Niagara Watershed Plan (Equivalency) – Volume 2: Niagara Watershed Management

Niagara Official Plan
Niagara Region, Ontario
Project # WW 20101001

Prepared for:

Regional Municipality of Niagara
1815 Sir Isaac Brock Way, Thorold, ON L2V 4T7

5/16/2022

Niagara Watershed Plan (Equivalency) – Volume 2: Niagara Watershed Management

Niagara Official Plan
Niagara Region, Ontario
Project # WW 20101001

Prepared for:

Regional Municipality of Niagara
1815 Sir Isaac Brock Way, Thorold, ON L2V 4T7

Prepared by:

Wood Environment & Infrastructure Solutions a Division of Wood Canada Limited
3450 Harvester Road, Suite 100
Burlington, ON L7N 3W5; T: 905-335-2353

North-South Environmental Inc.
101B King Street W.
Cambridge, ON N3H 1B5 Canada; T: 905-854-1112

Dougan & Associates – Ecological Consulting & Design
77 Wyndham Street South
Guelph, ON, N1E 5R3; T: 519-822-1609

5/16/2022

Table of contents

List of figures

List of tables

List of Attached Drawings

Appendices

1.0 INTRODUCTION AND STUDY PURPOSE

1.1 Introduction

Niagara Region (Region) is preparing a new Niagara Official Plan (NOP) which will achieve conformity with provincial plans and provide relevant guidance to local area municipalities. As part of this work, a Natural Environment Work Program (NEWP) is being undertaken, which is focusing on establishing a regional-scale natural heritage system (NHS) and water resource system (WRS), including policies and mapping, which will be implemented through the new NOP. As part of the NEWP, a Watershed Planning Discussion Paper (WPDP, October 3, 2019) was prepared to better understand the Provincial requirement that watershed planning must inform land use planning. The Discussion Paper was largely based on the Draft, Provincial Watershed Planning guidance document "Watershed Planning in Ontario – Guidance for Land-use Planning Authorities" (MOECC, MNRF 2018) highlighting its influence on how best to inform growth and infrastructure planning through the Official Plan process.

The Draft Provincial Watershed Planning guidance document, as well as the Growth Plan (2020) and Greenbelt Plan (2017), acknowledge the concept of leveraging equivalent information from existing documents, thereby offering the opportunity for re-use for informing growth planning.

The Discussion Paper discussed the possibility of preparing an "equivalency" document at a tertiary level, informed by a review of existing reports available from the Niagara Peninsula Conservation Authority (NPCA), Region of Niagara, local area municipalities (LAMs) and other organizations. Notably, based on the terminology in the Provincial Guidance, the "tertiary" level of watersheds refers to those lands draining to Lake Ontario, Lake Erie and the Niagara River for Niagara Region.

The Niagara Watershed Plan Equivalency document (NWP (E)) is being prepared as a watershed planning equivalency document in accordance with provincial direction in the Growth Plan which allows for the use of legacy data in watershed planning. The document builds on the guidance from the previously completed Watershed Planning Discussion Paper (WPDP); notably the WPDP outlined the status of watershed-oriented data across Niagara, specific to mapping, data and reporting. The WPDP also outlined the status of the available data/information and associated gaps. As noted, the NWP (E) builds on this understanding and further mines the available information, in order to better characterize the resources in the areas being planned for growth, and to inform the new NOP on constraints and opportunities, where the information is sufficient. Where there are information gaps, the NWP (E) has outlined those gaps and provided high-level scope for execution at the subsequent planning stages (i.e., Quaternary Watershed Plan or local OP). The NWP (E) has not filled any data gaps, through confirmatory field work, nor has it involved any analytical modelling of water systems (hydrology, hydraulics, hydrogeology); again, this effort is considered more appropriate at the subsequent planning stages.

Further, the Region is supported by the NPCA through an existing partnership, as well as emerging opportunities to collaborate and advance the watershed and subwatershed planning framework for Niagara conceptualized through the NWP (E). Notably, the

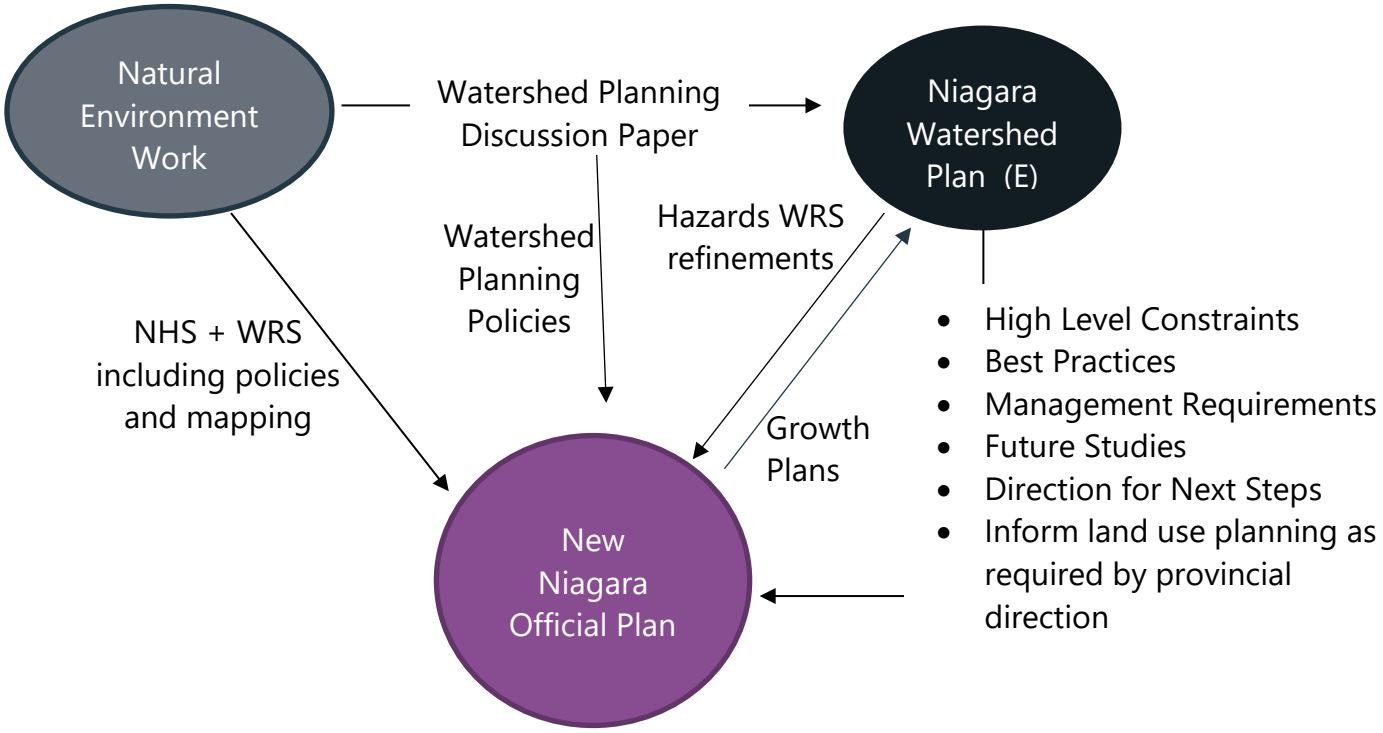
NPCA is positioned to support the Region with a watershed based natural resource management framework fundamental to Integrated Watershed Management (IWM). In accordance with sections 20 and 21 of the *Conservation Authorities Act*, Conservation Authorities are local watershed-based natural resource management agencies that develop programs that reflect local resource management needs within their jurisdiction. These programs and/or policies are approved by the conservation authority board. The NPCA uses the Integrated Watershed Management (IWM) as the local approach to natural resources management. IWM is the process of managing human activities and natural resources on a watershed basis, considering social, economic, and environmental issues, as well as local community interests to manage water resources sustainably

As noted, a core element of the Niagara Watershed Plan (NWP (E)) study has involved gathering and reviewing existing information (GIS-based mapping and data) which has been mined from the legacy studies, as well as the current NEWP, to support the area characterization (without field work and modelling analysis) and the establishment of growth scenarios to 2041 (proposed to be amended by the Province to 2051), while also providing management guidance at the tertiary scale. Key data sources have included:

- Legacy Reports
  - Watershed Plans
  - Subwatershed Plans
  - Master Drainage Plans
  - Source Protection Plan
- Data
  - Natural systems
  - Water quality and quantity
- Mapping
  - Hazards
  - Resources

The following graphic presents the high-level relationship between the respective initiatives supporting the new NOP, including the key information flow amongst the initiatives.

Relationship of the Niagara Watershed Plan (E) to New Niagara Official Plan

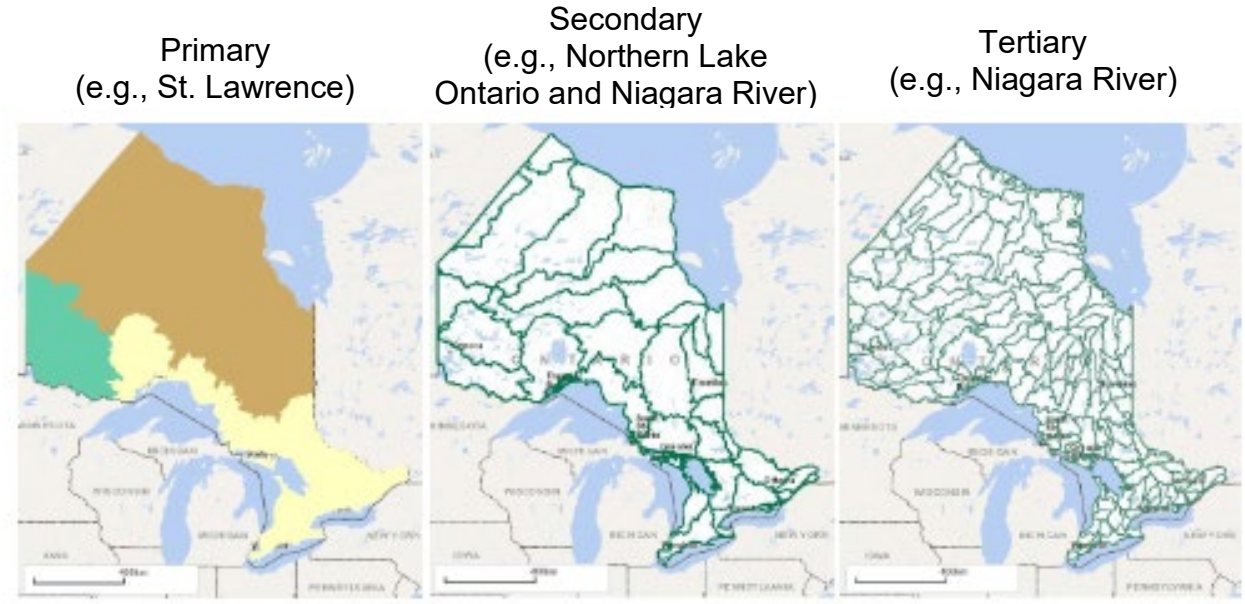


In addition, the Niagara Watershed Plan (E) has summarized stakeholder-driven issues, particularly in priority growth areas defined by the Region. Niagara Region staff has provided an initial outline of issues which has been further expanded as part of subsequent study tasks and consultation activities.

1.2 Tertiary Watershed Context

The Draft Provincial guidance for Watershed Planning (MNRF, MECP 2018) advocates for the use of existing data available from Provincial, Municipal, and Conservation Authorities, to establish the limits of watersheds and subwatersheds. Provincial mapping delineates watersheds at the primary, secondary, tertiary, and quaternary levels, representing nested levels of drainage areas, from largest (primary) to smallest (quaternary) (ref. Figure 1-1). Current watershed and subwatershed information in Niagara, available from legacy documents and the NPCA do not explicitly align with the common industry understanding of “watersheds” or “subwatersheds”.

Figure 1-1: Provincial Mapping – Watershed Delineation Scales



The WPDP states that Niagara Region is comprised of two secondary watersheds: Lake Ontario and Niagara Peninsula, and Northern Lake Erie. Also, while the majority of land in Niagara Region, and portions of Hamilton and Haldimand County, drain northerly into Lake Ontario, the southern part of the Region drains into the Lake Erie watershed. Further, Niagara Region drains into 3 tertiary watersheds, where the subject lands drain either into Lake Ontario, Lake Erie, or the Niagara River. This delineation reflects the unique hydrologic and ecological functions of the receivers, specific to the Lakes verses the Niagara River. Based on this approach, the NWP (E) has been structured to report at a tertiary watershed scale, where the lands in Niagara have been characterized and discussed based upon the three (3) tertiary receivers, including Lake Ontario, Lake Erie and the Niagara River.

Moreover, Provincial mapping cited in the WPDP identifies ten (10) quaternary watersheds within Niagara Region (Note: Table/Mapping has 10 however text refers to 9). At issue is that while these quaternary watersheds largely follow drainage divides, many of the quaternary watersheds which border the Lake Ontario or Lake Erie shorelines, or the Niagara River, include smaller drainage basins or hydrologic units which do not drain to a watercourse or river by way of a tributary, but rather outlet directly to the associated receiving waterbody. In the Provincial nomenclature cited above, this would make these drainage basins, by definition, individual watersheds.

