q28. Describe, in detail, the historic impacts of flooding in the project area: Provide details of how flooding has impacted the project area and community(s). This information could include frequency, severity, impact of recent/historical flooding events, changes to the hydrology of an area, impacts of a changing climate, erosions hazards, changes to watercourses, and other similar information.

Q29. Describe, in detail, any development pressures or planned development in the project area: Provide an overview of how development plans or pressures, zoning by-law requirements or changes, changes in land use designations, and other planned or existing development pressures may be contributing to enhanced prioritization of the project locally.

Q30. Describe, in detail, any financial constraints and considerations that impact, or limit, the ability to complete the project. Consider including information related to funding constraints, funding partnerships, or how receiving cost-share funding from the FHIMP program would impact the success of this project.

Q31. If available, provide existing flood maps, local studies, risk assessments or any other information that will support your application. This additional information will be used to evaluate your application. Check yes or no for the inclusion of additional information. If information will be submitted, include it with your application email to FHIMPapplications@ontario.ca.

2.4. Section 4: Workplan and Budget

Q32. Provide a workplan that clearly articulates all activities associated with the project: The workplan should include a breakdown of all deliverables, using multiple lines in the workplan chart. Click on the "Add Activity" button for additional lines in the chart. Refer to Section 2.4.1. Project Categories: below for detailed information on the standardized deliverables required under FHIMP. The workplan should also include a breakdown of all major activities/tasks that support the deliverable.

- **"Deliverable**" means project results, including data, reports, presentations, models and maps that will be completed and submitted. Standardized deliverables are required for each deliverable type. These are outlined below.
- **"Activities/Tasks**" means the activities/tasks that you will do to complete the deliverable, for example, a data collection report would have various data collection activities associated with it.
- **"Timelines"** (Start and End Dates) means the start and end dates for each deliverable. The end date should be the date that you plan to submit the deliverable to the MNR. This timeline should reflect a date following receipt and review by your organization of any deliverables prepared by a Service Provider, if applicable.
- **"Deliverable Cost"** means the total funding amount required to complete the deliverable (including applicable tax). This should reflect the total cost, not the cost-share amount being requested.

The following standardized deliverables are provided based on the FHIMP project categories. List the applicable project deliverables directly in your application.

Note: If your project includes more than one project category, include the deliverables from each of the applicable categories.

2.4.1. Project Categories:

2.4.1.1. Prioritization and Scoping

Standardized Deliverables	Description
Project Proposal / Prioritization Methodology Memo	Memo detailing scope and objectives of prioritization study, methodology for developing prioritization including engagement plan, timeline and expected outputs.
Engagement Report	Report detailing engagement activities conducted and findings, if applicable.

Standardized Deliverables	Description
Flood Mapping Prioritization and Scoping Report	Report detailing the data and existing mapping inventory, assessment of potential exposure by the community, engagement, flood mapping prioritization results and scoping of activities for future flood hazard mapping work.

2.4.1.2. Elevation Acquisition and Processing

Standardized Deliverables	Description
Lidar Point Cloud Data	Final and classified point cloud data delivered by the Lidar contractor.
Lidar Data Index File	Geo-referenced vector file containing coordinates of Lidar tiles, including the date, naming convention, and project name for the areas of interest.
Lidar Project Report	Final report of the Lidar project provided by the Lidar contractor detailing the data collection, acquisition specifications, Lidar processing and lidar QA/QC.
Lidar QA/QC Report	QA/QC report based on validation methods described in the Federal Airborne LiDAR Data Acquisition Guideline (NRCan, 2022)
Digital Terrain and Digital Surface Models	Digital Surface and Digital Terrain Models derived from the final and accepted Lidar dataset or other source.

2.4.1.3. Data Collection

Standardized Deliverables	Description
Data Collection Methodology Memo	Memo detailing scope and methodology to be implemented for data collection, including technical resources, expected location, equipment, collection and processing methods, QA/QC, assumptions and expected accuracy.
Data Collection Report	Reports for field surveys or other types of data collection or production, describing the methodology, results and accuracy standards, accompanied by final processed data.

2.4.1.4. Detailed Engineering Quality Flood Hazard Mapping

Standardized Deliverables	Description
Interim Report / Memorandum	Interim reports or memorandums prepared at pre-determined project milestones for review or validation (e.g., hydrology or hydraulics memos could be produced separately if deemed necessary by the Project Technical Team).

Standardized Deliverables	Description
Hydrologic, Hydraulic and/or Coastal Model	Hydrologic, hydraulic and/or coastal models developed for the production of detailed engineering flood hazard maps (including model files, inputs and outputs). Model files delivered should be accompanied by an engineering report or memo pertaining to the modelling activities (“Interim Report/Memorandum” or “Flood Hazard Mapping Engineering Report”).
Flood Hazard Maps, Report, and Associated Data	Detailed engineering flood hazard maps that display the results of hydrologic and hydraulic investigations, showing areas that could be flooded under a variety of scenarios and conditions, as well as associated engineering reports and data. Geospatial flood features must be provided as a distinct package.
Canada Flood Map Inventory (CFM) Compliance Form(s)	The CFM Compliance Form facilitates the conversion of flood mapping data products to CFM database standards. Each project involving the creation of a flood hazard map will be accompanied by its own form. The CFM Compliance Form is provided by NRCan.

2.4.1.5. Regional Quality (coarse level) Flood Hazard Mapping

Standardized Deliverables	Description
Project Proposal / Modelling Methodology Memo	Memo detailing scope, goals, and methodology to be implemented for regional modelling project, including data inputs, main assumptions and expected results from regional flood hazard analysis.
Interim Report/Memorandum	Interim reports or memorandums prepared at pre-determined project milestones for review or validation (e.g., hydrology or hydraulics memos could be produced separately if deemed necessary by the Project Technical Team).
Hydrologic, Hydraulic and/or Coastal Model	Hydrologic, hydraulic and/or coastal models developed for the production of regional flood hazard maps (including model files, inputs and outputs).
Regional Flood Hazard Maps, Report, and Associated Data	Regional flood hazard maps that display the results of hydrologic and hydraulic investigations, showing areas that could be flooded under a variety of scenarios and conditions, as well as associated engineering reports and data. Geospatial flood features must be provided as a distinct package.
CFM Compliance Form(s)	The Canada Flood Map Inventory (CFM) Compliance Form facilitates the conversion of flood mapping data products to CFM database standards. Each project involving the creation of a flood hazard map will be accompanied by its own form. The CFM Compliance Form is provided by NRCan.

2.4.1.6. Dissemination of Flood Hazard Information

Standardized Deliverables	Description
Community Engagement Deliverables	Summary of engagement activities and feedback on flood mapping products.
Dissemination Activity Report	For dissemination activities other than community engagement: complete description of the project, including methodology, analysis, results, along with associated data and outputs (as applicable).

Q33. Describe any additional information pertaining to the workplan that was not addressed in in the workplan chart if needed: Use this space to provide any additional information, as needed.

Q34. Budget – Funding Source: Populate the chart, breaking down the funding total (including applicable taxes) by:

- Federal Funding Requested (FHIMP portion): This amount can only be up to 50% of the Total Project Cost outlined as the last line in the table;
- Applicant Funding: Amount the applying organization will provide towards the total cost of the project;
- Other/Partner Funding: Financial amount other partners may be contributing towards the total cost of the project, if applicable; and
- Provide the Total Project Cost from all funding sources.

Q35. This space has been provided to describe any additional information pertaining to the project budget that will provide further clarification.

2.5. Submission Details

Following completion of your application form, please validate the form by clicking the “Validate Information” button at the bottom of the last page of the application form. This will confirm that all required sections of your application have been completed.

Once completed, please email the application form and applicable supporting materials to FHIMPapplications@ontario.ca. All applications must include the “Project Title” and “Organization/Community Name” in the subject line of your email.

Once your application has been received, applicants will receive a confirmation email that includes a unique FHIMP ID for your submission. This ID will be used for all future communication on your project.

PART 3: TECHNICAL PROJECT PROCUREMENT PRIMERS

Three technical project procurement primers (Primers) have been developed to support the acquisition of services under FHIMP and ensure that project deliverables meet the intended needs of the organization and the program. Primers are meant to support an organization's existing procurement mechanisms and are not meant to detract or alter local templates, processes or project administration. Primers are technical support tools that may be used for FHIMP activities related to rivers, streams and small inland lakes, large inland lakes and the Great Lake – St. Lawrence River system. Local site-specific information will be required to be added throughout each Primer to complete the descriptions.

The Primers focus on the following areas:

1) Appendix A:
   Technical Project Procurement Primer: Hazard Identification and Priority Setting for Flood Hazard Mapping (Appendix A);
2) Appendix B:
   Technical Project Procurement Primer: Data Acquisition Projects for Flood Hazard Mapping (Appendix B); and
3) Appendix C:
   Technical Project Procurement Primer:
   Flood Hazard Modelling and Mapping Projects (Appendix C).