The Province released an updated watershed boundary dataset on May 8th, 2020, which is collectively called Ontario Watershed Boundary (OWB). The boundaries relevant to Niagara Region were based on the recent Ontario Integrated Hydrology (OIH) data produced in the spring/fall of 2019 for areas within Ontario. Refinements to these OWB boundaries have been made by the Niagara Region, in consultation with the NWP (E) team, based upon more detailed knowledge of drainage systems and catchment boundaries for the quaternary watersheds and tertiary watershed systems.

Further discussion regarding these data sets and the delineation process applied for the drainage systems within the Niagara Region, which have been carried throughout the NWP (E) study and reporting, can be found in Volume 1: Characterization.

For ease of reference purposes in the current Volume 2, the figures demonstrating the tertiary watersheds, quaternary watersheds and subwatershed systems within the Niagara Region documented in Volume 1 have been repeated in the following **Figure 1-2**, **Figure 1-3**, **Figure 1-4**.

Figure 1-2. Niagara Region – Tertiary Watershed Areas

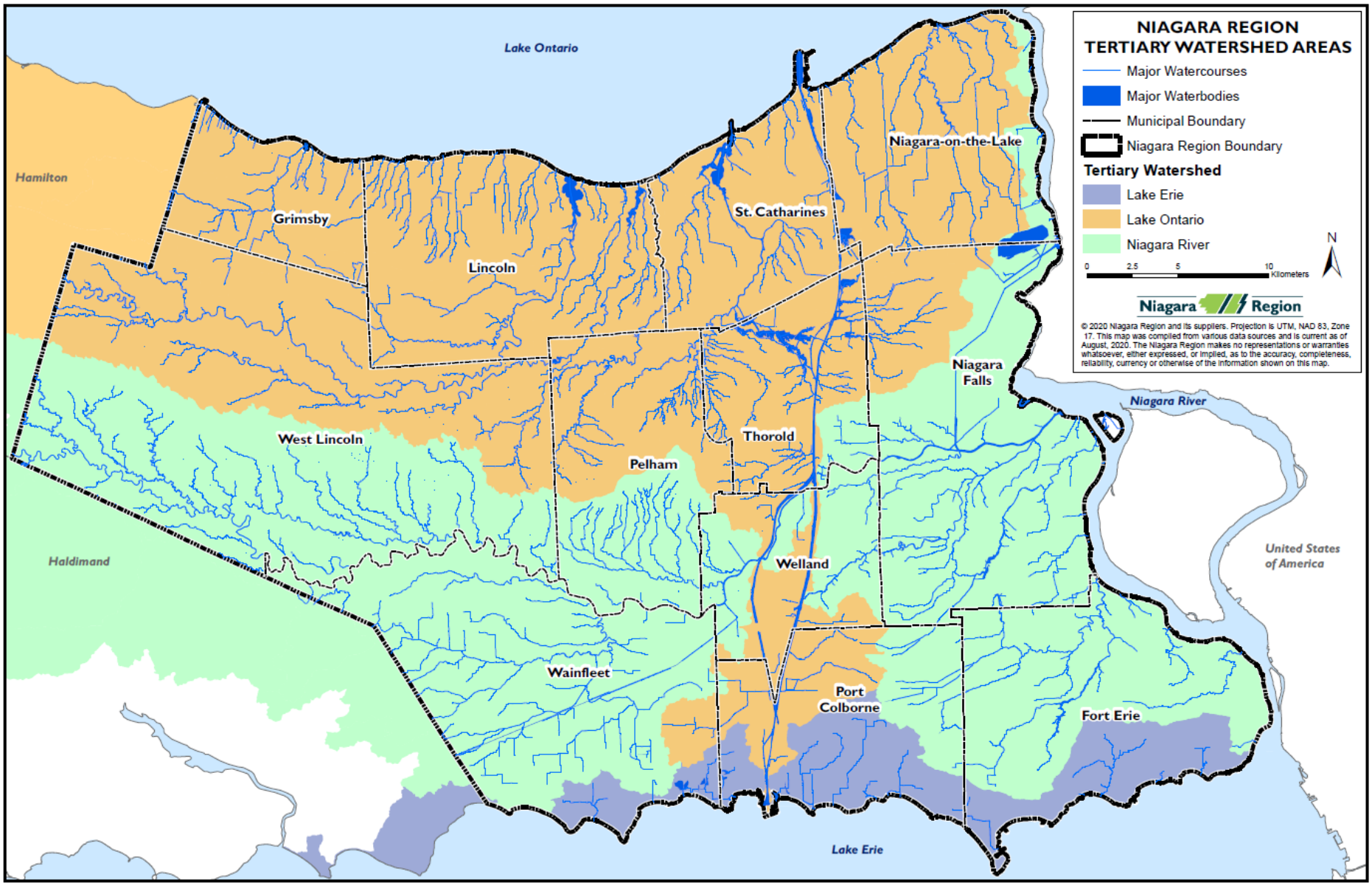


Figure 1-3. Niagara Region – Quaternary Watershed Areas

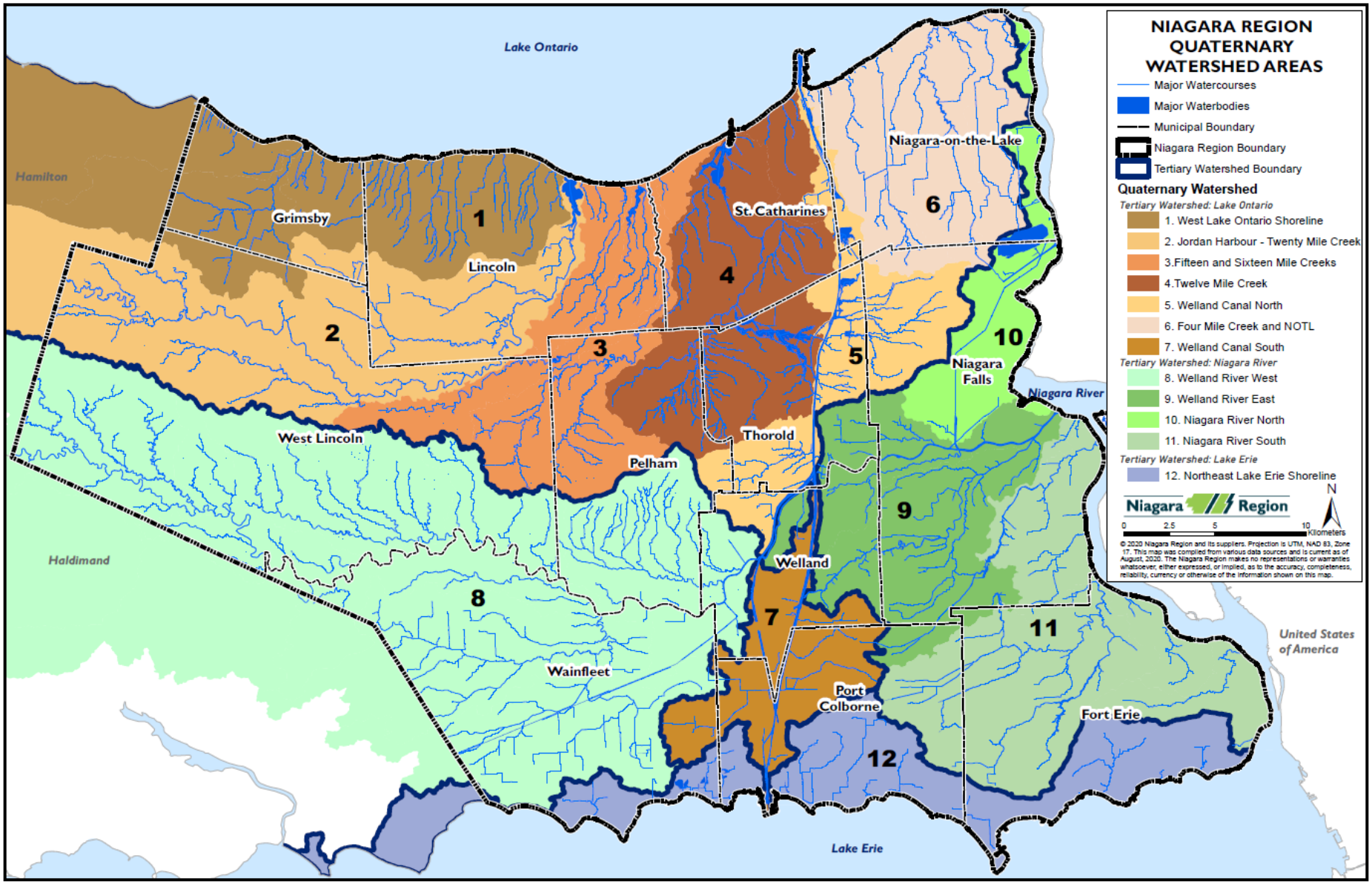
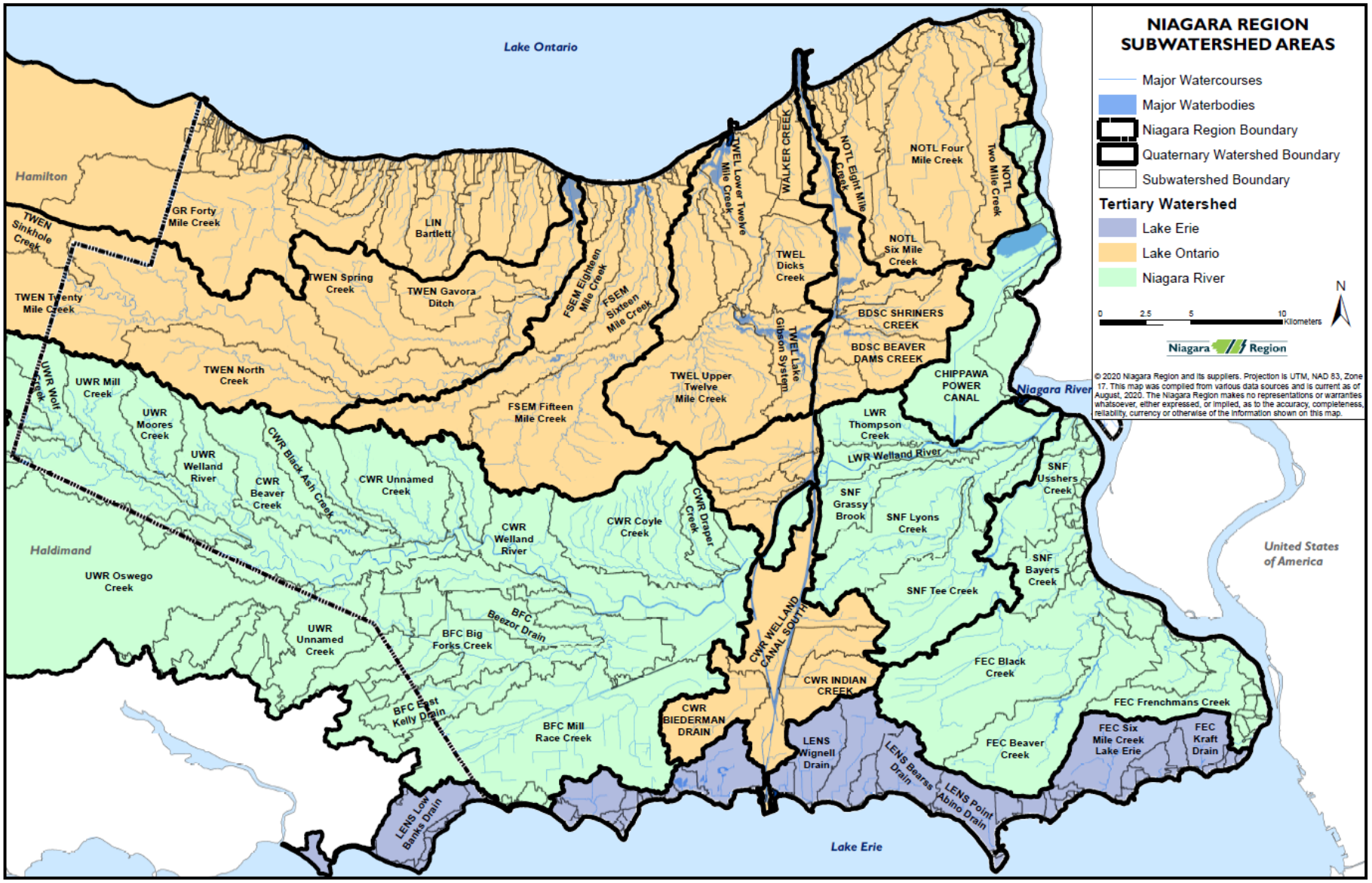


Figure 1-4. Niagara Region Subwatershed Areas



1.3 Work Plan

The NWP (E) has been completed through five (5) primary tasks:

Task 1 Confirm Boundaries & Establish Priorities

- *Task 1-1 Confirm & Collect Available Data & Reports* | The Natural Environment Work Program (NEWP) collected, considered and summarized an extensive range of datasets (geospatial) and reports that have informed or been used in analyses of the current Niagara Watershed Plan Equivalency project. The Wood Team has worked with the Region to confirm that the list of available data and reports represents the most current and 'best available' data and information for use in the Niagara Watershed Plan Equivalency document.
- *Task 1-2 Watershed and Sub-watershed Delineation* | The Wood Team has worked with the Region to confirm or refine watershed and subwatershed mapping for the Region based upon available sources. Substantive mapping and modelling have been undertaken as part of separate studies and as such, has required consolidation of existing mapping and rationalizing any minor mapping discrepancies to produce appropriate and supportable watershed and sub-watershed delineations for the purpose of the Niagara Watershed Plan Equivalency document.
- *Task 1-3 Establish Priority Areas* | While the Watershed Plan Equivalency document broadly characterizes the tertiary watersheds in their entirety, identification of more localized priority areas within Niagara's watersheds has allowed for an opportunity to focus guidance and direction for the subsequent tasks and work effort of the Wood Team. Priority watershed areas and subwatersheds include those which have been informed by the new NOP work being completed by the Region (e.g., known or potential settlement expansion areas), known areas experiencing higher levels of development or resource pressure, or are known to have functional concerns related to management of water quality or quantity.