Where appropriate, applicants may also refer to MNR's flood hazard technical guidance to support technical criteria of procurement work:

- Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b);
- Technical Guide – River and Stream Systems: Erosion Hazard Limit (MNR, 2002a);
- Technical Bulletin – Flooding Hazard: Data Survey and Mapping Specifications (MNR, 2023); and
- Technical Guide for Great Lakes – St. Lawrence River Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001).

Interested organizations are not required to use the information provided in the Primers to complete their applications, however they may contain useful information which support this process.

Where there is interest from organization in using a Primer to procure services, they are encouraged to also work with their PTT to obtain additional support, if needed. The PTT

will confirm the scope of work as part of their role at the beginning of projects.

Appendix A:
Technical Project Procurement Primer: Hazard Identification and Priority Setting for Flood Hazard Mapping

1. Background Information

The Proponent is seeking proposals from qualified engineering Service Providers (Consulting) firms to conduct a flood hazard identification and priority setting exercise for the jurisdiction. The objective of this project is to determine priority areas where new or updated flood mapping is needed, and what data will need to be acquired, to complete the mapping.

This project is aligned with the Federal Flood Mapping Framework (NRCan, 2018c), of which the objectives of this project will be to:

- identify current mapping status;
- identify shortfalls in current data and mapping;
- identify and prioritize areas for acquiring new mapping; and
- develop a plan to acquire data required for flood mapping and implement flood mapping across the county. These plans will enable the Proponent to be prepared for effective response to any future potential flood mapping funding opportunities.

Notes:

Background information is important to provide details about the jurisdiction, the context of the project and tell a story of why there is a need for the information, including the spatial scope of the initiative to highlight where data are known to be needed, and how the acquisition of these data will address the need. The background section should be expanded beyond what has been provided with this local information.

Where some form of hazard identification and priority setting exercise has been previously completed, information from such an exercise would assist in informing the scope and associated data required to advance a flood hazard identification project to the modelling and mapping phase.

2. General Requirements

In preparing this proposal, the Service Provider shall consider the following:

a) Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b);

b) Federal Flood Mapping Framework (NRCan, 2018c);

c) Guidance for Flood Risk Analysis and Mapping, Project Planning (FEMA, 2022);

d) Hazards Risk Assessment Methodology Guidelines, 2012-2013 (Public Safety Canada, 2013); and

e) Flood Risk Mapping Using GIS and Multi-Criteria Analysis: A Greater Toronto Area Case Study (Rincón et al., 2018).

Notes:

A draft version of the new Federal Flood Mapping Guidelines Series' Flood Hazard Identification and Priority Setting document can be obtained from NRCan and be provided to the successful bidder for reference during contract implementation. The content of this document informed the methodology and approach proposed for Primer.

3. Scope of Work

This project will be part of a multi-phase plan leading to updated flood hazard maps, including data acquisition and flood hazard modelling. This project will allow the Proponent to identify shortfalls in current mapping, identify and prioritize areas for acquiring new mapping, plan strategies for acquiring the data required, and prepare work plans for future budgeting exercises.

It is anticipated that the assignment will comprise of the following Activities, which are further detailed in the subsequent sections of this document.

Notes:

The Scope of Work section outlines the scope and nature of work that is required to undertake a hazard identification and priority setting project. Additional detail is provided in Section 4. Deliverables.

Any partner organizations working with the Proponent and encompassed by this work should also be identified within this section.

3.1. Hazard Identification

The Service Provider will work with partners throughout the area of jurisdiction of the proponent to identify and document flood hazard types in the area, as well as additional

factors that may contribute to a hazard (e.g., climate change, land cover change, obstructions in river channels or at crossings, among others).

After identifying hazard types and their frequency estimates, the Service Provider will estimate hazards. This process will involve several steps, including the compilation of existing flood hazard mapping, the identification of historical flood locations, estimates of hazards in unmapped areas and the identification of potential future flood locations.

The Service Provider will not be expected to develop hydrological & hydraulic models to estimate flooding hazards in unmapped areas as part of this assignment, however existing large-scale datasets as well as GIS-based approaches to estimate hazard should be leveraged as much as possible following good practices for similar assignments in Canada. The final approach to be used will be validated and confirmed with the Proponent prior to implementation.

This review will also include a summary of major recorded recent and historic floods to provide insight into flood mechanisms. Results will be summarized in the 'Hazard Identification Report'.

3.2. Priority Setting

A high-level flood risk assessment will be developed to characterize exposure and consequence to the flood hazards previously identified. This assessment will consider available data such as population distribution, buildings and facilities, critical infrastructure, environment, and cultural assets. Results from the assessment will be used to prioritize new flood hazard mapping in the area.

Using a rubric provided by the Proponent, the Service Provider will use results from the assessment to prioritize new flood hazard mapping in the area. Potential criteria that may be used to prioritize mapping projects include the following:

- Current and future flood risk;
- Presence and relevance/age of existing floodplain mapping;
- Development density and pressure;
- Known history of flooding or recent flooding;
- Available resources (e.g., funding, staff, current LiDAR, among others);
- Component of larger project (e.g., flood mapping coordination with other stakeholders such as counties, cities, or conservation authorities); and
- Local engagement (e.g., community, councillors).

Relevant criteria will be selected and confirmed with the Proponent. The priority setting exercise will be informed by consultation workshops with local stakeholders. The Service Provider will be responsible for facilitating discussions, preparing and delivering relevant

presentation materials for these consultation workshops as well as compiling meeting minutes. The Proponent will organize the sessions, manage organization/logistics and invite the participants.

The high-level risk assessment and priority setting results will form the basis of a 'Priority Setting Report.'

3.3. Data Inventory and Gaps Assessment for Priority Area

The Service Provider will be responsible for completing an inventory of existing mapping, models, studies, and technical data inputs for the priority area identified. This inventory will include engagement with key flood mapping stakeholders in the region to take stock of previous flood mapping that might be relevant to the current assignment.

This inventory will cover any data required for the development, calibration and validation of the hydrological & hydraulic models for the production of updated flood hazard maps. These include, without being limited to:

- Hydrometric and meteorological data;
- Bathymetric data;
- Hydraulic structures;
- Flow measurements, high water marks and profiles lines for model validation and calibration;
- Existing information on resistance coefficients and boundary conditions;
- Dams and reservoirs (including operating records for streamflow regulation);
- Topographic LiDAR;
- Aerial and satellite imagery;
- Land use and land cover; and
- Other relevant and required data/information.

For the purposes of the assignment, the inventory will be completed for the highest priority area identified in the prioritization exercise, corresponding to one study area for a flood hazard mapping project. A study area usually includes a contiguous and continuous section of river including and connecting two areas of high priority.

The inventory will be followed by a detailed gaps assessment. This assessment will consider any data gaps and provide the details of field investigations required to complete flood hazard mapping in the priority area.

Findings will be summarized in the 'Data Inventory and Gaps Assessment Report,' including all existing data, reports, and models collected in the inventory phase.

3.4. Priority Setting and Future Scope Report

This activity will be twofold:

1) Prioritize data needs and prepare a detailed scope of work for field investigations in the priority area, including detailed work plan, schedule, budget, and technical requirements. Recommendations and technical requirements for these field investigations will be provided in accordance with the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b), the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023) and the Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023).

2) Prepare a general scope of work to complete flood hazard mapping for all the prioritized areas in the Proponents jurisdiction. This will outline all phases of the flood mapping projects including data collection, modelling and mapping, engagement, and dissemination work. This outline will also include high-level budget and schedule estimates.

The 'Priority Setting and Future Scope Report' will provide "shovel-ready" information for the Proponent to initiate field investigations in the priority area as well as prepare future flood hazard modeling and mapping work in the priority area and elsewhere.

4. Deliverables

All deliverables are to be received in accordance with the general Project Schedule outlined in Section 5. Project Submission Requirements and Project Schedule, or as otherwise approved.

The Proponent considers all plans, drawings, specifications, reports, and mitigation plans to be the property of the Proponent and available for exclusive use and distribution at the discretion of the Proponent unless otherwise agreed.

A Project Technical Team (PTT) will be responsible for the technical supervision, overall administration of the study and approval of the deliverables. The Proponent will be responsible for coordinating that committee, which will also include provincial and federal representatives from the Flood Hazard Identification and Mapping Program (FHIMP). The Service Provider may be required to attend meetings with the PTT to discuss the technical aspects of the study. Meetings will be held by videoconference.

Notes:

Deliverables are to be provided by the Service Provider during and upon the completion of the assignment. An example of how the deliverables could be identified and listed is included below and may vary by project and area of interest/focus.

4.1. Deliverables

The following deliverables are required for submission:

a) Digital copies of all collected data and documents from the data and mapping review in a Geospatial Database:

- Gridded raster files should be provided in an open industry standard format such as GeoTIFF.
- Vector files should be provided in an open geospatial data format.
- For simpler data schemas the Shapefile format may be appropriate.
- For more complex schemas the proprietary ESRI file geodatabase format may be appropriate for feature types like topology, geometric network, and linear referencing functionality.
- Geospatial data made available using other current Open Geospatial Consortium (OGC) geospatial data standards can be delivered provided they are compatible and agreeable with all recipients involved.

b) One (1) finalized digital MS Word copy and PDF copy of each of the following Deliverable Reports:

Report 1: Hazard Identification Report;

Report 2: Priority Setting Report;

Report 3: Data Inventory and Gaps Assessment Report; and

Report 4: Priority Setting and Future Scope Report.

c) Presentation materials outlined in the scope of work are to be provided in MS PowerPoint format.

d) Digital copies of all site photographs in .jpg format on a USB flash drive or other solution deemed acceptable by the Proponent.

4.2. Available Information

The Proponent will provide to the successful Service Provider the following information to the extent available:

a) Available flood maps in the jurisdiction;

b) Available location maps of all water crossing structures, and dams;

c) Past flood mapping reports and studies implemented by the County; and

d) Available data relevant to flood hazard modelling.

The Service Provider shall satisfy themself to the adequacy of the information that is being provided by the Proponent.

4.3. Services

The Proponent will provide to the successful Service Provider the following services to the extent available:

a) General direction of the Service Provider in the provision of the services;

b) Arrange and make provision for the Service Providers entry and ready access to property (public and private) as necessary to enable the Service Provider to perform their services; and

c) The Proponent's Project Manager, will transmit instructions to, and received information from, the Service Provider.

5. Project Submission Requirements and Project Schedule

The RFB/RFP should detail what is to be included in the RFB/RFP submissions, including, but not necessarily limited to the following:

1) Corporate experience and expertise;

2) Project team expertise, qualifications, experience relative to the needs of the project and proposed project responsibilities;

3) References;

4) Statement of project understanding, including a detailed outline of the proposed approach to the work including the proposed methodology for the assignment, as well as including a discussion of anticipated challenges, and approaches to mitigate them;

5) Proposed tasks including time, task and cost matrix for all project staff outlining each members degree of involvement for each task;

6) A detailed schedule, ensuring deliverables and milestones meet project requirements, timelines and objectives;

7) Deliverables (see Section 4. Deliverables);

8) Budget, including proposed division by deliverable (see Section 6. Budget) showing hourly charge out rates for each member of the Service Provider's Team; and

Additional requirements (see Section 7. Additional Requirements).

Notes:

A precise schedule should be requested as part of the RFB/RFP highlighting the specific date that each milestone will be delivered. It is useful for the Proponent to highlight the expected start date for the project in the RFB/RFP such that the Service Provider can produce GANTT charts and other timing related content working from that date. These can be further modified at the initial start-up meeting with the Service Provider, as required.

6. Budget

Notes:

It may be that the Proponent already has ownership of some or all the required data which should be outlined within the RFP. It should also be noted that the cost of obtaining the data could vary depending upon the technical requirements (e.g., LiDAR precision). Where information is unavailable on data needs prior to tendering work, modifications or change orders may be required if the strategy to fill data gaps is greater than initially budgeted. In advance of releasing the RFB/RFP for tender, the proponent may want to reach out to other organizations that have recently completed similar projects to refine what the anticipated costs may be.

7. Selection and Evaluation Criteria

Notes:

The following measures are an example of how selection criteria could be applied for scoring each project proposal:

a) Understanding of the assignment (5%),

b) Experience of the project team, including experience on similar projects (10%),

c) Details on methodology, procedures, and work plan (15%),

d) A time / task matrix for staff working on the project (10%),

e) Demonstrated expertise and experience on similar projects (10%),

f) Quality and content of the proposal (20%),

g) Satisfactory references for similar types of projects (10%), and

h) Cost (20%).

It is important to identify that while cost will have a bearing on the selection of the successful service provider, it will not be the only consideration. Depending on local procurement rules, the proponent or agency procuring the work, may wish to reserve the right to accept a proposal from a service provider that is not the lowest bidder. Furthermore, it may be desirable to set a minimum threshold score (e.g., 70%) that is outlined in the RFB/RFP, to ensure that only the highest quality bids are considered and move on to the financial envelope or cost/pricing considerations stage.

8. General Terms and Conditions

Notes:

It will be important to include any technical criteria as outlined in the FHIMP project requirements, related to the project, in a section similar to this one.

Appendix B:
Technical Project Procurement Primer: Data Acquisition Projects for Flood Hazard Mapping

1. Background Information

The Proponent is seeking proposals from qualified engineering Service Providers (Consulting) firms to collect and acquire flood hazard data within the jurisdiction. The objective of this project is to collect required data that will support key flood hazard mapping project elements, including base mapping, hydrologic and hydraulic model development, as well as later study phases, including model calibration and validation, and mapping of the flooding hazard.

Notes:

Defining the flooding hazard heavily relies on a variety of data types from a range of sources. The Background Information section should explain how the data will be used to inform the preparation of flood hazard modelling and or mapping. This may include how base mapping is required to support hydrologic and hydraulic mapping, or how hydrologic data or proxy hydrologic data are needed to support the work.

The following guiding principles should be reflected when completing project works.

•Collated and generated data should meet recommended accuracy standards to support use in flood hazard mapping, such as the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023).

•Data incorporated into models and mapping must be publicly accessible, and wherever possible all other project data should be open and transparent, so everyone has access to the data.

•Any Indigenous knowledge collection should be collected, protected, used, and shared according to the First Nations principles of ownership, control, access, and possession.

Background information is important to provide the context of the project. It should tell a story of why there is a need for the information, including the spatial scope of the initiative to highlight where data are needed, and how the acquisition of these data will address the need. This will often be informed by a previous formal or informal hazard identification and priority setting exercise to focus the data acquisition and subsequent modelling and mapping on areas that pose the greatest risk (see Appendix A: Technical Project Procurement Primer: Hazard Identification and Priority Setting for Flood Hazard Mapping). Where a hazard identification and priority setting

exercise has been previously completed, information from such an exercise would assist in informing the scope and associated data required to advance a flood hazard identification project to the modelling and mapping phase.

The following is typically contained in the Background section of the RFP/RFB document for data acquisition projects.

a) A description of the organization and its purpose,

b) The history surrounding the need for the information, including relevant background information that contributes to the area(s) being a priority for data acquisition (and future modelling and mapping). This may include information such as:

i) History on the frequency of flooding in the area(s) of interest, including the spatial extent of affected areas. This can include documentation from recent flood events or notable historical events and can include information from historical sources such as newspapers or other sources.

c) How the information collected will be used to address the need.

2. General Requirements

In preparing this proposal, the Service Provider shall consider the following:

- Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b);
- Technical Bulletin - Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023);
- Technical Guide for Great Lakes – St. Lawrence River System Shorelines: Flooding, Erosion and Dynamic Beaches (MNR, 2001);
- Technical Guide for Large Inland Lakes (MNR, 1996); and
- Technical Guide – River & Stream Systems: Erosion Hazard Limit (MNR, 2002a).

For consideration of available sources of hydrometric data nearby including real-time and archived data:

- Water Survey of Canada, Government of Canada website, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

For background information on data related to hydrology and hydraulics analyses, the

following document may be useful:

- Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation, Version 2.0 (NRCan, 2023).

3. Scope of Work

It is anticipated that the assignment will comprise of the following Activities, which are further detailed in the subsequent sections of this document.

This data acquisition project is a precursor to flood hazard modelling and mapping. The project work is to be divided into five key Activities which are further outlined in the proceeding subsections.

3.1. Identify, Obtain and Evaluate Existing Data Sources

The Service Provider will be responsible for completing an inventory of existing mapping, models, studies, and technical data inputs for the project area. This inventory will include engagement with key flood hazard mapping agencies (e.g., municipalities, conservation authorities, and others) in the region to take stock of previous flood mapping that might be relevant to the current assignment.

> Notes:
>
> The proponent or agency procuring the work may wish to undertake a preliminary assessment of available data within their jurisdiction that may exist, and which may support the flood hazard mapping initiative. Proponents are encouraged to identify and summarize these available data sets within the background section of the Request for Proposals to the extent feasible. Any relevant data sets or useful information regarding possible data sets should be outlined. Including this information will aid the Service Provider in identifying and estimating costs of acquiring new data and filling data gaps.

The Service Provider will work with various levels of government, conservation authorities (where established), academia, indigenous communities, community organizations and others, to identify relevant sources of information that would assist in characterizing the watershed and any key elements impacting the flooding hazard.

Key information to be gathered includes, but is not limited to the following data types:

a) Relevant previous studies defining historic flood observations, the flooding hazard, or hydrology including flood hydrology for the study area;

b) Land use and land cover;

c) Soils;

d) Aerial and satellite imagery;

e) Topographic data, including LiDAR (as appropriate, see MNR's 2023 Flooding Data Survey and Mapping Technical Bulletin);

f) Bathymetric data;

g) Infrastructure data, including:

   i. Bridges, and culverts;

   ii. Dams, reservoirs, in-line weirs or other significant channel structures impacting flow;

   iii. Berms, dykes and flood walls;

   iv. End of pipe Stormwater Management Facilities;

   v. Storm sewer networks (to identify areas of major/minor drainage splits, and locations where the sewer network has been designed to provide conveyance of major systems; and

   vi. Buildings;

h) Transportation corridors;

i) Land Parcel data;

j) Hydrometric data (e.g., streamflow and meteorological) to inform hydrologic analyses, as well as any high-water marks or water surface elevation profile lines that may exist, to support hydrologic/hydraulic model validation and calibration; and

k) Existing information on resistance coefficients and boundary conditions

Notes:

While some of these data may be available from provincial (e.g., Ontario Geo Hub,) or federal (e.g., CANSIS) information sources, many may consist of more locally derived sources of information.