Task 2 Characterization of Existing Conditions

- *Task 2-1 Data Mining & Gap Analysis* | Existing legacy datasets and reports (as outlined in the WPDP and others) have been mined, pulling from the various formats, geospatially referenced datasets and information that can be used to characterize existing conditions across the tertiary watersheds. Focus has been given to priority areas identified through Tasks 1-1 to 1-3 to refine the level of understanding within these critical areas for land use planning within the Region. Through this data mining and review exercise, the Wood Team has identified gaps or deficiencies including age, quality / accuracy and/or availability, for its use in prioritizing recommendations for future work.
- *Task 2-2 Stakeholder Consultation #1* | *Issues & Opportunities Workshop* | Extensive stakeholder engagement was undertaken as part of the NEWP and continued through the new NOP process. This engagement has identified that protection of the environment, and water specifically, are amongst the community's top priorities. This stakeholder engagement was conducted as a remote public meeting in 2020 due to the pandemic, involving numerous community participants; this session provided an introduction to the project and solicited input on topics,

themes, goals and objectives, and encouraged knowledge sharing to inform the project and identify potential gaps/issues.

Task 3 Set Watershed Plan Equivalency Goals & Objectives

- *Task 3-1 Policy Review & Identification of Key Conformity Support* | The key purpose of the Niagara Watershed Plan Equivalency document is to provide tertiary watershed planning direction to inform the new NOP. In support of this, the Wood Team has reviewed applicable provincial policies, plans and guidance documents (i.e., specifically the "Watershed Planning in Ontario – Guidance for Land-use Planning Authorities", 2018) related to watershed planning, natural heritage and water resource systems to identify key areas of conformity. This review has directly informed the goals and objectives of the Niagara Watershed Plan Equivalency document.
- *Task 3-2 Watershed Equivalency Goals & Objectives* | Drawing on work completed through primary Tasks 1, 2 and 3-1, the Wood Team has worked with the Region's Project Team to establish goals and objectives for the Niagara Watershed Plan Equivalency document. This effort has provided key direction on scope and prioritization of outcomes for the report to ensure that it meets the needs of the Region and Stakeholders.

Task 4 Integrate the Natural Heritage System & Inform the Water Resource System

This task has built on the work completed through the NEWP to support the Niagara Watershed Plan Equivalency document and also has drawn upon data mined through Task 2-1, to refine and inform the WRS within priority areas. Through this task, key elements of the systems supporting the tertiary watersheds of the Niagara Region have been confirmed to inform the development of recommendations and implementation priorities.

- *Task 4-1 Integrating the Preferred Natural Heritage System* | A key input to watershed planning is the natural heritage system prepared as part of the NEWP. The interrelationship between natural heritage and water resource systems is recognized in the PPS and is an essential component informing watershed planning. A preliminary preferred option and associated system mapping was completed in March 2021. Additional consultation occurred through April 2021 with an anticipated confirmation of the preferred system in Q3 2021.
- *Task 4-2 Informing the Water Resource System* | Through the NEWP, initial options for a WRS have been identified based on sources of information to inform the WRS through watershed planning (per the WPDP). This task has used data 'mined' from existing sources (Task 2-1) to further inform and refine the preliminary WRS discussed through the NEWP. This task has focused on informing the WRS within priority areas identified through Tasks 1-3 to maximize the utility of project resources and ensure effective input and direction for land use planning for the new NOP.

Task 5 Watershed Plan Elements & Best Practices

Drawing on work completed through the preceding tasks, the Wood Team has identified and developed recommendations for prioritizing gap filling in the future and establishing implementation priorities. In their development, the Wood Team has explored best practices associated with those key elements that influence land use planning at a tertiary watershed planning scale to inform the new NOP. Section 6 of the "Watershed Planning in Ontario – Guidance for Land-use Planning Authorities", 2018, outlines the expectations and scope associated with defining those elements which typically constitute a Watershed Plan. Given the scope of the current project, an "equivalency" approach has been advocated to optimize the use of existing desktop resources to address the respective items to the extent possible and thereby develop informed tertiary guidance for the new NOP. A brief summary of key watershed plan elements is provided in the tasks which follow:

- *Task 5-1 Water Management Guidance (Quantity / Quality)* | The Source Protection Plan and available watershed and subwatershed plans have been used to establish a tertiary understanding of conceptual water budgets and water quality for the respective systems (no modelling was conducted). This information has been used to prioritize locations where land use change and supporting growth would be anticipated to have low, medium and high impacts.
- *Task 5-2 Climate Change Guidance* | Numerous municipalities, including Niagara Region, are actively involved in considering the potential impacts due to climate change on infrastructure and growth. The Wood Team has used "lessons learned" from Ontario-based initiatives, as well as other local examples, to provide guidance on best practices to consider climate change influences in the new NOP.
- *Task 5-3 Natural Hazards* | Earlier tasks (ref. Task 2.1) have collected mapping and background to NPCA's hazard delineation in its watersheds. These data are understood to be contemporary and reflect the best available information. As part of this task the information has been checked against other on-going and future initiatives to ensure the information is current and consistent, with acknowledgement of future updates and/or refinements to come through other studies.
- *Task 5-4 Cumulative Impact Guidance* | For a study of this scale (tertiary watersheds) and scope, a fulsome cumulative effects study was not feasible. Rather, in order to provide direction/guidance related to cumulative impacts, the characterization established earlier (ref. Task 2.1) has been used to identify sensitivities through which, existing development and proposed growth, have been overlain to define areas anticipated to be under the greatest impact due to past, current and proposed development, in the form of a screening lens.
- *Task 5-5 Land Use Impact Management* | Best practices for managing impacts due to urbanization are well documented. Current trends and approaches, particularly those in Niagara, have been reviewed to provide appropriate insights for the new NOP. Balanced consideration of grey/green infrastructure is considered important to inform the new NOP, building from acceptable local area municipal approaches. The categories of management include: NHS, watercourses and water (surface and ground).

- *Task 5-6 Future Studies / Priorities* | The Wood Team has mined the available desktop resources of information related to the NHS, WRS and associated resource/water-focused data. As is clearly understood and outlined in the WPDP, numerous gaps exist. Furthermore, numerous future studies will be required to support growth (notably Quaternary Watershed plans and/or Subwatershed Studies); strategies and experiences from these types of studies have been outlined to appropriately inform the new NOP.
- *Task 5-7 Monitoring / Adaptive Management* | As part of this task, it was required to determine those aspects of the NHS and WRS, and associated natural and water-based resources, which should be monitored as part of broad-scale growth plans. The Wood Team has outlined a framework and requirements for developing both local and holistic monitoring strategies for large scale development over extended periods (10 years +/-) for the Niagara Region.

Each of these tasks represented an important milestone in the background review, consultation, data collection, analysis and developing the framework for the resulting NWP (E); each task has been completed individually and submitted to the Region under separate cover (Technical Memoranda) for review and approval, prior to the compilation of the current final NWP (E).

1.4 NWP (E) Report Structure

The NWP (E) has been structured as an overall framework which provides an overview of existing data sets and has developed an outline for subsequent quaternary watershed plans. The findings from each project task outlined in the previous section have been integrated into the following report volumes which represent the contents of the three (3) NWP (E) documents, which together constitute the NWP (E):

- **Volume 1: Characterization**
  - Niagara Watersheds Characterization (Lake Ontario, Niagara River, Lake Erie)
    - *Drainage Systems*
    - *Surficial Soils*
    - *Slopes / Topography*
    - *Groundwater System & Source Water Protection*
    - *Natural Hazards*
    - *Natural Heritage (Fish & Terrestrial)*
    - *Land Uses (Urban & Agricultural)*
    - *Watershed Monitoring (Climate, Streamflow, Water Quality and Groundwater)*
- **Volume 2: Niagara Watershed Management**
  - Goals & Objectives
  - Integrating the Natural Heritage System (NHS) & Water Resource System (WRS)
  - Watershed Plan (Equivalency) Guidance
    - *Water Management Guidance (Quantity/Quality)*
    - *Climate Change Guidance*
    - *Natural Hazards*

    - *Cumulative Impacts*
    - *Land Use Impact Management & Preliminary Guidance*
  - Future Studies & Monitoring

- **Volume 3: Growth Analysis**
  - Growth Scenarios / Priority Areas
    - *Total Potential Growth*
    - *Priority Areas*
    - *Growth Area Screening Matrix*

The contents of the current report pertain to **Volume 2: Niagara Watershed Management**, which provides a review of the goals and objectives for the NWP(E), integration of the NHS & WRS, watershed planning equivalency guidance and the needs for future studies and monitoring. The contents of this volume build upon Volume 1, which outlined the existing data sources as part of the existing conditions characterization of the three (3) tertiary watershed systems present within the Niagara Region. The findings from both Volume 1 and the current Volume 2 will help to support the analysis of potential growth across the Niagara Region, outlined in Volume 3.

These report volumes encompassing the final NWP(E) have been compiled to improve the understanding of the natural and water-based systems present within the Niagara Region. The information also helps inform the new NOP and provides direction for the subsequent studies, which will be required to support future quaternary watershed planning and local subwatershed planning initiatives in the Niagara Region.

2.0 GOALS AND OBJECTIVES

2.1 Introduction

The key purpose of the NWP (E) is to provide tertiary watershed planning direction to inform the new NOP. The Project Team has reviewed applicable provincial policies, plans and guidance documents related to watershed planning, the NHS and WRS, as well as consulted with the public and relevant stakeholders to inform the goals and objectives of the NWP (E) document. Further discussion regarding the development process and the resulting goals and objectives are outlined in the subsequent sections.

2.1.1 Watershed Planning Principles

Based on guidance from the Provincial Policy Statement, the watershed has been identified as the ecologically meaningful scale for integrated and long-term planning, and also the appropriate scale for identifying natural heritage systems and water resource systems. Further, watershed planning can provide high-level guidance to water (surface and ground) management practices to minimize the impacts of adverse runoff from urban areas (stormwater peaks/volumes and contaminant loads), among other requirements.

Watersheds are defined as an area that is drained by a river and its tributaries, while subwatersheds are defined as an area that is drained by a tributary or some defined portion of a stream. The Growth Plan and Greenbelt Plan share the same definition for watershed planning, which is defined as follows:

Planning that provides a framework for establishing goals, objectives, and direction for the protection of water resources, the management of human activities, land, water, aquatic life, and resources within a watershed and for the assessment of cumulative, cross-jurisdictional, and cross-watershed impacts.

The current Provincial Guidance for Watershed planning (MNRF, 2018 (Draft)) prescribes a number of components of watershed planning as follows: watershed characterization, water budgets, and conservation plans; nutrient loading assessments; consideration of climate change impacts and severe weather events; land and water use management objectives and strategies; scenario modelling to evaluate the impacts of forecasted growth and servicing options, and associated mitigation measures; environmental monitoring plans; requirements for environmental best management practices, programs, and performance measures; criteria for evaluating the protection of quality and quantity of water; the identification and protection of hydrologic features, areas, and; and targets for the protection and restoration of riparian areas.

Watershed planning can be undertaken at many scales and considers cross-jurisdictional and cross-watershed impacts. Subwatershed planning which accompanies local municipal planning, has a higher level of analysis and related management details.

Provincial land use plans that are applicable within the Greater Golden Horseshoe area provide direction for municipalities to ensure that watershed planning is undertaken to inform municipal policy and decision-making. Policies in the Growth Plan and Greenbelt Plan require that upper and single tier municipalities, in partnership with conservation authorities, as appropriate, shall ensure that watershed planning is undertaken to

support a comprehensive, integrated, and long-term approach to the protection, enhancement or restoration of the quality and quantity of water within a watershed.

Furthermore, the Growth Plan requires planning for large-scale greenfield development, including secondary plans, to be informed by subwatershed planning, or equivalent. Settlement Area Boundary Expansions need to demonstrate that any proposed expansion will minimize or mitigate potential impacts on watershed conditions and the water resource system, including the quality and quantity of water.

2.1.2 Review of Background Documentation

The new NOP is required to be consistent with the Provincial Policy Statement (2020) and conform to provincial plans. For the NWP (E) document to inform the new NOP, it is important to identify the key areas of conformity through a review of provincial guidance to inform the Goals and Objectives of the NWP (E) document.

The Project Team has reviewed provincial policies and plans to determine legislative requirements regarding Watershed Plans and suitable equivalents to inform land use planning. The Draft Provincial Watershed Planning guidance document "Watershed Planning in Ontario – Guidance for Land-use Planning Authorities" (2018) was specifically reviewed to determine existing provincial guidance regarding the setting of watershed plan goals and objectives.

In order to rationalize the provincial level guidance to the Regional level, as well as identify key areas of conformity and Niagara Region priorities and concerns, the Project Team has reviewed the existing ROP (2014), the NEWP Consultation Summary Report (2019) and the NEWP Watershed Planning Discussion Paper (2019). Furthermore, the Niagara Region Stormwater Management Guidelines, which are under development (2020-2021)were reviewed, and the Regional priorities identified at the Project Kick-off Meeting on May 14, 2020 were also incorporated to provide further insights at the Regional level.

The following provides a listing of the documents which were reviewed to establish the goals and objectives for the NWP (E) document, specific to Niagara Region:

- Provincial Policy, Plans and Guidance
  - Provincial Policy Statement (PPS) (2020)
  - A Place to Grow – Growth Plan for the Greater Golden Horseshoe (Growth Plan; 2020)
  - Greenbelt Plan (2017)
  - Niagara Escarpment Plan (2017)
  - Watershed Planning in Ontario – Guidance for land-use planning authorities (Draft February 2018)
- Niagara Region Policy, Reports and Guidance
  - Existing Regional Official Plan (ROP) (2014)
  - Natural Environment Work Program: Watershed Planning Discussion Paper (2019)
  - Natural Environment Work Program: Consultation Summary Report – 1st Point of Engagement (2019)

- Niagara Stormwater Management Guidelines – Technical Memorandum #1: Background Review, Research Municipalities, Summarize Legislation (July 2020)

The relevant policy excerpts for each of the documents outlined above have been summarized and linked to the NWP (E) goals and objectives. The policy review summary can be found in Appendix A-2, and and the goals and objectives for the NWP (E) have been outlined in the subsequent section.

2.2 Goals and Objectives

In the context of watershed planning, “Goals” represent the aspirational outcomes established for a watershed, while “Objectives” represent the supporting actions or outcomes necessary to achieve those goals, explicit to watershed planning. The goals and objectives of a watershed plan ultimately set the parameters for some of the land-use planning decisions made under that plan. It is therefore essential that these goals and objectives for the watershed planning process align with all relevant policies and plans, as well as reflect local priorities and existing conditions.

The goals and objectives of the NWP (E) document have been categorized into the following key topic areas:

- Water Resource System (WRS)
- Natural Heritage System (NHS)
- Land Use Planning and Resiliency
- Engagement

For each key topic area, relevant provincial guidance, legislative requirements and ROP (2014) policies have been identified. Subsequently, Niagara Region specific documents (e.g. NEWP reports) have been reviewed to identify Regional and stakeholder priorities, as well as local conditions. The provincial guidance, Regional guidance and stakeholder input were then used to develop preliminary goals and objectives for the key topic areas to be considered through the NWP (E) document and through future actions / recommendations.

As noted above, in the context of the Niagara NWP (E), the “Goals” are the aspirational outcomes established at the tertiary watershed level, encompassing long term and high-level watershed planning goals. The NWP (E) “Objectives” represent those actionable items and outcomes that have either been accomplished by the Project Team, as part of this scope of work, or become recommendations for future work by the Region through Quaternary Watershed planning or of the Local Area Municipalities, through subwatershed planning. This section presents the set of goals and objectives which has supported the development of a framework for the NWP (E).

Regional input and stakeholder consultation have also played an important role in refining the NWP (E) goals and objectives, in order to ensure they represent local priorities and existing conditions. As the NWP (E) goals and objectives have been evaluated as part of subsequent project tasks, future actions and recommendations have also been identified, in order to provide Niagara Region with the next steps required to implement and achieve the NWP (E) goals and objectives, as well as inform the new NOP and local area municipal plans, to ensure land use decisions are informed by watershed planning. Recommendations have included partnership opportunities with

the local municipalities, NPCA and the public, in order to further develop the NWP (E), and may include, among others, ground truthing, monitoring programs, modelling, outreach programs, future watershed and subwatershed study recommendations and NWP (E) refinements. Further discussion regarding guidance and future studies has been presented in Section 4 and Section 5.

2.2.1 Summary of Goals & Objectives

The following is a summary of the goals and objectives to establish a framework for the NWP (E) as well as the context for future action. A working set of goals and objectives was shared with the public and stakeholders through a Virtual Public Information Centre in September 2020, followed by an online distribution through the "*Goals and Objectives Discussion Paper"*, published in October 2020. Feedback was received from the public, stakeholders and regulatory agencies which has been summarized in the Consultation Summary Report completed by the Niagara Region for the NOP. This feedback allowed for the NWP (E) Goals and Objectives to be modified and expanded upon, resulting in the final Goals and Objectives as outlined in the subsequent sections. It is important to acknowledge that the Goals and Objectives have guided the development of the NWP (E) and will also be used to support the subsequent actions of the Region and its municipal partners in the implementation phases, through future Quaternary Watershed plans and/or subwatershed plans.

Goal 1: Establish and Maintain Contemporary and Accurate Understanding and Mapping of the Watershed

a. Identify the WRS

- Review all available and relevant data sources
- Delineate Watershed at the Tertiary and Quaternary-levels and Subwatershed Boundaries to establish contemporary and accurate understanding of the watershed systems
- Characterize the existing conditions of the watershed based on existing desktop data specific to natural hazards, natural features and the water resource system components, using the best available information for the area
- Identify/refine the WRS for Niagara Region, based on initial WRS from the NEWP, including key hydrologic features and key hydrologic areas
- Include areas with particularly sensitive karst systems
- Provide appropriate connections with WRS Options identified in the NEWP

b. Support the development of WRS Mapping

- Review all available and relevant data sources
- Delineate Watershed (tertiary and quaternary) and Subwatershed Boundaries
- Map WRS elements based on available mapping, including:
  - Key hydrologic features
  - Key hydrologic areas
  - Functional considerations, such as appropriate recognition of human-made features
- Identify gaps or deficiencies including age, quality / accuracy and/or availability of available data

- Present existing/accessible data and gaps as a mapped index to clearly illustrate this information and its use in prioritizing recommendations for future work
- Provide recommendations for consideration of WRS GIS/Data portal
- Maintain contemporary and accurate mapping of the watershed, incorporating the most recent and available data sources as part of long-term Watershed Plan refinements (e.g., aerial imagery, field studies, modelling), at the Tertiary, Quaternary and Subwatershed scales.

Goal 2: Protect Water Quality & Water Quantity

a. Develop a Water Budget for respective systems, building from a tertiary level of data

- Review Source Water Protection Plans, preliminary identification and mapping of the WRS, and other available data sources to develop water budget
- Identify water quality and water quantity concerns (e.g., nutrient loading, pollution)

b. Identify best practices for water conservation and maintaining water quality in order to plan for efficient and sustainable use of water resources

- Identify considerations for surface water features and areas
- Identify considerations for groundwater features and areas
- Provide best practices to enhance stormwater capture / infiltration

Goal 3: Adaptively Manage and Monitor the Watershed

a. Monitoring and Adaptive Management

- Collate existing resources (e.g. GIS) of monitoring programs, including location and scale
- Identify NHS, WRS and associated natural and water-based resources which should be monitored as part of broad-scale growth plans (refer to Goal 5 for additional growth management objectives)
- Develop local and holistic monitoring strategies to establish a monitoring framework for Niagara Region building from existing programs including provincial, NPCA, Great Lakes Strategy initiatives and others

b. Future Studies / Priorities:

- Establish guidelines and terms of reference for additional subwatershed studies
- Provide monitoring guidance for future studies required to support growth (notably SWS) including natural and water-based systems
- Provide recommendations for gap-filling and strategic study prioritization

Goal 4: Protect and Enhance Interactions Between the NHS and WRS

a. Identify the NHS

- Incorporate preferred/recommended NHS from NEWP, and the identification of the WRS (refer to Goal 1)
- Characterize existing conditions across the tertiary watersheds based on desktop accessible information determining areas of high sensitivity and risk

- Identify gaps or deficiencies including age, quality / accuracy and/or availability of existing data and reports
- Present data and gaps as a mapped index to clearly illustrate this information and its use in prioritizing recommendations for future work

b. Identify, preserve and enhance interactions between the WRS and the NHS

- Identify interactions between the WRS and the NHS to support connectivity
- Incorporate targets for restoration and protection of the NHS from the NEWP, such as targets for wetland, riparian, forest and grassland cover
- Incorporate targets from the NEWP and Great Lakes Strategy initiatives to protect Species-at-Risk and enhance fisheries and aquatic habitat
- Identify best practices recommended in the NEWP related to, among others:
  - Management of agricultural related water features and practices
  - Buffers
  - Invasive species

Goal 5: Ensure Land Use Planning is Informed by Watershed Planning

a. Review Growth Scenarios to Inform Land Use Planning

- Review potential growth scenarios, potential settlement expansion areas, known areas experiencing higher levels of development or resource pressure, or are known to have functional concerns related to management of water quality or quantity.
- Identify high level constraints based on functional sensitivities in areas where the NHS & WRS are at higher risk of impact to inform growth alternatives for Niagara Region and allow for an iterative approach providing feedback through the NWP (E)
- Apply a hierarchical approach to assess prioritized locations where land use changes and growth are anticipated to have low, medium and high impacts on the WRS, to ensure effective input and direction for land use planning for the new NOP.
  - Growth planning will be informed and balanced with a strong local watershed-based natural resources management needs and requirements

b. Provide Best Practices / Recommendations

- Provide balanced consideration of grey/ green infrastructure to inform the new NOP building from acceptable local area municipal approaches
- Identify and develop recommendations for prioritizing gap filling, and implementation priorities
- Provide insights into best practices for managing impacts due to urbanization

c. Provide Best Practices for protecting, enhancing and restoring the WRS related to, among others:

- Shoreline management
- Flooding and erosion
- Buffers

- Water quality and water quantity (including stormwater management) (refer to Goal 2)

Goal 6: Create Resilient Communities to Protect Human Health and Safety, and the Natural Environment

a. Manage Natural Hazards

- Review NPCA's flood hazard mapping to confirm mapping is current and consistent
- Incorporate flood hazard mapping into WRS mapping (refer to Goal 1)

b. Identify climate considerations and potential impacts to the WRS and NHS to improve resilience and inform land use and environmental planning

- Summarize lessons learned from other communities (e.g. City of Ottawa and City of Welland)
- Provide best practices/recommendations for flood hazard management
- Provide best practices/recommendations regarding climate change adjusted rainfall patterns

c. Develop Cumulative Impact Considerations

- Characterize the watershed to identify sensitivities and areas at risk
- Overlay areas of existing development and proposed growth
- Define areas anticipated to be under the greatest impact due to past, current and potential future development
- Identify flood vulnerable areas
- Provide best practices/recommendations regarding key environmental indicators and developing thresholds for future cumulative impact assessments

Goal 7: Engage communities to understand and reflect community-identified priorities and local conditions in the Niagara Watershed Plan (E)

a. NWP (E) Objectives:

- Incorporate public, stakeholder, development industry and Indigenous Groups input and priorities identified in the NEWP Consultation Summary Report(s) into the NWP (E)
- Conduct additional public consultation (e.g. public open houses, surveys, etc.) to gather feedback from the community
- Engage with Indigenous Groups specifically on the Niagara Watershed Plan Equivalency (NWP (E)) project

b. Future Actions & Recommendations

- Partner with NPCA (e.g. watershed planning, monitoring, mapping etc.)
- Partner with local municipalities (e.g. subwatershed planning, stormwater management etc.)
- Continue to engage with Indigenous Groups
- Continue to engage with Stakeholders (e.g., development industry, businesses, environmental groups, agricultural community)

- Develop Watershed Planning Steering and Stakeholder Committees comprised of NPCA, LAM, NGO and other interested groups
- Undertake stewardship, education and outreach opportunities on an ongoing basis, as appropriate, to ensure the NWP (E) reflects the community's priorities
- Continue to explore partnership opportunities with NPCA, such as:
  - Erosion and Sediment Control / Low Impact Development educational material for local businesses and development industry
  - Grant program
- Explore partnership opportunities with the Province of Ontario's Great Lakes Strategy initiatives to support the implementation of the Great Lakes Strategy goals, such as:
  - Information sharing (research, workshops, public educational materials)
  - Strategic partnerships (projects, plans and programs)

3.0 INTEGRATING THE NATURAL HERITAGE SYSTEM (NHS) AND THE WATER RESOURCE SYSTEM (WRS)

3.1 Introduction

3.1.1 Background

The Natural Environment Work Program (NEWP) for the new Niagara Official Plan (NOP) was initiated in 2018 to support the Region in the identification of, and preparation of policies for, the natural environment system(s) (NES)). The NES is comprised of both a Natural Heritage System (NHS) and a Water Resource System (WRS) and the NEWP included consideration of both. Key project outcomes are identified as follows:

Natural Heritage System:

- Identify a recommended NHS for Niagara
- Provide criteria and recommendations for mapping of the preferred NHS
- Provide policy direction for the New Official Plan for the NHS

Water Resource System:

- Identify a recommended WRS for Niagara
- Provide criteria and recommendations for mapping of the preferred WRS
- Provide policy direction for the New Official Plan for the WRS

Through the work of the NEWP, it was recommended that a watershed plan, or equivalent study be completed to inform the identification of the WRS in accordance with policy 4.2.1.3 a) of A Place to Grow: Growth Plan for the Greater Golden Horseshoe (Growth Plan, 2020). This direction was a key driver behind the current Niagara Watershed Plan Equivalency (NWP (E)) project.