The proponent should undertake a preliminary assessment of available data within their jurisdiction that may exist, and which may support the flood hazard mapping initiative. Any relevant data sets or useful information regarding possible data sets should be outlined. Including this information will aid service providers in identifying and estimating costs of acquiring new data and filling data gaps.

After identifying the various information sources and obtaining the data, the service provider will review the data to assess the data suitability for the project in question as

well as the data quality against the requirements listed under the various technical guidance and reference documents listed in Section 2. General Requirements. Particular attention should be paid to the quality of both the topographic data (i.e., elevation data) and data for hydraulic features (e.g., bridges, culverts, weirs, dams and other features) including information from railway and road crossings, as the modelled extent of flooding is highly sensitive to these inputs.

The service provider will ensure that all required permits and approvals are obtained prior to gain access a property to collect data.

3.2. Assess and Document Data Gaps

The inventory completed in Activity 1 (Section 3.1. Identify, Obtain and Evaluate Existing Data Sources) will be followed by a detailed gaps assessment. This assessment will consider and document any data gaps and outline any data that are outstanding. This assessment will provide details regarding the actions required, including any field investigations, to acquire or obtain the necessary data to complete flood hazard mapping in the area(s) of interest, including outlining the data, or data sets required, including the minimum recommended accuracies, as appropriate.

Findings should be summarized in a report, including all existing data, reports, and models collected in the inventory phase, as well as outlining data that were available, but of insufficient resolution to support the study, based on recommended criteria outlined in provincial guidance, such as the Flooding Data Survey and Mapping Technical Bulletin (MNR 2023). This should be rolled up with the content presented in Activity 5 (Section 3.5. Document the Data).

3.3. Develop a Strategy to Fill Data Gaps

Where Data gaps are identified, the Service Provider will generate a strategy to fill these data gaps. This could involve direct field work, for example, surveying of bridges/culverts, acquisition of remotely sensed data (i.e., LiDAR) where it does not exist or does not meet the recommended accuracies, or the collection of other data from available sources.

Where appropriate, the service provider may recommend a data filling technique. The approach should be justified relative to general considerations, which may include but are not limited to:

a) feasibility, limitations (i.e., access permissions, safety concerns, among others), timelines, and costs required to directly collect/measure the data;

b) availability and sufficiency of surrogate data sources that may be applied if modelling is not highly sensitive to the data set;

c) sensitivity of the future analysis relative to the data set;

d) application of industry standard approaches to support estimation techniques;

e) alternate analysis methods and approaches that could be applied to validate study findings if data cannot be collected.

The service provider will prioritize data needs and prepare a detailed scope of work for field investigations in the project area, including a detailed work plan, schedule, budget, and technical requirements. Recommendations and technical requirements for these field investigations will be provided in accordance with the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b) and the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023) or other MNR Technical Guidance relevant to the system being investigated (see Section 2. General Requirements). Service providers may also wish to consult the Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023).

3.4. Collect, and Analyze Additional Data

The service provider will implement the data collection strategy completed in Activity 3 (Section 3.3. Develop a Strategy to Fill Data Gaps), to fill any data gaps and analyze the data. This will follow the agreed upon work plan, schedule, and budget. This may include but not be limited to, topographic data acquisition, screening meteorologic and streamflow data for consistent reporting of times, data gaps, or potential errors, and collating and parsing the data to identify correlated events involving large rainfall and peak flow which may be used in later study phases to support model calibration.

3.5. Document the Data

The service provider will document the collected data in a comprehensive report and geodatabase.

4. Deliverables

The following deliverables are required for submission:

1) Geospatial data summary report including:
    a) Land Use Data;
    b) Soil Data;
    c) Topographic and Bathymetric Data;
    d) Infrastructure Data;
2) Hydrometric Data including summary report;
3) Meteorological Data including summary report;
4) Satellite Imagery including summary report; and
5) Drone Photography including summary report.

Please refer to the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023), for more information on the recommended technical requirements for these categories of data.

Notes:
Detailed descriptions of these deliverables can be found below in Section 10. Appendix 1: Data Acquisition Project Deliverable Descriptions

5. Proposal Submission Requirements and Project Schedule

The RFB/RFP should detail what is to be included in the RFB/RFP submissions, including, but not necessarily limited to the following:

1) Corporate experience and expertise;
2) Project team expertise, qualifications, experience relative to the needs of the project and proposed project responsibilities;
3) References;
4) Statement of project understanding, including a detailed outline of the proposed approach to the work including the proposed methodology for the assignment, as well as including a discussion of anticipated challenges, and approaches to mitigate them;
5) Proposed tasks including time, task and cost matrix for all project staff outlining each members degree of involvement for each task;
6) A detailed Schedule, ensuring deliverables and milestones meet project requirements, timelines and objectives;
7) Deliverables (Milestones in Table 5.1. *Example Project Milestones*, below);
8) Budget, including proposed division by deliverable (see Section 6. Budget, below) showing hourly charge out rates for each member of the Service Provider's Team; and
9) Additional requirements (see Section 7. Additional Requirements, below).

Table 5.1. Example Project Milestones for a Generic Data Acquisition Project

Milestone
1) Identify existing data sources required to support the development of a flood hazard mapping study.

2)	Review data sources to confirm which data set represents the most complete and detailed data set available for the study area relative to each listed data type.
3)	Collate and parse hydrometric, meteorological, and streamflow data to support future data analysis. Screen for consistent reporting of times, data gaps, potential errors, etc.
4)	Identify rainfall and streamflow events that may be used to support future data calibration.
5)	Generate a Digital Elevation Model.
6)	Identify data gaps and develop a strategy to fill data gaps.
7)	Collect and analyse additional data (as required)
8)	Document collected data within a geodatabase and report

6. Budget

Notes:

It may be that the Proponent already has ownership of some or all the required data which should be outlined within the RFP. It should also be noted that the cost of obtaining the data could vary depending upon the technical requirements (e.g., LiDAR precision). Where information is unavailable on data needs prior to tendering work, modifications or change orders may be required if the strategy to fill data gaps is greater than initially budgeted. In advance of releasing the RFB/RFP for tender, that the proponent or organization preparing the RFB/RFP reach out to other organizations that have recently completed similar projects to refine what the anticipated costs may be.

7. Additional Requirements

Notes:

It will be important to include any technical criteria as outlined in the FHIMP project requirements, related to the project, in a section like this one.

8. Selection Criteria

Notes:

The following provides an example of how selection criteria could be applied for

scoring each project proposal:

a) Understanding of the assignment (5%),

b) Experience of the project team, including experience on similar projects (10%),

c) Details on methodology, procedures, and work plan (15%),

d) A time / task matrix for staff working on the project (10%),

e) Demonstrated expertise and experience on similar projects (10%),

f) Quality and content of the proposal (20%),

g) Satisfactory references for similar types of projects (10%), and

h) Cost (20%).

It is important to identify that while cost will have a bearing on the selection of the successful service provider, it will not be the only consideration. Depending on local procurement rules, the proponent or agency procuring the work, may wish to reserve the right to accept a proposal from a service provider that is not the lowest bidder. Furthermore, it may be desirable to set a minimum threshold score (e.g., 70%) that is outlined in the RFB/RFP, to ensure that only the highest quality bids are considered and move on to the financial envelope or cost/pricing considerations stage.

9. General Terms and Conditions

Notes:

This section outlines the general terms and conditions for an RFB/RFP. Examples of information contained in this section include, but may not be limited to, the terms of acceptance and rejection of proposals, who owns the data, conflict of interest, conditions for cancellation of the RFP, and insurance coverage required for the project. Organizations may have other additional procurement rules or directives that must be followed to support this initiative.

10. Appendix 1: Data Acquisition Project Deliverable Descriptions

The following detailed descriptions are provided for reference and are intended to provide relevant background to support organizations who may wish to compile available background data independently, without relying on a Service Provider.

10.1. Geospatial Data

Geospatial data typically includes information such as watershed boundaries, topographic information, bathymetry, surface water networks, land use coverage and more. This section will outline the various kinds of geospatial data that are typically required to fully assess the flood hazard. Recommended data, survey and mapping specifications, related to geospatial data are provided in the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023).

10.1.1. Land Use Data

Land use data plays an important role in developing hydrologic models and to undertake regional flood frequency analysis. An important aspect of these analyses includes a runoff coefficient, which is largely informed by soil permeability and land use. For instance, the runoff coefficient is a larger value for areas having low infiltration and high runoff such as paved areas or steep gradients, and a lower value for well vegetated areas such as forested lands and natural areas.

Current GIS data, aerial photography and municipal zoning data can provide high-quality land use information that is helpful in this regard. Future land use should also be considered and can typically be found in municipal planning documents such as Official Plans and Zoning By-laws in which some lands within a planning authority's jurisdiction are identified as future growth areas. For more information refer to the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b) and the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023).

10.1.2. Soil Data

Soil data for the study area, in particular its permeability, is an important factor. General classifications of soils are available in GIS layers, such as those available through the Canadian Soil Information Service (CaNSIS), Global Soil Datasets for Earth systems modelling (GSDE), or hard-copy maps by provincial agricultural agencies.

Substrate material of a channel or watercourse can affect the hydrodynamics of flow which is helpful when studying the flood hazard for inland (non-coastal) watercourses.

10.1.3. Topographic and Bathymetric Data

Topographic data (physical features of the landscape) plays a key role in defining the flood hazard, including supporting hydrologic modelling (catchment delineation, catchment and channel routing, among others), hydraulic modelling and the hazard mapping component of the work. In many jurisdictions, Light Detection and Ranging

(LiDAR) is the preferred data source for topographic information. LiDAR is a pulsed laser located on the underside of an airplane that measures variable distances to the earth. LiDAR data have been generated for many areas of Ontario, including under the Ontario Elevation Mapping Program, and are located on Ontario GeoHub. This includes identification of provincial scale coverage of the LiDAR derived Ontario Digital Surface Model and the LiDAR derived Ontario Digital Terrain Model. in vertical and horizontal accuracies in relation to topographic data are included in the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023).

Bathymetric data (depths and configuration of underwater terrain) may also be collected using LiDAR flights or by sonar surveys by boat. It is important that the topographic and bathymetric data mesh along the water's edge to provide an accurate depiction of the terrain along the shoreline that is being studied. Further information on channel morphology including cross sections to support hydraulic modelling for flood hazard mapping can be found in the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023).

10.1.4. Infrastructure Data

Infrastructure includes but is not limited to bridges, culverts, stormwater management facilities, berms, dykes and reservoirs. These structures influence streamflow and water levels. The relationships of stage (water elevation), storage volume, and discharge for reservoirs, tailings ponds, and stormwater ponds are required to assess the parameters for hydrologic routing or hydraulic routing models to determine the design flows. Record drawings or field surveys showing the size of culverts and bridge piers, distances between bridge piers, revetment berms, embankments, and dikes allow the hydraulic models of the stream channel to determine the extent, depth, and velocities of flooding. Refer to the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b) and the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023) documents for additional guidance and recommendations, including guidance on Ontario-specific approaches to addressing dykes, berms, dams as well as culverts, in modelling (MNR, 2002b).

10.2. Hydrometric Data

Hydrometric data is an important component for any flood hazard delineation study. The data typically includes hourly and mean daily stream discharges and water levels collected at riverine or static lake level hydrometric gauge stations.

The availability and duration of hydrometric data is instrumental in choosing hydrologic procedures and to the accuracy of hydrologic design streamflow output as well as to support extrapolation to support definition of a regulatory storm event. Where long term

data is not available, data may still support an understanding of the watershed response. Hydrometric data in Canada is available from the Environment and Climate Change Canada (ECCC) Water Level and Flow web page (ECCC, 2024b), from provincial agencies, and other sources, such as hydroelectricity generation facilities and private companies.

Please see the link to the Water Survey of Canada website provided in Section 2. General Requirements, above.

Measured water level data and tidal constituents may be required for flood delineation studies near marine coasts. Data is available from the Canadian Hydrographic Service (CHS, 2021b), which maintains a network of stations along Canada's marine and Great Lakes coasts. The ECCC Water Level and Flow web page (ECCC, 2024b) also maintains a network of inland lake stations. The data is typically used to examine historical storm surge events, determine tidal planes, and support numerical modelling efforts. For riverine flood studies, Great Lakes levels acts as a downstream boundary condition that influences water levels in the river. Approaches to address these levels are outlined in the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b).

Where no data exist for the project area, methods are available to predict or quantify flows. Practitioners are directed to the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b), and the Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023) for further information.

10.3. Meteorological Data

Meteorological data includes precipitation (rainfall / snowfall), temperature, barometric pressure, wind, number of days above/below zero, and other data. Reliable meteorological data is necessary for hydrotechnical analysis.

Historical meteorological data is available for download on an hourly, daily, or longer time step from Environment and Climate Change Canada (ECCC, 2024a). Other sources of meteorological data can also include provincial government sources, local and regional municipalities, conservation authorities and other water management entities, environmental non-governmental organizations (NGOs), and citizen scientists.

Intensity duration frequency (IDF) curves can be an input into hydrologic models. IDF curves, derived from recent precipitation data, are available for selected sites from ECCC.

Flood event standards for use in Ontario included detailed information on the methods and procedures to inform hydrologic and hydraulic analyses to support flood hazard mapping are found in the Technical Guide – River and Stream Systems: Flooding Hazard

Limit (MNR, 2002b).

10.4. Satellite Imagery

Satellite imagery may be used, if available, to determine historical floodwater extent at different times and to characterize land use. Canada's RADARSAT-2 satellite can provide a spatial resolution of 1 m and data is available through MDA Ltd. (MDA Space, 2024) for commercial clients and the Canadian Space Agency (CSA) for federal government clients (CSA, 2023). Satellite images can be acquired, received, processed, and delivered based on client requirements. RADARSAT-2 data can be excellent for delineating flood extents to provide model calibration points (NRCan, 2023).

10.5. Drone Photography/Unmanned Aerial Vehicle

Drone photography can be a useful tool for the collection of oblique digital photographs of the shoreline that can be used to produce 3-dimensional models, Digital Elevation Models, and stitched orthophotos for flood modeling. The data collected from drone photography can also be used to perform simulations of the flood event using HEC-RAS software.

For the use of drones, it is recommended that Transport Canada website be viewed (https://tc.canada.ca/en/aviation/drone-safety/learn-rules-you-fly-your-drone) to learn the rules before flying a drone.

Please refer to Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023) for additional information on photogrammetry and UAVs.

Appendix C:
Technical Project Procurement Primer:
Flood Hazard Modelling and Mapping Projects

1. Background Information

The objective of the flood modelling and flood hazard mapping project is to undertake all studies and analyses leading to the development of flood hazard maps that illustrate the extent of flood inundation, under the requisite flood events that satisfy Ontario and FHIMP specific requirements. The scope of study will include base mapping and field surveys(where fewer data are required than justify a separate data collection project) to document existing conditions, hydrology to generate peak flow rates and quantify the potential impact of climate change, hydraulic modelling to generate flood elevations, and flood hazard mapping to illustrate the extent of riverine flood inundation for various scenarios, including the flooding hazard limit under the flood event standard (as identified in the Provincial Policy Statement and as included in the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b).

Notes:

Background information is important to provide details about the jurisdiction, the context of the project and tell a story of why there is a need for the modelling and mapping. The background section should be expanded beyond what has been provided with this local information.

If the area is also under the jurisdiction of a conservation authority, O.Reg. 41/24: Prohibited Activities Exemptions and Permits should be included in the policy requirements and should confirm whether the local regulatory event is different than as prescribed in the Technical Guide for riverine flooding hazard limit (MNR, 2002b).

It is important for applicants to note that the extent and nature of background information they provide is critical to defining the Scope of Work and the methodology that can be employed. Therefore, it is beneficial to collect all available information at the project outset and then include the information with the RFP. The following information can be collected directly by the Proponent or through a Service Provider (e.g., Service Provider):

a) Existing flood hazard maps and studies;

b) Map illustrating the limits of the watershed and watercourses to be mapped;

c) Existing & Future Land use maps including Official Plans;

d) Soil maps (e.g., https://sis.agr.gc.ca/cansis);

e) List of Water Survey of Canada streamflow gauges https://wateroffice.ec.gc.ca/search/historical_e.html;

f) Municipal or conservation authority rainfall and streamflow gauges including period of record (where available);

g) Storm water management reports especially for urban watersheds;

h) Dams, bridges and culverts that cross the waterways to be mapped;

i) Bathymetric data on the watercourses to be mapped; and

j) Historic flood records, including reports, articles and photographs.

It is recommended that prior to issuing the RFB/RFP the Proponent or Service Provider determine the source of the topographic mapping that will be used for developing the base mapping as this will significantly impact the scope of services required to develop the floodplain maps. The best source of base mapping typically will be Ontario's LiDAR-derived Digital Terrain Model (DTM). Where not available, two additional options can be considered: acquire the data directly from a LiDAR contractor, or where available use more traditional topographic mapping or other data sources that achieve the recommended vertical and horizontal accuracies specified in the Flooding Data Survey and Mapping Technical Bulletin (MNR, 2023). Information on Data Acquisition is provided in the preceding Technical Project Procurement Primer – Data Acquisition Projects (Appendix B: Technical Project Procurement Primer: Data Acquisition Projects for Flood Hazard Mapping).