The major phases of work under the NEWP are briefly summarized in Figure 3.1. Detailed reporting on the technical work supporting the NEWP, engagement, and recommendations have been provided through the project. Key reports include:

- Mapping Discussion Paper (September 2019)
- Watershed Planning Discussion Paper (October 2019)
- Natural Environment Background Study (October 2019)
- Consultation Summary Report #1
- Identification and Evaluation of Options Report (July 2020)
- Consultation Summary Report #2
- The Regional Natural Environment System and Considerations for Implementation (pending - 2021)
- Consultation Summary Report #3 (pending)

Figure 3-1: Diagram of the NEWP major work phases

Considerations for Mapping	The first phase was used to collect and review available mapping with the Region, and to determine considerations for system mapping through meetings with the Mapping Working Group (region, local municipalities, CA), and the Technical Advisory Group (TAG).
Comprehensive Background Study	To inform the development of options for the NHS and WRS and to inform policy development two discussion papers (Mapping and Watershed Planning) and one technical report (Natural Environment Background Study) were completed. Engagement during this phase was used to inform the public and stakeholders of these documents and to seek input for the development of system options.
Options Identification and Selection of Preferred **In Progress**	The Identification and Evaluation of Options for Regional Natural System(s) report (July 2020) resulted in 3 main NHS options and two WRS options for consideration. Engagement through this phase was used to present the options and seek input. This process continues as further engagement and review with local area municipalities was triggered. Refer to section 3.2.2 and 3.3.3 for additional information.
Considerations for Implementation **In Progress**	Consideration and recommendations for implementing the systems (NHS and WRS) will be documented in a technical report. This report will consider policy development, implementation tools and recommendations for wise use of resources. **Anticipated completion: August 2021**
Policy Development & System Mapping **In Progress**	The Region will undertake mapping of the preferred system(s) and prepare draft NOP policies supported by technical advice from the NEWP consultant team. **Anticipated completion: November 2021**

3.1.2 Purpose

While direction from the province is to identify an NHS and WRS as separate systems, there is an intrinsic understanding in provincial guidance, as well as at the Region, that these systems are mutually dependent. Integration of these systems as a comprehensive 'Natural Environment System' provides a clearer understanding of this perspective. Policies within the New NOP are expected to address each independently to ensure compliance with applicable provincial policies, but should also speak to their connected nature.

This report chapter is intended to:

- Briefly outline status of system identification under the NEWP and anticipated process(es) for their confirmation.
- Summarize confirmed and potential components of the system(s) within Priority Areas identified for potential growth (ref. NWP (E) – Volume 3: Growth Analysis).
- Identify key interactions and interdependencies between features and functions of the NHS and WRS to inform planning for an integrated Natural Environment System.
- Provide preliminary direction on how interactions can be confirmed or refined through future study.

While the systems are not confirmed, the nature of the interactions and integrations between the systems will remain applicable. System interactions are based on feature, form and function and exist on the landscape irrespective of status in policy.

3.2 Natural Heritage System

The NEWP is ongoing (per Section 3.1.1 and Figure 3.1); information presented here is based on status at the time of report preparation. Readers are directed to documentation prepared through the parallel project for current status and outcomes. A summary is provided in this report as context to the preparation of the Niagara Watershed Plan – Equivalency.

3.2.1 NHS Components

The Provincial Policy Statement defines a Natural Heritage System as:

> *"a system made up of **natural heritage features and areas**, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems **can include** natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support hydrologic functions, and working landscapes that enable ecological functions to continue. The Province has a recommended approach for identifying natural heritage systems, but municipal approaches that achieve or exceed the same objective may also be used"* (PPS 2020)

Where natural heritage features and areas are defined as:

> *"features and areas, including significant wetlands, significant coastal wetlands, other coastal wetlands in Ecoregions 5E, 6E and 7E, fish habitat, significant woodlands and significant valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River), habitat of endangered species and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area" (PPS 2020)*

The definition for a Natural Heritage System provides clear direction that natural heritage features and areas are required components for an NHS, and also identifies optional components for consideration in identifying an NHS, including 'other natural heritage features'. While the NHS is described as a separate system from the WRS, these two systems are considered interconnected and reliant on each other; as such, these two systems are being considered holistically as the Natural Environment System. For the sake of describing the components of the NHS, only those components that are exclusive to the NHS are described in Table 3.1 (i.e., those components that were previously included in the NHS as "options", but were required components of the WRS, such as 'other wetlands', 'permanent and intermittent streams' and 'inland lakes', are not described). Based on NEWP project status, a summary of features and areas exclusive or required as components of the NHS are presented in Table 3-1. 'Required' features and areas those which 'shall' be included within an NHS in accordance with provincial policy (PPS, Greenbelt Plan, Growth Plan) and represent the minimum standards. 'Optional' features and areas are those which 'may' be included within an NHS be included as a component of the NHS. As the NEWP work program is in progress, components are identified as confirmed or in development. Confirmed features have defined criteria which are not anticipated to change over the remainder of the NEWP; features 'in development' for which definitions and criteria are being discussed and will be an outcome of the NEWP. Not all components of the final NHS may be mapped on official plan schedule(s). Decisions to map or not map features are based on data availability or status, sensitivity, etc.

Table 3-1: Summary of NHS feature types

Feature / Area	System Status
Provincially Significant Wetlands	**Required** Defined by the province, mapped features are a **confirmed** component of the system. Feature(s) are **mapped**.
Areas of Natural and Scientific Interest (ANSI) - Life Science, Earth Science	**Required** Defined by the province, provincially significant life science and earth science ANSIs are a **confirmed** component of the system. Feature(s) are **mapped**.
Significant Woodlands	**Required** Defined by the Region using provincial guidance and Niagara-specific landscape considerations (e.g., % cover).

Feature / Area	System Status
	Criteria for identifying *significant* woodlands are **in development**. Feature(s) are **mapped**.
Fish Habitat	**Required** Defined in accordance with the Department of Fisheries and Oceans definition for Fish Habitat. This is a **confirmed** component of the system. Feature(s) are **not mapped**. Upon confirmation through more detailed study, fish habitat may be mapped.
Significant Valleylands	**Required** Significant valleylands are to be identified in accordance with provincial guidance. This is a **confirmed** component of the system. Feature(s) are **not mapped** due to insufficient data. As identified through more detailed study, significant valleylands may be mapped.
Habitat for Endangered and Threatened Species	**Required** Habitat for Endangered and Threatened species is protected. Habitat is delineated and/or confirmed by the Ministry of Environment, Conservation and Parks (MECP). This is a **confirmed** component of the system. Feature(s) are **not mapped** due to insufficient data and sensitive nature of the information. As habitat becomes mapped internal mapping will be retained for these areas
Significant Wildlife Habitat (SWH)	**Required** Defined in accordance with provincial guidance – the Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E. This is a **confirmed** component of the system. Features are **not mapped** due to insufficient data. As SWH is identified through more detailed studies, these areas may be mapped as part of the system or maintained internally.
Linkages	**Required** Regional-scale linkages are mapped through the Province's NHS and are **confirmed** components of the system. Additional linkages are being considered outside of the Provincial NHSs and are **potential** features of the system. Provincial linkages are **mapped**. Additional linkages **may be mapped**.
Enhancement Areas	**Optional** Per the PPS, opportunities to improve the system should be identified *where possible*. The mapping of potential enhancement areas is being considered through the

Feature / Area	System Status
	evaluation of options. The requirement to consider enhancement areas will be addressed in policy. These feature(s) are **not mapped**. Enhancement areas may be mapped as they are identified.
Other Woodlands	**Optional** Woodlands not meeting criteria for *significance* may be included within the system (i.e., 'other' woodlands). These are **potential** features of the NHS. If included, criteria to identify these features within the system will be established. If included, they will be **mapped**.
Grasslands / Meadows / Thickets	**Optional** Grassland and successional habitats are being lost on the landscape across Ontario. Some may be captured through Significant Wildlife Habitat. Consideration is being given to including additional open country habitats to support biodiversity and habitat diversity in Niagara. These are **potential** features of the NHS. If included, criteria to identify these features within the system will be established. If included, they will not be **mapped**.

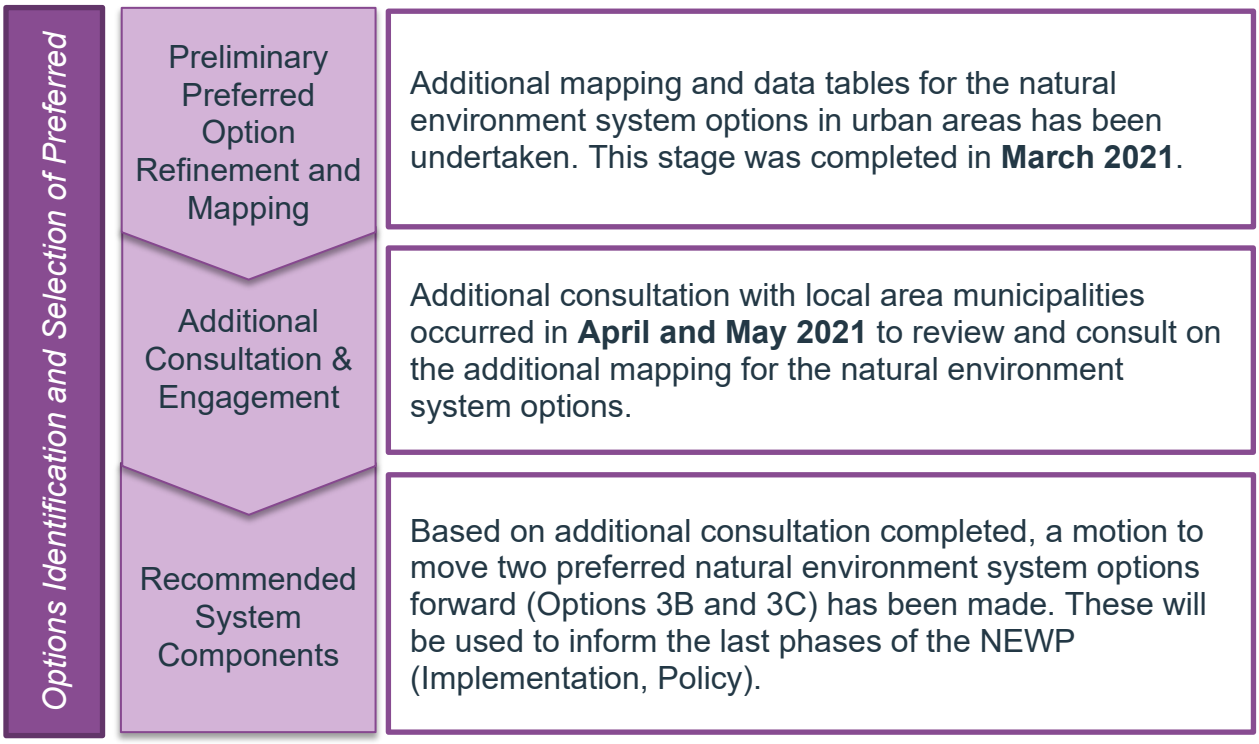
Through the NEWP, a total of three (3) primary options were developed for the NHS. Options were prepared to illustrate a range of potential systems from relatively basic components to meet required Provincial standards (Option 1) through to an enhanced systems approach (Option 3) which would go beyond the required standards.

3.2.2 Process to Confirm the NHS

Per Figure 3.1 in Section 3.1.1, several key phases of the NEWP are in progress and a preferred NHS has not been confirmed. As of the time of writing, a motion has been moved by Countil to support N.H.S Options 3B and 3C. This refines the options to two 'preferred' options.There are relatively minor differences between these two sub-options; confirmation of the final preferred system and any associated refinement of definitions and criteria, and mapping of the NHS is occurring in parallel to the current Niagara Watershed Plan (Equivalency) work through the NEWP. Work to compare and contrast these two preferred options for the final recommended system and policy direction the system, which will be carried forward to policies and schedules of the NOP, is in progress and is anticipated to be completed in July 2021 and public release in the fall of 2021.

A summary of key steps to the confirmation of the NHS in process is provided in Figure 3-2.

Figure 3-2: Summary of process to confirm the NHS (NEWP)



Per Section 3.2.1, features of the NHS may be mapped or unmapped in the new NOP. Some features will be identified 'on the ground' through subsequent studies where data and information required to confirm presence / absence or refine limits will be completed. It is also important to note that refinements to feature boundaries may occur through more detailed studies (e.g., local subwatershed studies, environmental impact studies) where detailed data are collected in accordance with recognized standards (e.g., Ontario Wetland Evaluation Process) and applicable municipal and, as appropriate, provincial policies.

3.2.3 Natural Heritage System Features within Priority Areas

Most features which comprise the NHS are **required** and as such are confirmed components of the NHS. While the components are generally known, criteria and definitions are being developed to inform the identification of these features on the landscape. As such, while the composition of the NHS is generally known, they cannot at this time be identified (i.e., mapped or confirmed) within the Priority Areas. For example, significant woodlands are a known component, however their definition and criteria are in final stages of development. However, available datasets provide the opportunity to summarize existing features and areas which occur within the Priority Areas for growth to generally characterize existing natural land cover and inform the review of potential interactions between the NHS and WRS (Section 3.4).