The Proponent or Service Provider will also determine which flood event standard must be used for the flood hazard mapping. Appendix 1 (Section 9. Appendix 1, below) provides additional detail from Section 2.3 from Chapter B of the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b) of the three zones where each event is used (see Figure B-1 from MNR, 2002b).

2. General Requirements

2.1. Provincial Reference Documents

The Service Provider should reference the following guidelines, scoped to the specific area of investigation, for the purposes of undertaking a flood hazard mapping project. The natural hazard guides are available from MNR upon request by emailing: FHIMPapplications@ontario.ca. These Ontario Guidelines are as follows:

- Technical Guide – River & Stream Systems: Flooding Hazard Limit (MNR, 2002b);
- Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023);
- Technical Guide for Great Lakes – St. Lawrence River System Shorelines: Flooding, Erosion and Dynamic Beaches. (MNR, 2001);
- Technical Guide for Large Inland Lakes. (MNR, 1996); and
- Technical Guide – River & Stream Systems: Erosion Hazard Limit (MNR, 2002a).

For consideration of available sources of hydrometric data nearby including real-time and archived data:

- Water Survey of Canada (ECCC, 2019), Government of Canada website, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

For background information on data related to hydrology and hydraulics analyses, the following document may be useful:

- Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023).

3. Scope of Work

The process of developing flood hazard maps is a delicate balance of data collection and analysis, well established policies, and procedures, and engineering judgement.

> Notes:
>
> The level of data collection effort should generally reflect the requirements of the intended flood mapping application, which typically depends on the level of flood risk and the regulatory framework. Maintaining accuracy for flood hazard mapping is important for understanding the extent of areas and properties susceptible to flooding. Project specific detail should be included to provide clarity on the intent and end use planned for the mapping being sought.

Good mapping relies on accurate source data in both horizontal (i.e., flood extent) and vertical (i.e., flood depth) dimensions. The Data Survey and Mapping Technical Bulletin (MNR, 2023) outlines recommended risk criteria levels for vertical and horizontal

accuracy to produce suitable flood hazard mapping based on population density, critical infrastructure, and land use within the flooding hazard. This Technical Bulletin (MNR, 2023) should be used to direct the data, survey, and mapping specifications for this flood hazard mapping project.

In developing the flood hazard mapping, the Service Provider will:

1) Develop base mapping;
2) Complete flood frequency analyses on monitored streamflow data (as appropriate);
3) Generate design flows;
4) Assess climate change;
5) Complete field surveys;
6) Generate flood elevations; and
7) Map flooding hazard limit.

Notes:

Not all components are necessarily conducted during the same study, and a particular study may choose to update or reuse components from a previous study where it is justified and defensible. Project specific details will inform the components that comprise this list (i.e., updated data vs. reused data).

3.1 Develop Base Mapping

Notes:

It is important to highlight that the development of the base mapping may be undertaken as a separate contract from the flood hazard mapping contract, recognizing that it involves a specialized skill set. Ideally the base mapping contract should be initiated at least six months ahead of the flood hazard modelling and mapping contract to ensure that required spatial data (e.g., topographic/elevation and survey data etc.) are available upfront given their importance in both calculating flows and mapping the flooding hazard. Where base mapping and other associated data acquisition is undertaken under a separate contract, please refer to the Data Acquisition Primer that MNR has prepared for FHIMP (see Appendix B: Technical Project Procurement Primer: Data Acquisition Projects for Flood Hazard Mapping). MNRF's Technical Bulletin provides extensive details regarding the

development and performance criteria associated with topographic LiDAR data and the DTM.

Base mapping serves three fundamental purposes:

1) Mapping aids in the development of hydrologic models where hydrologic modelling is a required tool in estimating flow rates used to create flood hazard maps.

2) Topographic information included in the base mapping is used to develop the hydraulic model.

3) Mapping is used to delineate the flood-lines that represent the outer boundary of the flooding hazard (i.e., flooding hazard limit)

The Service Provider shall adhere to all base mapping recommendations as provided in the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023).

The Service Provider shall specifically address each of the following:

a. Identify the source of the topographic base mapping that shall be used and as necessary acquire the mapping.

b. Identify and document horizontal and vertical datums on base maps, hydraulic models used to develop the flood hazard mapping, and in the Hydraulics and Flood Hazard Mapping Report.

c. Identify mapping accuracy based on the requirements of Section 3.3.3 (*Accuracy Class Specifications*) of the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023), and provide a data accuracy confirmation block on each flood hazard map.

d. List the additional information that will be added to create base mapping compliant with the level of detail outlined in Section 5.5 of the MNR's Technical Bulletin mentioned in the previous item.

e. Indicate whether the base maps will be orthophoto base maps or line base maps.

f. Document all analyses in a 'Base Mapping Report'.

Notes:

As part of a proposal submission, the Service Provider shall determine the need to complete a field check/validation of the base mapping, and if necessary, the recommended scope of services and methodology to be applied.

3.2. Quantifying Flows Under the Flood Event Standard

Notes:

The technical description included herein are produced for the purpose of addressing flood hazard mapping, as required under NRCan's FHIMP. This guidance should not be interpreted as new or a fully endorsed method or approach otherwise endorsed by Ontario for flood hazard identification or mapping.

3.2.1. Flood Frequency Analysis (where appropriate)

The Service Provider shall be compliant with the applicable portions of the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b). These include Section 3.1 of Chapter C, Flood Frequency Analysis, which details the procedures for undertaking flood frequency analyses such as conversion of regulated flows to natural conditions. Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation (Version 2.0) (NRCan, 2023) may be used to support this work, for direction related to confidence limits and sensitivity analyses.

Guidance for defining the flooding hazard for the Great Lakes – St. Lawrence River system and for Large Inland Lakes are provided in MNR Guidance (MNR, 2001 and MNR, 1996, respectively).

The Service Provider shall address each of the following:

a. Complete frequency analyses for all gauge records that are directly within the study or are adjacent watersheds with similar hydrologic characteristics. All analyses to include confidence limits and extend up to the 1:100-year return period or more.

    - The accuracy of a flood frequency analysis in predicting rare events decreases with the number of years of record. As a general guide any extrapolation beyond double the flow record is commonly unreliable (e.g., 50 years of data generally adequate in predicting no more than the 1:100-year flood within the confidence limits).

b. Assess stationarity;

c. Evaluate sensitivity to outliers;

d. Identify trends;

e. Determine whether the individual frequency analyses are sufficient to establish return periods along the river reaches where the flooding hazard will be mapped;

f. As a provisional item, detail the scope of work for a regional flood frequency analysis; and

g. Document all analyses as part of the Hydrology Report (sealed and signed by a qualified Professional Engineer licensed in the Province of Ontario).

3.2.2. Flood Event Standard Modelling

The objective of flood hazard modelling is to define specific flow rates, such as 1:100-year flood event or the peak flows generated by a specified meteorological event (e.g., Hurricane Hazel or Timmins Storm), that may have never been specifically measured in the watershed or catchment under study.

> Notes:
>
> Where the flood event standard is based on a specific return period (e.g., 100-year flood it may be possible to derive flood flows from the frequency analysis outlined in the previous Section (Section 3.2.1. Flood Frequency Analysis (where appropriate)), provided sufficient natural streamflow records are available to reasonably estimate the regulatory event. If these two conditions cannot be met, then a hydrologic model must be developed to generate the regulatory flood flows. Section 9. Appendix 1, provides an overview of hydrologic modelling.

Guidance on modelling the 100-year flood, Hurricane Hazel and Timmins Storms is provided in Chapter B and Chapter D of the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b).

The Service Provider shall address each of the following:

a. Assess the need for hydrologic modelling, and whether an existing model exists that adheres to current modelling requirements;

b. Where a new or modified hydrologic model is required, detail the steps for model development, model calibration, and model verification;

c. Document consistency with provincial guidance:

i. Technical Guide: River & Stream Systems: Flooding Hazard Limit (MNR, 2002b) including paying particular attention to “Section 4. Special Flood Hazard Conditions” on pages 17 and 18a of the Technical Guide;

d. Where monitored data is not available, compare the model results to results from similar studies, particularly those that were calibrated;

e. From local hydrometric records, identify the season or seasons where the most severe flooding is likely to occur, and then develop appropriate Design Storms that will generate peak flow rates consistent with what has been observed or calculated through the flood frequency analysis, where the flood event standard is based on a defined return period;

f. As per requirements under the FHIMP, as a minimum, generate peak flows for the flood event standard and return period events (25-year, 50-year and 100-year). When the flood event standard is the 100 year flood, or for circumstances where a historic storm-based (i.e., Hurricane Hazel, Timmins Storm) or other flood event standard produces a flood magnitude less than the 200-year flood (0.5% AEP), compute peak flows for the 200-year flood event (see Section 3.4 for more detail). Evidence of the corresponding return-period/recurrence interval for the event standard flow shall be provided to confirm whether it exceeds the 200-year (0.5% AEP) flood event;

g. Repeat above for both existing land uses and future land uses as per available Official Plans; and

h. Document all analyses as part of the Hydrology Report.

3.3. Climate Change

The Service Provider will conduct climate change modelling and mapping in a manner consistent with Section 1.7.9. Climate Change Considerations, in Ontario’s FHIMP Program Guide. All analyses and discussion should be presented in the Hydrology Report.