A summary of NHS features within Priority Areas based on currently identified components of the system has been prepared as part of NWP (E) – Volume 3: Growth Analysis. While this summary in Volume 3 provides a snapshot of landcover, readers

are referred to NWP (E) – Volume 1: Characterization for a comprehensive summary of existing conditions by tertiary and quaternary watershed. Preparation of future study plans should consider the context for the priority areas within their respective watersheds, to ensure that potential presence of significant features, land cover, etc. is considered.

3.3 Water Resource System

Like the NHS, planning and preliminary options for a WRS have been prepared through the NEWP process. As noted in Section 3.1.1, the Growth Plan (2020) requires that the WRS be informed by watershed planning, and this requirement is a major driver for the current Niagara Watershed Plan (Equivalency) project.

3.3.1 Developing a WRS

The Province has prepared guidance for watershed planning in Ontario: *The [Draft] Watershed Planning in Ontario: Guidance for land-use planning authorities* (MOECC and MNRF, 2018)[1], which is intended to support implementation of provincial land use plans (e.g., the Growth Plan, Greenbelt Plan, Niagara Escarpment Plan) and the PPS. The identification and development of a water resource system (WRS) is required by policy within the PPS, Growth Plan, and Greenbelt Plan.

The PPS (MMAH, 2020) states a WRS consists of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, with the intended purpose of supporting the ecological and hydrological function of the watershed.

Similarly, the Growth Plan (MMAH, 2020b) requires the identification of a WRS to support healthy communities and ecosystems, and to protect key hydrologic features and areas. Like with the PPS, key hydrologic features may also be identified as part of the Natural Heritage System (NHS). This supports the benefit of integrating the WRS and NHS to sustain ecological function and thereby maintain biodiversity. Developing a WRS is an important part of watershed planning and is essential in planning for growing communities.

The Growth Plan (2020) states that the WRS is to be informed by watershed planning and other applicable information for the long-term protection of key hydrologic features and areas, and their associated functions. The development of a WRS is vital to supporting healthy aquatic and terrestrial ecosystems and providing safe drinking water for human consumption.

The Niagara Escarpment Plan (NEP) (MNRF, 2017) does not explicitly define or require the identification of a WRS; however, the plan identifies key hydrologic features as permanent and intermittent streams, lakes (and their littoral zones), seepage areas and springs, and wetlands, and states development should protect the quality and quantity of groundwater and surface water.

[1] It is important to note that this is a draft document and as such may be subject to change.

Section 3.2 of the Draft Watershed Planning in Ontario (MOECC and MNRF 2018) document provides direction for the identification of the WRS, recommending that the system be identified as part of the watershed characterization process. The basic approach includes 4 steps:

(1) Determine what information already exists and identify gaps

(2) Undertake reviews or studies to identify water resource system features

(3) Identify functions and interrelationships

(4) Identify linkages to support connectivity

To the extent possible, this structure has informed the approach to the current Watershed Plan (Equivalency) project to support the identification of the WRS for Niagara.

Based on provincial land use plans, the following features are identified as forming required and potential (optional) components of the WRS:

Confirmed Features and Areas

- Key Hydrologic Features (per Greenbelt Plan / Growth Plan)
  - Permanent and intermittent streams;
  - Inland lakes and their littoral zones;
  - Seepage areas and springs; and
  - Wetlands (Provincially Significant, unevaluated, evaluated-other)
- Key Hydrologic Areas (per Greenbelt Plan / Growth Plan)
  - Significant groundwater recharge areas;
  - Highly vulnerable aquifers; and
  - Significant surface water contribution areas..
- Shoreline areas necessary for the ecological and hydrological integrity of the watershed;
- Vegetation Protection Zones for Key Hydrologic Features (outside of settlement areas);
- Headwater drainage features (i.e., headwater drainage features classified as ‘Protection’ or ‘Conservation’ in accordance with the Evaluation, Classification and Management of Headwater Drainage Features Guidelines (CVC and TRCA 2014)); (catchment areas are considered through significant surface water contribution areas);
- Karst features and areas with potential to influence groundwater water quality and quantity; and
- Floodplain, flooding hazard, or floodway(s).

Key Hydrologic Features (KHF), Key Hydrologic Areas (KHAs) and other confirmed WRS features with available spatial datasets are shown on Drawing 3-1. No spatial datasets were available through the NWP (E) study for headwater drainage features; these are anticipated to be identified through future work by NPCA and quaternary and local subwatershed studies, completed in support of secondary plans and plans of subdivision. Information is also available for hazards (floodplain, top of slope); this information is managed by NPCA and is mapped as part of the WRS. Mapping of

floodplains and other hazards by NPCA is ongoing with updates to mapping occurring on a priority basis (areas without current mapping, updates to aged data, etc.).

Optional Features and Areas

- Surface Water Features and Areas
  - Other recharge and discharge areas (i.e., those not considered to be 'significant groundwater recharge areas');
  - Associated riparian lands.
- Ground Water Features and Areas
  - Water table(s);
  - Other aquifers (i.e., those not considered 'Highly Vulnerable');
  - Unsaturated zone(s);
- Hydrologic functions
- Natural Heritage Features and Areas
- Headwater drainage features classified as 'Mitigation' in accordance with the Evaluation, Classification and Management of Headwater Drainage Features Guidelines (CVC and TRCA 2014).

The capture of natural heritage features and areas as 'optional' components of a WRS recognizes intersections and interactions between natural heritage features and water – surface and ground. Natural features on the landscape serve to support both ecological and biodiversity functions as well as supporting and being supported by features and processes associated with the WRS (e.g., infiltration, seepage, etc.). In accordance with policy direction, the WRS and NHS are identified as separate systems, but they are recognized as supportive and connected and their import to land use planning and overall health of the natural environment are inherently interconnected, through the identification of the comprehensive NES for Niagara.

Headwater drainage features classified as mitigation are identified as optional features for a WRS. They have a recognized function as part of the WRS by performing critical water quality and quantity functions. They are considered optional because they may be managed (e.g., through land use or engineered methods) to replicate their function while removing the 'feature' from the landscape (i.e., the function is maintained, but the feature is not). Regardless of management, their function is to be considered and addressed in the context of the WRS.

Limited data exist to map optional WRS features. No spatial datasets were obtained through the NWP (E) study for water table, other aquifers, other recharge and discharge areas, unsaturated zone, associated riparian lands or hydrologic functions. Natural heritage features and areas are mapped through the NHS and natural cover datasets.

3.3.2 Preliminary NEWP WRS Options

This section summarizes work completed and in-progress through the NEWP. Areas where refinement and where opportunities for more detailed direction for refining the WRS are identified through this work as well as additional opportunities identified through the NWP(E) are discussed in Section 4 of this report.

Options Development

The “Natural Environment Work Program Technical Report #2: Identification of Options for Regional Natural Environment System(s)” (NSE 2020) report put forward two preliminary options for the WRS based on policies and direction in provincial planning documents and a review of existing practices, where available.

Option 1 directly reflected the requirements set out in the Growth Plan Greenbelt Plan and PPS. The PPS and these two provincial plans provide refined direction for the identification of a WRS. Key Hydrologic Features, Key Hydrologic Areas, Shorelines and VPZs to Key Hydrologic Features outside of settlement areas (per Section 3.4.1) form the required components of the WRS for Niagara. The PPS includes more general language stating that the WRS will include features which are ‘necessary for the ecological and hydrological integrity of the watershed’ (PPS s. 2.2.1). Per the Draft Watershed Planning guidelines (MOECC and MNRF 2018), watershed planning will assist in informing this assessment to determine if additional features (i.e., optional features per Section 3.4.1) are to be included in the WRS.

Option 2 included all features and areas in Option 1 and built upon it by including some features and areas considered optional components of a WRS or those that went beyond base policy requirements (e.g., Ecologically Significant Groundwater Recharge Areas; ‘hydrologic functions’). It was understood that optional components are to be informed by watershed planning or equivalent study.

Coming to a Single Option

Through policy development discussions of the NEWP, it was determined that there was effectively a single option for the WRS (NSE, 2021). Some components initially identified as ‘optional’ were, upon further review, determined to be ‘required’ based on best practices and current direction for watershed planning being completed in other jurisdictions. Based on this review, a single option for the WRS has been brought forward and includes the following:

- Key Hydrologic Features (KHF)
    - Permanent and intermittent streams
    - Inland lakes and their littoral zones
    - Seepage areas and springs
    - Wetlands
- Key Hydrologic Areas (KHA)
    - Significant groundwater recharge areas
    - Highly vulnerable aquifers
    - Significant surface water contribution areas
- Ground Water Features and Areas
    - Other recharge / discharge areas
    - Ecologically Significant Groundwater Recharge Areas (ESGRA)
    - Water tables
    - Aquifers and unsaturated zones

- Surface Water Features and Areas
    - Floodplain, flood hazards and floodways
    - Headwaters
    - Other recharge / discharge aeras
    - Associated riparian lands that can be defined by their soil moisture, soil type, vegetation or topographic characteristics.
- Hydrologic Functions
- Shoreline Areas
    - Recommended to be 30m from the limits of the shoreline flood hazard
- Vegetation Protection Zone (VPZ)
    - For key hydrologic features, a VPZ of no less than 30m measures from the outside boundary of the key hydrologic feature is required outside of settlement areas.

'Headwaters' is broadly defined in policy as a component of the WRS and can include headwater drainage features as well as land areas which support these features (i.e., the headwater drainage area). Through the NEWP, the WRS explicitly includes headwater drainage features identified as 'Protection' or 'Conservation' (per CVC and TRCA 2014) as they are to be retained on the landscape. Consideration is to be given to other headwater drainage features (e.g., those identified as 'mitigation') and 'headwater areas' for their function(s) through detailed study (e.g., a sub-watershed study) to determine their inclusion or role within the WRS at a localized scale (i.e., quaternary or sub-watershed).

Groundwater and Surface Water Features, Hydrologic Functions, and Ecologically Significant Groundwater Recharge Areas are to be informed by watershed planning or equivalent study to determine which optional features may be included in the system. Detailed information collected through these studies will confirm feature presence, inform decisions regarding optional features to include within the WRS and support delineation or refinement of boundaries for features and areas, as appropriate.

Required features shall be identified across the Region (i.e., within and outside of settlement areas).

3.3.3 Processes for refinement

Components of the WRS, the basic system structure and preliminary mapping is established through the NEWP process. The system will be informed and refined through several processes:

- **Watershed Planning** will inform the system and its components and will set out high-level guidance for the management of the water resource system and for detailed studies through which the WRS (i.e., its features and areas) will be refined.

- **Detailed Studies** are the process(es) through which features and areas refined. This may include confirmation, delineation and is to include an assessment of the function of a feature or area within the WRS as well as interactions and interdependencies with the NHS.

Niagara Watershed Plan (Equivalency) Study

The current Niagara Watershed Plan (Equivalency) Study (NWP (E)) includes a review of available secondary source information to identify current information gaps and characterize existing conditions based on the information currently available. The current study includes a review of all tertiary watersheds within the Region and, to the extent possible, summarizes information by quaternary watersheds. This study does not include in-field assessments or modelling. Outcomes of this study do however provide a good understanding of needs and opportunities to inform and refine the WRS through future studies. Through Section 4, the NWP (E) provides direction and guidance for management and refinement of the system across a range of factors including climate change, natural hazards, cumulative impacts, land use impact management, future studies and priorities, and monitoring and adaptive management; all of which support the objectives and refinement for the WRS. Section 4 summarizes information presented throughout preceding sections and provides recommendations with respect to management to inform policy and implementation, and future studies to support identification and a refinement of the WRS.

Detailed Studies

While watershed planning informs and guides, detailed studies are the process through which features and areas of the WRS will be refined and functions, interactions and interdependencies understood. Generally, the process for WRS component refinement can be divided into two groups:

- **Confirmation and refinement** apply to features and areas which are identified as part of the WRS and are mapped. This process includes confirmation of feature / area presence on the landscape, or refinement to feature / area limits through refined, more detailed levels of study. Examples may include confirmation that a wetland is present where it is mapped and refinement of the limits (i.e., boundary) of the wetland to reflect ‘on the ground’ conditions.
- **Identification and delineation** apply to features and areas which are identified as part of the WRS but are unmapped. Features and areas may be unmapped where:
  - Insufficient data (i.e. data gaps exist) were available to adequately map them at the time the NEWP or NOP are completed,
  - The feature or function is more appropriately identified at the site-specific level, or
  - Features /areas require an assessment of their relative function at a specific planning scale and within the context of the WRS and NHS, to determine if they are to be included within the WRS.

Examples include:

- Seepage areas and springs – site-specific assessment is required to identify and delineate these features.
- Ecologically Significant Groundwater Recharge Areas (ESGRA) – require refined information on the natural heritage / ecological feature and the area of recharge which supports its ongoing form and function. This would typically be undertaken through a detailed or targeted study.

Several potential studies or initiatives may be used to refine the WRS via the processes noted above. These may include planned activities and initiatives, as well as future study types which would support the process of refinement through gap filling or identification. Additional activities and initiatives may be identified in the future to further address identified gaps to support refinement of the WRS.