Notes:

Methodologies for considering climate change impacts on flood risk are evolving in Ontario. The provincial natural hazard technical guides do not define a methodology, however PPS Policy 3.1.3 highlights that planning authorities shall prepare for the impacts of changing climate that may increase the risk associated with natural hazards and specific methodologies for FHIMP have been developed.

A number of key considerations can scope this analysis.

It is generally agreed that rainfall intensity will increase as a function of the increase in temperature.

At this time, any increase in the magnitude and associated extent of flooding would only be applied for information purposes to satisfy the requirements under the FHIMP and to understand the potential impact of climate change. This information is not to be used for generating regulatory flood-lines and associated mapping.

Where a return period event such as the 100-year flood is the Regulatory Event, it is requested that a 200-year return period flood (0.5% AEP) and a 350-Year flood (0.29% AEP) event be used as a proxy for climate change. Please see 1.7.9. Climate Change Considerations, of Ontario's 2024 FHIMP Program Guide for more information.

All analyses should be documented in the Hydrology Report.

3.4. Field Surveys

Notes:

A hydraulic model simulates the conveyance of the flood event standard, thus the model needs details of the channel and valley characteristics, as well as details of structures such as dams, culverts and bridges that can impede flow.

Some information such as valley details are available from the DTM, but details of the river itself (bank to bank) could require field surveys of regularly placed cross-sections to provide a digital representation of the river topography and bathymetry. This is because the LiDAR technology does not accurately penetrate water. In addition, each structure must be surveyed with a focus on opening sizes and elevations, deck elevations and bounding sections.

The Service Provider shall address each of the following:

a. Identify the location of all cross-sections and structures to be surveyed;

b. Complete all surveys in accordance with requirements and specifications outlined in Section 3.4 (Data Acquisition and Collection Recommendations) of the Technical Bulletin - Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023); and

c. Document all surveys and prepare Data Sheets for all dams, weirs, culverts, and bridges, and include in the Hydraulics and Flood Hazard Mapping Report.

Notwithstanding the guidance provided in the Technical Bulletin, the Service Provider shall exercise judgement in terms of the number of cross-sections to be surveyed and the

number of survey points required for each cross-section. A larger spacing may be acceptable for larger rivers that are relatively slow moving. The level of survey detail for each cross-section will depend on the importance of the channel details in accurately calculating flood elevations. There are cases such as small watercourses in urban areas where the combination of the DTM and cross-sections surveyed at road crossings may be sufficient.

3.5. Generation of Flood Elevations/Water Surface Elevations

Once the magnitude of the flood event standard is known and the field surveys are complete, the Service Provider shall assemble the hydraulic model. Most typically this includes the use of a one dimensional (1D model). All modelling cross-sections must be geo-referenced within the model.

The Service Provider may wish to consider specific exceptions where a different modelling approach may be considered. These two exceptions include the use of 2-dimensional models (i.e., coupled 1D-2D modelling) and variable state models. In both cases the need for this modelling approach shall be determined following initial model development, and their use should be limited in scope and application.

The Service Provider shall address each of the following:

a. Prepare a detailed description of how the hydraulic model will be developed;

b. Following development of the standard 1D model, identify the need for any 2D modelling outside of the riverbanks, to support a coupled 1D-2D model;

c. Following development of the standard 1D model, identify the need for variable (i.e., unsteady) state modeling for a defined and limited portion of the river or stream (i.e., where the flow is rapidly varying and hydraulics are complex);

   - However, where the Regulatory flood hydrography is rapidly varying, a moderate approach to modeling the extent of the flood hazard would be to assume the flow is gradually varying, so the estimated peak regulatory flow is used and is modeled with a steady state approach;

d. Calibrate the hydraulic model and undertake sensitivity analyses;

e. Identify all areas where the model identified flooding that spills from the riverine corridor and provide recommendations on how spill areas should be labelled and whether further analysis is required to document the extent and consequence of the spills;

f. Generate water surface elevations for future land use conditions for both the existing design storms (i.e., flood event standards) and the design storms associated with climate change. This should include an event both greater than and less than the regulatory event or flood event standard (refer to Section 1.7.9. Climate Change Considerations, of Ontario's 2024 FHIMP Program Guide for more information);

g. Generate a summary of the hydraulic performance of all structures including peak flow that they will convey, hydraulic head change across the structure, depth and velocity of flood flow that spills across a roadway (for all return period where spill occurs);

h. Identify and document all buildings that are in the regulatory flooding hazard and identify the return period at which flood encroachment on the building will occur; and

i. Document in the Hydraulics and Flood Hazard Mapping Report (sealed and signed by a qualified Professional Engineer licensed in the Province of Ontario).

3.6. Flood Hazard Mapping

Flood hazard mapping is a compulsory mapping product as it illustrates the flooding hazard limits (i.e., flood lines) under the flood event standard that are used for land use planning purposes to direct development outside of the flooding hazard.

The Service Provider shall include the following details in addition to what is illustrated on the base maps:

a. Flood-lines under the Flood Event Standard;

b. The 1:100-year flood-lines where they are different from the Regulatory flood-lines and/or the water surface elevation at corresponding cross sections;

c. Modelling cross-sections including both the cross-section number and the Regulatory flood elevation at the cross-section;

d. As an option include the overtopping cross-sections (this is the cross-section that was used for the deck/roadway in the hydraulic model);

e. As an option include the overtopping cross-sections (e.g., the centreline or downstream side of the roadway);

f. Label each structure with an identification number;

g. Map and identify spill from the floodplain that occurs; and

h. Seal and signature of a qualified Professional Engineer licensed in the Province of Ontario.

The Service Provider shall address each of the following:

a. As a minimum plot the 100-year and the Regulatory flood-lines (Note: Proponent could also request flood-lines with other return periods also be plotted);

b. Ensure that the flood-lines are properly plotted at all crossings, as some of the current modelling tools will not plot these correctly without manual intervention;

c. As per FHIMP requirements it is recommended to map a minimum of three flood events with varying magnitude to better inform flood risk assessment and management at the local level;

   - The regulatory flood magnitude would be mapped according to the Flood Hazard Criteria Zones of Ontario, in addition to a flood event with a magnitude lower than the regulatory flood, and a flood event with a magnitude higher than the regulatory flood;

d. Create the flood hazard maps in accordance with the requirements of Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023). As such the mapping will include the flood-lines, cross-section locations, and flood elevations;

e. Document the mapping methodology in the Hydraulics and Flood Hazard Mapping Report; and

f. Prepare all maps in paper, digital and web formats in accordance with Section 5.0 (Mapping Products: Flood Hazard Map Dissemination and Sharing) of the Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (MNR, 2023).

4. Deliverables

Deliverables to be provided by the Service Provider during and upon the completion of the assignment, shall include the following:

1) Base Mapping Report – document all aspects related to the development of the Base Maps, including source of topographic mapping, vertical and horizontal accuracy, map checking, among others;

2) Hydrology Report – document all aspects of the flood frequency analysis, hydrologic modeling, and climate change;

3) Hydraulics and Flood Hazard Mapping Report – document all aspects of the survey of structures, hydraulic modelling, flood hazard mapping, and flood risk mapping (where applicable); and

4) Paper, Digital and Web Maps – All mapping to be provided in paper, digital and web formats.

5. Proposal Submission Requirements, Evaluation Methodology and Project Schedule

The RFB/RFP should detail what is to be included in the RFB/RFP submissions, including, but not necessarily limited to the following:

1) Corporate experience and expertise;
2) Project team expertise, qualifications, experience relative to the needs of the project and proposed project responsibilities;
3) References;
4) Statement of project understanding, including a detailed outline of the proposed approach to the work including the proposed methodology for the assignment, as well as including a discussion of anticipated challenges, and approaches to mitigate them;
5) Proposed tasks including time, task and cost matrix for all project staff outlining each members degree of involvement for each task;
6) A detailed Schedule, ensuring deliverables and milestones meet project requirements, timelines and objectives;
7) Deliverables (see Section 4. Deliverables);
8) Budget, including proposed division by deliverable (see Section 6. Budget, below) showing hourly charge out rates for each member of the Service Provider's Team; and
9) Additional requirements (see Section 8. General Terms and Conditions to be included in the Request for Proposals, below)

5.1. Expertise

Notes:

Flood hazard mapping requires a multi-disciplinary team with expertise in geomatics, surveying, and water resources engineering (flood frequency analysis, hydrologic modeling, and hydraulic modelling). The project lead should be a water resources engineer with experience in all aspects of flood hazard mapping. Either the project lead or a second water resources engineer will be required to stamp and seal the completed flood hazard maps.

A single team could be retained to complete the project, or alternatively the work could be subdivided as follows: base mapping, hydrology, and surveys and hydraulic modelling.

5.2. Project Schedule

Notes:

The following table provides guidance on target dates for key study tasks. The target dates are based on a calendar year but can be shifted based on the start date. Overall, 15 to 24 months should generally be provided to work through the complete process, where that is required for the study at hand. The duration will depend on the number of partners that may be involved, the size of the project, the extent of public consultation, and the potential need for revisions. The example below is based on 18 months and is provided only as an example to assist Proponents in defining a project schedule and associated deliverables.

Key Tasks	Target Date	Notes
Develop Base Mapping	January – June	
Flood Frequency Analysis	February -March	
Compute Flood Magnitudes	March-August	Flood Frequency Analysis to be completed before starting
Climate Change Flood Analysis	September-October	Design flows to be completed before starting
Field Surveys	May-August	No prerequisite, but due to weather needs to be completed between May and November
Hydraulic Modelling/Generation of Flood Elevations/Extents	November – March	Field surveys to be completed before starting
Flood Hazard Mapping	April-June	Flood elevations to be generated before starting

6. Budget

Notes:

The cost of flood hazard mapping varies significantly depending on the location and size and scope. Generally, flood hazard mapping in urban areas is considerably more expensive than mapping in rural areas due to the complexity and number of structures in urban areas. The size of the study area and potential to realize

economies of scale may also be an important factor in pricing.

A review of pricing for a range of studies in Ontario where hydrology and hydraulics were undertaken or priced separately and those combining both hydrology and hydraulics in the same study, was undertaken. Findings show that the price of studies can vary considerably by land use (rural vs. urban) and by the complexity of modelling required to address hydrology and hydraulics in highly urbanized areas.

For studies in Ontario where both hydrology and hydraulics were completed under the same contract, costing ranged from approximately $2K/kilometer of mapping in a rural area ranging up to approximately $7.5K/kilometer in urban areas. While data on the specific complexity of the modelling was not readily available, the limited financial data available suggests there may be economies of scale, whereby the cost per km of mapping may decrease with the greater numbers of kilometers modelled in the study. The average cost per kilometer in urban areas was slightly over $6K, in 2019 dollars.

Data for studies where hydrology was considered exclusively, were only available for urban areas, and further suggesting economies of scale. Costs ranged from approximately $800/km^2 for a 60km^2 catchment to $19K/km^2 for a 1.5km^2 study area. Again, complexity of the study can add to the cost, however the data analysed showed a mean of $6K/km in 2016 dollars, but a median of approximately $1100/km^2.

The above are derived from a small sample size and include studies undertaking from years 2015 to 2021. The results are intended to provide some indication of the possible range of expected costs but should be interpreted and applied with a modicum of caution.

7. Selection Criteria

Notes:

The following provides an example of how selection criteria could be applied for scoring each project proposal:

1) Understanding of the assignment (5%),

2) Experience of the consulting team, including experience on similar projects (10%),

3) Details on methodology, procedures, and work plan (15%),

4) A time / task matrix for staff working on the project (10%),

5) Demonstrated expertise and experience on similar projects (10%),

6) Quality and content of the proposal (20%),

7) Satisfactory references for similar types of projects (10%), and

8) Cost (20%).

It is important to identify that while cost will have a bearing on the selection of the successful service provider, it will not be the only consideration. Depending on local procurement rules, the proponent or agency procuring the work, may wish to reserve the right to accept a proposal from a service provider that is not the lowest bidder. Furthermore, it may be desirable to set a minimum threshold score (e.g., 70%) that is outlined in the RFB/RFP, to ensure that only the highest quality bids are considered and move on to the financial envelope or cost/pricing considerations stage.

8. General Terms and Conditions to be included in the Request for Proposals

Notes:

This section outlines the general terms and conditions for an RFB/RFP. Examples of information contained in this section include, but may not be limited to, the terms of acceptance and rejection of proposals, who owns the data, conflict of interest, conditions for cancellation of the RFP, and insurance coverage required for the project. Organizations may have other additional procurement rules or directives that must be followed to support this initiative.

9. Appendix 1

This Appendix provides additional detail to aid the proponent in understanding the types of technical analyses that are undertaken as part of a flood hazard mapping study.

9.1. Regulatory Events/Flood Event Standards

As defined in Section 2.3 (Flood Standards for River Systems) of the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b), the regulatory event used for flood hazard mapping is defined differently for each of three zones:

Zone 1: Greater of 1:100 year and Hurricane Hazel

Zone 2: 1:100 year

Zone 3: Greater of 1:100 year and the Timmins Storm

The Technical Guide provides additional detail regarding both Hurricane Hazel and the Timmins Storm.

Flood frequency analyses may be used to generate the Design Flows in Zone 2. Alternatively, the hydrologic model can be used. In the case of Zone 1 and Zone 3 it will be necessary to develop a hydrologic model to estimate Design Flows for either Hurricane Hazel or the Timmins Storm, or the 100-year flood.

Where a Conservation Authority has been established in a watershed, the Service Provider should also check whether the local regulatory event is different than is prescribed by the MNRF. The flood events standards outlined in O.Reg. 41/24: Prohibited Activities Exemptions and Permits, is a useful resource in this regard.

9.2. Flood Frequency Analyses

The Water Survey of Canada (with financial contributions from the province of Ontario), maintains a network of streamflow gauges in Ontario. Ontario's conservation authorities also maintain a separate network of streamflow gauges. These gauges continuously record water levels which are later processed to flow rates using rating curves. Some gauges are relatively new while some have been in place for more than 100 years. Using the instantaneous peak flow recorded each year, a flood frequency analysis can be completed to estimate the probability of any flood. Of course, the longer the record the more accurate the estimate. Commonly, flood frequency analysis is used to estimate floods with probabilities equivalent to peak flows ranging from the 2-year flood to the 100-year flood.

In the case of a single gauge the flood frequency analysis provides the flood estimates for a single point, however, there are a number of methods to transpose the estimate upstream and downstream of the gauge.

Although having one or more gauges on a river is ideal, it is also possible to estimate flood flows using gauges from nearby watercourses. In this case the method may be referred to as a regional flood frequency analysis, or other suitable ways of transposing data may also be appropriate, using various watershed variables as similarity indices.

9.3. Hydrologic Model Development

Hydrologic modelling is the primary method used to estimate design flows. Exceptions may occur where a flood frequency analysis of streamflow gauges can be used to estimate design flows.

Hydrologic models are developed using site specific terrain, soil, and land use information. They accept storm and climate data as input and produce hydrographs (which define how flow varies over time) as output. Typically, the peak flow from the hydrograph is used for floodplain mapping.

On the surface, development of a model is straight forward. The challenge is developing a model that estimates design flows as accurately as possible. To this end hydrologic

modelling includes model development, calibration, and validation.

Hydrologic modelling is discussed extensively in the provincial and federal documents listed at the outset.

Ideally sufficient streamflow gauge data will be available to calibrate the model against historical events. Frequently this type of information is not readily available, and it is necessary to develop a model calibrated with best available data. In such case the following are critical to minimizing model error.

- Ensure that key watershed features are modelled such as storage behind dams, bridges and culverts, and large stormwater management ponds. Note: While recognizing and understanding this type of storage is important to support model calibration, to remain consistent with protocols in the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002b), related to 'Special Flood Hazard Conditions' the attenuating effect of these structures on flood flows are not accounted for in the final modelled flood line.
- Undulating terrain with no overland flow path is accounted for in both urban and rural settings.
- Major diversions in both urban and rural areas are considered.
- Generated flood flows and the related extent/frequency of flooding is consistent with historical observations.
- Flood flows for the 1:1.5 - year flood are generally contained within the channel banks.

9.4. Design Storm Selection

The selection of the appropriate Design Storm is one of the most critical exercises. If the most severe flooding occurs in the winter or early spring then the Design Storm should be based on a combination of snow melt and precipitation, if the most severe flooding occurs in the late spring through to early fall, then the Design Storm most likely will be based on an intense summer storm, and finally if flooding is most severe in the fall then the Design Storm should be similar to the frontal systems that typically occur at that time of the year. MNR's Technical Guide, includes guidance on selecting an appropriate design storm for computing the magnitude of the 100-year flood, and provides depth/duration information to support the quantification of flows under the Hurricane Hazel and Timmins storm, across all watersheds.

9.5. 1D and 2D Hydraulic Modelling

1D models are sufficient when flows are gradually varying, are predominantly perpendicular to each cross-section, and it can be assumed that the energy grade line (elevation plus velocity energy) is equal across the cross-section. However, there are cases where the flow regime is much more complex and a two-dimensional (2D)

modelling approach may be warranted to model flows outside of the channel. Examples include:

- floodplains through complex topography or urban areas where flow can either spill from the floodplain or diverge then re-combine at a point further downstream; or
- multiple culverts, bridges or embankments that create flow complexity.

9.6. Steady and Unsteady State Modelling

1-Dimensional or 1D models are often run in what is called steady state. This means that the flow rates modelled are the peak flows and don't vary over time and space. Typically, unsteady flow analysis is necessary to model rapidly varying flows associated with dam break or levee breach modeling, rather than regulatory flood hazard mapping. Unsteady modeling has its limitations, typically unsteady models have to simplify the representation of the hydraulics to achieve stability, the simplified representation of hydraulics can be at the expense of accuracy.

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