- **Quaternary and Sub-Watershed Studies**: It is anticipated that environmental and water resource-based planning will proceed through studies with increasing levels of geographic and technical refinement and detail. This may include one or more levels of study that support and inform the refinement and management of the WRS. Quaternary and/or sub-watershed levels are appropriate scales to conduct numerical modelling of water systems (ground and surface), field inventories and other technical work required to fill gaps identified through the NWP (E). Use of these two scales for study and planning is further discussed in Section 5. Generally, these can be anticipated to include detailed natural heritage, hydrogeological, geomorphology (fluvial and/or landform, as appropriate), surface water and hazards considerations for existing land uses and, as appropriate to the scale and purpose of the study, future land use conditions (e.g., land use planning). Through these studies, features limits should be confirmed and refined, if required. As appropriate, some minor refinements may occur at site-specific study levels (e.g., through an Environmental Impact Study). The scale of the study and specific objectives will inform what detailed studies and outcomes are completed.
- **Niagara Peninsula Conservation Authority (NPCA)** has identified numerous planned and potential initiatives which would support refinement to mapping, identification and delineation of features and areas of the WRS. These include:
  - ***NPCA Watershed Natural Areas ELC Mapping Update[2] (approved for 2021)***. This is planned to include softcopy interpretation updates to existing NAI and ELC mapping using 2020 imagery at 1:2000 scale. To the extent possible, this will integrate available attributes associated with NAI site coding, available age and species information.

[2] Note: Niagara Region completed an updated ELC layer for the Region in its entirety in 2020. It is anticipated that this updated Regional dataset will continue to be used as the primary ELC data within its jurisdiction.

- ***NPCA Watershed Digital Terrain Model (DTM) Update (approved for 2021)***. This is planned to include updated planimetric feature coded breaklines and topographic mapping derivatives. The DTM is to be completed at a 1m contour interval and 1:2000 scale. Completion of this work will support additional technical studies listed below.
- ***Enhanced NPCA Watershed Restoration Program Design (approved for 2021)***. This initiative will conduct a market-based gap and needs analysis and consultation with local municipalities to identify opportunities to enhance and better leverage opportunities for watershed restoration. This program review and is planned to result in an enhanced restoration program that capitalizes on NPCAs knowledge of the watershed and provide value to a range of potential clients and partners by providing coordinated services that support broad watershed-level targets and opportunities, including mitigation for existing and future pressures, such as climate change.
- ***NPCA Watershed Surface Water Inventory Update (planned for 2022, pending approval)***. Using the DTM prepared in the preceding study, this work is intended to create an updated inventory of surface water features including feature type, identify candidate headwater drainage features, regulated watercourse refinements and integrate Ontario Hydro Network information. Consistent with preceding studies, this will be completed at a 1:2000 scale and be completed through interpretation of 2020 imagery. Headwater drainage features will not be classified into management regimes through this work; however, NPCA has regulatory needs to proactively identify management classification to support their core mandate.
- ***Updated Shoreline Management plans to be developed in (proposed for 2022 / 2023)***. This initiative will prepare updated plans for management of shoreline areas regulated by NPCA considering flooding, wave uprush, erosion and natural heritage (e.g., dune systems, including backshore dunes). This work will provide additional information for the mapping of features and functions for the NES (captured within the NHS and/or the WRS). NPCA has completed a preliminary gap analysis on existing management plans to inform scoping of this work program and updates to the management plans.
- ***NPCA Water Resources Spatial Framework (planned for 2023)***. This continues to build on preceding work and will include updates and further integration. Anticipated elements include delineation of the drainage hierarchy (catchment, subwatershed, watershed), local stream code development, labelling / integration of common names / local names for features and watercourses, hydrologic digital elevation model and analysis surfaces. This work is primarily to establish the information architecture for NPCAs hydrologic and hydraulic modelling needs. However, through this work, additional opportunities to support land use planning and impact assessment are anticipated, including the ability to derive anticipated catchment areas of wetlands.

- In addition to those mentioned above, the NPCA is also considering the following concepts and/or projects to support ongoing watershed-based local natural resources management framework across the Region, and in response to Bill 229; further information regarding the status of these initiatives as part of future studies should be confirmed by NPCA staff.
  - *Geomorphology studies/monitoring and Meander Belt Analysis to support non apparent riverine erosion hazard, quantitative and qualitative erosion monitoring on the Great Lakes Shorelines to support hazard management and shoreline resiliency*
  - *Low flow/spot flow, aquatic ecosystems and thermal regime monitoring and mapping as further compilation and assessment (i.e., support headwater drainage feature protocol classification) of watercourses/regulated surface water features*
  - *Karst Landform mapping to inform karst regulation and hydrogeologic influences in the watershed*
  - *Hydrologic Models/information architecture for floodplain mapping, flood forecasting and warning potential, and to inform water budgeting and balance at both the system and feature assessment needs.*
  - *Climate Vulnerability Assessment to inform hazard regulation policy*
  - *Update (NPCA ELC database) and operationalize Flora and Fauna Observations database, and terrestrial ecosystem monitoring.*
  - *Establish Systematic Conservation Planning approach and associated information architecture to support analysis/scenario evaluations, mapping of objectives etc.*

3.3.4 WRS Features & Areas within Priority Areas

As discussed in Section 3.3.2, some component features, and areas of the WRS are mapped while others require further information to be identified. As noted through Section 3.3.3, detailed studies (e.g., a subwatershed study), completed for these areas as appropriate, will refine the WRS through confirmation of features, delineation and assessments that require detailed site-level information to complete. A summary of mapped features for the WRS has been provided for Priority Areas as part of the NWP (E) – Volume 3: Growth Analysis, as a snapshot of current information and to inform the review of potential interactions between the NHS and WRS (Section 3.4). Readers are referred to NWP (E) – Volume 1: Characterization for a comprehensive summary of existing conditions by tertiary and quaternary watershed, and to NWP (E) – Volume 3: Growth Analysis for a Priority Area based summary. Preparation of future study plans should consider the context for the priority areas within their respective watersheds to ensure that potential presence of features and areas which, per the new NOP, are to be identified as part of the WRS.

3.4 Systems Integration

3.4.1 Interactions and Interdependencies

The WRS and NHS interact across the landscape. Many of the features and functions which comprise these systems are interdependent when viewed at different scales – from highly localized site scales (e.g., catchment and water balance for a small discrete wetland) to the landscape scale (e.g., downstream flooding due to a loss of wetlands and landscape permeability in headwater areas). To recognize these connections, the Region considered these two systems as comprising a single Natural Environment System (NES).

System interactions and interdependencies can be complex, influenced by factors such as bedrock geology (e.g., aquifers), surficial geology (e.g., infiltration), climate, existing land uses, biological and hydrologic functions. It is imperative that land use planning at the Regional scale consider the landscape holistically and take into consideration these interdependencies and the influence they will have on the health and wellbeing of the land and people (e.g., hazard risks, agriculture, water quantity and quality). Understanding and managing this complex system is important for the long-term protection and function of the natural environment and its influence on both human health and safety. The landscape of Niagara Region, and throughout southwestern Ontario, is dotted with fragmented natural cover. Planning for and proactive management of a Natural Environment System will be critically informed and affected by ongoing consideration of cumulative impacts, adaptive management, and striving towards decision-making and activities which establish or strength connectivity and support interactions between water and natural heritage.

For the purpose of this study, potential system interactions are generalized into key elements (Table 3-2). It is expected that the interaction summarized in this report exist within each tertiary and quaternary watershed. Further exploration of the location, magnitude and potential influence of these interactions should be explored through more detailed levels of study to inform specific targets, management, and other guidance for land use planning at refined scales. Potential interactions between the WRS and NHS have also been identified for the Priority Areas within the Niagara Region, to be considered as part of growth planning and subsequent studies; these findings are presented in the NWP (E) – Volume 3: Growth Analysis.

Section 4 (Watershed Plan (Equivalency) Guidance) of this report volume provides direction for management of the WRS including consideration for identifying and understanding the influence of system interactions and interdependencies. Section 5 provides direction for future studies through which these interactions and interdependencies will be further identified / confirmed, and management guidance (per Section 4) is to be implemented.

Table 3-2: Summary of Interactions and Interdependencies within the Natural Environment System (Water Resource and Natural Heritage)

Interaction / Interdependencies	Description	Indicators Used for NWP (E)	Considerations for Detailed Watershed Studies (e.g., Quaternary Watersheds)
Water Quality & Quantity: Groundwater Recharge	Groundwater recharge is critical to maintaining the WRS, acting as a key input to the water balance. It is influenced by conditions at the site scale and the broader landscape scale. Groundwater recharge should be assessed at multiple scales to ensure information is available to support the management of sub-surface functions of the WRS. The NHS supports and interacts with this hydrologic function wherever natural cover occurs by providing permeable surfaces, slowing flows to permit infiltration, and where topographic lows (depressions) occur within natural cover; these areas can act as important infiltration points, supporting recharge over time. These functions may be important at both the site and landscape scales in supporting local water balance, and the broader function and system within the watershed, subwatershed or catchment. Natural features occurring in areas where surficial geology supports increased infiltration rates may have a greater impact on overall recharge within a given system.	• Presence of SGRAs	Detailed review of existing geotechnical and/or hydrogeological studies where data on recharge layers for regional scale analysis are present. Review and analysis of surficial geology, soils mapping and depth to bedrock / overburden may also inform identification of key areas of recharge on the landscape using available information. Where there is insufficient existing information, or where a refined level of understanding is required, conduct studies to ascertain recharge conditions and identify key areas of recharge. Areas with high recharge/infiltration (e.g., relative to landscape averages) where they overlap with natural vegetation.
Water Quality & Quantity: Groundwater discharge	Groundwater discharge areas are places where groundwater transitions to surface water, bringing cooled, filtered water to the surface and supporting both aquatic and terrestrial functions in the NHS. Groundwater discharge plays an important role in supporting hydric soils and some wetlands, seeps and springs, and providing baseflow to watercourses (‘gaining’ streams) and other drainage features; this is particularly important in maintaining and supporting coldwater streams such as Twelve Mile Creek.	• Coldwater watercourses / streams and associated headwater areas (e.g., Twelve Mile Creek)	Detailed review of existing geotechnical and/or hydrogeological studies where data on depth to groundwater, shallow aquifers and topographic intersections with the surface occur within the study area (e.g. work from Ontario Geological Survey (OGS), Geological Survey of Canada (GSC), etc.). Review and analysis of surficial geology, soils mapping and depth to bedrock / overburden may also inform identification of areas of potential discharge on the landscape using available information. Where there is insufficient existing information, or where a refined level of understanding is required, conduct studies to refine understanding of groundwater depth, shallow aquifers and deep aquifers where appropriate. Pairing this information with topographic and natural heritage information will assist in identifying potential areas of discharge. Site-specific surveys will allow for a refined understanding and identification of discrete areas of discharge at surface (e.g., thermal regime of watercourses, upwellings, seeps and springs, topographic minima in valleys, exposed bedrock, etc.).
Water Quality & Quantity: Flow attenuation	Flow attenuation involves two broad elements: **At surface**: movement of water overland and places in which water moving overland can accumulate before reaching watercourses (slowing) or permitting infiltration. **Below surface**: through infiltration and the ability to attenuate flows ‘at source’ or where the water first comes into contact with the landscape.	• Wetlands • Natural cover	Flow interception and accumulation will vary across the landscape based on a range of factors: • Topography • Surficial geology and soils (infiltration rates) • Total natural cover • Type and location of vegetation cover (e.g., headwater wetlands) • Presence of green infrastructure (e.g., infiltration galleries).

Interaction / Interdependencies	Description	Indicators Used for NWP (E)	Considerations for Detailed Watershed Studies (e.g., Quaternary Watersheds)
	From a water quantity perspective, flow attenuation slows the movement of water through the system, supporting natural functions and a healthy, balanced system. Flow attenuation supports groundwater functions and reduces fluctuations in volumes ('flashy' characteristics) of flows within receiving systems (watercourses). The benefits of distribution across the landscape can be observed across the watershed (e.g., baseflow conditions, thermal regimes, etc.) but are most acutely observed moving downstream in the system. Addressing flows holistically (surface and ground water) can directly influence issues such as flooding, erosion, and water quality. Flow attenuation also influences water quality, which affects both the WRS and NHS. At surface, water moving through vegetated areas is slowed, reducing its erosive power, thus reducing potential downstream sedimentation, allows material to move out of suspension, reducing suspended solids in receiving watercourses, and providing opportunities for vegetation to 'filter' or 'take-up' nutrients present in the water – again supporting potential downstream water quality by mitigating for some excess nutrients. Pooling of water in natural topographic lows – such as vernal pools and wetlands, is critical to their ecological functions, by sustaining hydric soils and hydroperiods for pools which support amphibian breeding, and other species (e.g., invertebrates). Sedimentation (increased tubidity) can impact light penetration (affecting in-water vegetation), visibility for foraging fish species, altering substrates (infilling interstitial spaces), smothering eggs (e.g., spawning fish), etc. in receiving watercourses. Sediment also often carries other deleterious substances (e.g., heavy metals, contaminants) which can have direct and indirect impacts on aquatic communities (vegetation, invertebrates, fish, etc.). By supporting infiltration, water quality is improved through the above actions and also by providing opportunities for water to cool as it moves through the system and ultimately to supporting groundwater supported features and functions (e.g., coldwater streams).		Flow attenuation can be confirmed through hydrologic and hydraulic modelling (e.g., existing conditions runoff, floodplain modelling., erosion thresholds) and should be considered through watershed and / or subwatershed studies. Interactions between the WRS and the NHS can be considered in more detail by integrating natural heritage feature mapping with integrated hydrologic / hydraulic modelling and could be used to inform conservation and management of the NHS and WRS at more refined levels of study. Some examples include: • Vegetated areas on high recharge areas (e.g., relative to local landscape averages) as providing supportive water quality functions (also potential increases to evapotranspiration). • Vegetation within a predetermined distance of watercourses based on catchment or site-specific conditions. • Isolated topographic depression areas within catchments where areas do not contribute to the cumulative overland drainage to watercourses.
Water Quality & Quantity: Thermal Effects	Water temperature is influenced through both surface features and subsurface functions. At the surface, vegetation along watercourses (i.e., riparian vegetation) and flow attenuation within vegetated areas (e.g., wetlands) provide shading, cooling water / mitigating warming effects. Conversely areas with limited natural cover (including riparian cover) can result in increased water temperatures / warming effects. Infiltration also influences water temperature, cooling it as it moves through the subsurface and reducing the temperature of water entering receiving systems.	• Wetlands • Natural Cover	Assessment of natural heritage cover, relative influence of features on supporting thermal management (e.g., for coldwater watercourses), or mitigation to improve aquatic habitat and water quality within the WRS should be considered. For example: • Existing riparian cover and targets for riparian cover based on existing condition and ultimate conditions within the context of the catchment, subwatershed or watershed;

Interaction / Interdependencies	Description	Indicators Used for NWP (E)	Considerations for Detailed Watershed Studies (e.g., Quaternary Watersheds)
			• Identification and management of wetlands and other features which attenuate flows at critical points of headwaters and which support existing cold or cool water watercourses.
Vegetation Communities/ Structure: Wetlands	Wetlands are an important component of the WRS. They can act as points of groundwater recharge, groundwater discharge, provide flow attenuation (moderate downstream flow conditions), and support watercourse baseflow – particularly in smaller order / headwater features. These functions are important throughout a catchment or watershed. Similarly, a healthy and functional WRS is important for the maintenance and function of wetlands. Wetland water balances are dependent on inputs from adjacent lands via overland flow and/or groundwater in addition to precipitation. Wetland hydrologic conditions are critical to supporting wetland plants (wetland obligate species) and the fauna that depend on them as well as the presence and duration of available water.	• Wetlands	Site-specific characterization of wetlands and their hydrologic inputs and outputs will inform the interactions within the WRS and their functions within a site-specific and sub-watershed or watershed context. For example: • Riparian wetlands support flow attenuation, remove deleterious substances and cool inputs to receiving watercourses. • Internally drained wetlands attenuate overland flow, and may support important recharge functions, and may support baseflow conditions.
Vegetation Communities/ Structure: Woodlands	Woodlands can support the WRS through infiltration, attenuation (e.g., sloughs, vernal pools), evapotranspiration, and shading. Woodlands are dependent on the WRS to provide and maintain soil moisture conditions. Soil moisture is a substantial component of forest composition and history. Tree species are adapted to certain moisture ranges and fauna have adapted to use certain habitats to meet their critical life cycle needs. A healthy and functional WRS will continue to support the broad range of communities that occur across the landscape.	• Woodlands	The nature of woodland interactions with the WRS should be considered in additional detail through subsequent levels of study and be informed by topography, community series and location of the woodland relative to other features (e.g., woodlands in proximity to watercourses, wetlands or areas with shallow depth to groundwater). Opportunities to use non-point source modeling to assess the role and relative function of woodlands (and other cover types) on water quantity and quality should be explored. Information from this modeling can be used to inform enhancement opportunities which best support both the WRS and the NHS as integrated systems.
Vegetation Communities/ Structure: Open Country Habitats	Open country habitats such as grasslands, meadows, thickets and savannahs maintain permeable cover on the landscape for infiltration and slow the flow of water overland. Many of these habitat types occur in drier conditions, potentially increasing soil capacity to store water (unsaturated zone) where suitable soil conditions exist. Where well drained soils occur, they may act as important recharge areas.	Presence of features in areas of high infiltration: • Meadows • Thickets • Savannahs	These features are often lost on the landscape as land conversion to built-up areas occurs. Reductions in landscape permeability can influence downstream functions (e.g., downstream flooding, etc.) Where open country habitats occur in areas of high infiltration, they may represent important areas to support the WRS.
Specialized Habitats; and Significant Wildlife Habitat	Several specialized habitat types are highly dependent on sufficient water quality and quantity including amphibian breeding habitat (wetlands, vernal pools, ponds), turtle overwintering habitat, and seeps & springs. Hydrology is an important factor in the presence and function of these specialized habitats. Water quality may also influence the functional success of some (e.g., amphibian egg development). Alterations to the conditions which support and maintain these habitats can directly and indirectly affect their continued function and presence on the landscape.	Not mapped. Insufficient information at this scale.	Understanding of the hydrology of these functions (water balance) is important to protecting their presence and function(s) on the landscape in the long-term. Detailed survey(s) to identify locations of existing specialized habitat and significant wildlife habitat is required. Local-scale hydrologic assessments will be required for some feature types to ensure they are maintained and protected.

Interaction / Interdependencies	Description	Indicators Used for NWP (E)	Considerations for Detailed Watershed Studies (e.g., Quaternary Watersheds)
Aquatic Habitat: Thermal Regime	Temperature is major driver of ecological processes in aquatic habitats. Thermal regime in watercourses influences the overall health of aquatic ecosystems, including aquatic species biodiversity and water quality. Thermal regime influences the growth rate, movement and emergence of aquatic organisms, and their distribution as most aquatic species require a specific range of temperatures. A change in water temperature can occur naturally or as a result of anthropogenic disturbances (e.g., pollution, deforestation, and climate change). Extreme temperature changes can affect early-stage growth and development which can influence breeding success and limit population recruitment. Twelve Mile Creek is the only significant coldwater stream with a self-sustaining population of Brook Trout. Protection of the thermal regime is critical to this system.	• Coldwater watercourses • Coolwater watercourses	Further refinement to thermal classifications and consideration of historic values and species composition, and management opportunities to improve conditions, where appropriate.
Riparian Habitat	Riparian habitat provides vital sources of water, food, and shelter for most wildlife species, and can function as important migration stopping areas and movement corridors. Riparian vegetation stabilizes streambanks preventing erosion, reduces downstream flooding, and uptakes nutrients (e.g., nitrogen, phosphorus) improving water quality. Overhanging vegetation provides habitat for aquatic invertebrates and casts shade, both important in sustaining fish populations.	Not mapped. It is known where riparian areas will occur (along watercourses, waterbodies), however delineation of the riparian area is based on site-scale topography, hydrology (soil moisture), etc. This information is obtained through detailed, site-specific study.	Presence of existing, and opportunities to increase, riparian cover should be explored through further planning studies. Consideration may be given to setting refined targets for different planning scales (e.g., subwatershed or watershed).
Aquatic Habitat: Benthic invertebrates	Benthic invertebrates are significantly affected by their environment including water quality, sediment composition and quality, and other hydrological factors. Sampling of benthic invertebrates is commonly used in monitoring programs as a biological indicator of water condition and determining the overall health of a waterbody, including monitoring the impact of pollution and human disturbance. The composition and quality of the physical environment including habitat, vegetation and fluvial landscape also influences the composition of benthic community.	• Permanent or Intermittent Watercourses	Benthic invertebrates may be used as indicators for water quality. At study scales where in-field surveys are conducted, presence and composition of aquatic invertebrates may be used to assist in evaluating current conditions and targets for WRS system and aquatic habitat functions.
Terrestrial and Aquatic Biodiversity	The management of habitat types and the associated diversity directly impacts terrestrial and aquatic biodiversity and their interactions with the WRS. The loss of biodiversity leads to the loss of ecosystem functions affecting water resources. Specialist species are more sensitive to changing habitat conditions and are typically more susceptible to climate change and other changes causes by human activities. A loss of native species biodiversity provides an opportunity for invasive species to either out-compete weak native populations or invade unoccupied territory in both terrestrial and aquatic habitats.	n/a Present across the landscape.	Future studies should include a refined assessment of habitat composition, existing conditions and species diversity to inform protection, management, and opportunities to enhance form and function in the long-term. Maintaining or increasing biodiversity across a range of species groups (e.g., birds, amphibians) should be identified as objectives of watershed and sub-watershed planning. Focus of biodiversity studies should be on features which are captured within the NHS and/or WRS and those features which support these systems.

Interaction / Interdependencies	Description	Indicators Used for NWP (E)	Considerations for Detailed Watershed Studies (e.g., Quaternary Watersheds)
			Maintaining or increasing biodiversity can be based on total species diversity or use occurrence frequency / site distribution as indicators. Biodiversity assessments are to include species native to the Region; consideration may also be given to increasing ranges because of climate change. In this way, biodiversity tracking can provide valuable information over time in considering the influence of climate change and help to inform natural heritage planning in the future.

3.4.2 Process Outcomes

As evident through Section 3.4.1, interactions and interdependencies occur across the Niagara landscape. This is reflective of the nature of these systems and the integrated manner in which they function on the landscape. The NWP (E) provides a preliminary identification of potential or anticipated interactions to inform planning and management direction at the scale of the Region. As with refinements to the NHS and WRS, interactions between these systems will be confirmed, refined and identified through subsequent studies. It is expected that this refined level of assessment will occur through detailed watershed or sub-watershed studies. Assessment of interactions will require data gap filling and / or detailed studies or analyses. These may include:

- **Data development** may be required to facilitate additional study. This may include further compilation or analysis of existing datasets, detailed field study, etc. Datasets may range in scale from landscape level (e.g., water table elevations) to site specific (e.g., identification of specialized wildlife habitats with high hydrologic dependencies).
- **Geospatial analyses and modelling** to identify areas of potential interaction using available or newly developed data sets to assess interactions and interdependencies at watershed or subwatershed study scales. This may include point-source and non-point source modeling, and systematic conservation planning tools amongst others.

Generally, it is anticipated that identification and confirmation of interactions and interdependencies will be developed at increasingly refined scales, as land use planning proceeds from broad scale (e.g., quaternary watershed studies) to site scale (e.g., an EIS). It is imperative that the understanding be developed at appropriate points in the planning processes, to ensure the form and function of these systems can be adequately planned for and managed. To be achieved, this will require the support and involvement of local area municipalities and the NPCA. Local area municipality conformity and implementation of Regional policies (e.g., through zoning, by-laws, etc.) will be required. The NPCA can act as a resource for identifying functional dependencies between the systems. and will act as regulator for some components of the WRS (e.g., wetlands, watercourses). This integrated approach to land use planning is to be informed by un-biased science balanced and driven and supported by planning (e.g., policy direction and drivers). This approach will ensure that the policies and direction provided through provincial planning documents is met.

4.0 WATERSHED PLAN (EQUIVALENCY) GUIDANCE

4.1 Introduction

Background data/information related to the watershed planning elements and best practices applicable to Niagara has been largely summarized in Volume 1: Characterization. This information provides guidance at the tertiary watershed level, providing a basis to identify and develop recommendations for future gap filling and establishing implementation priorities, in accordance with the "*Watershed Planning in Ontario – Guidance for Land-use Planning Authorities*", 2018 (Draft). As noted in the Provincial Guidance, not all watershed plan elements are applicable to all areas or at all scales; the sections which follow outlines the information gathered through this Watershed Plan Equivalency, such that it sets the framework for future land use and resource planning. For the current NWP (E), the following watershed planning elements and associated best practices have been detailed further in the following sections:

- Watershed Management (Quantity/Quality)
- Climate Change Guidance
- Natural Hazards
- Cumulative Impacts
- Land Use Impact Assessment & Management
- Future Studies / Priorities
- Monitoring and Adaptive Management

These elements and best practices can help to inform the new NOP, through the identification of management opportunities to support growth and future development throughout the Region, while ensuring natural systems are protected and maintained. Through previous sections and study tasks, the NWP (E) process has identified data gaps, and thus the following sections provide direction and a framework for the subsequent studies which will be required to support future watershed and subwatershed planning initiatives in the Niagara Region.

4.2 Water Management Guidance (Quantity/Quality)

4.2.1 General Guidance

A variety of background data sources including existing legacy datasets and reporting have been reviewed to determine where there is existing guidance and associated recommendations across the tertiary watersheds. The focus has been placed upon those subwatersheds for which potential growth areas have been identified by the Region; this summary with respect to potential growth areas can be found in Volume 3: Growth Analysis. Notwithstanding, as part of previous study components, including watershed characterization (ref. NWP (E) Volume 1: Characterization), environmental issues identified through watershed monitoring and/or previous legacy studies, have been summarized in order to be further assessed as part of future quaternary watershed plans and/or subwatershed plans.

The primary data sources for this review have included current Watershed Plans, as applicable for the quaternary watersheds within the study area, as well as applicable regional level studies, mapping provided by the Niagara Region and NPCA, and

sources outlined in the Watershed Planning Discussion Paper (WPDP) completed in 2019. A cross-connection to the *Niagara Region Stormwater Management Guidelines (DRAFT)* (currently in development) has also been completed, to ensure consistency across the Region, in terms of best practices for stormwater management. As noted in "*Watershed Planning in Ontario – Guidance for Land-use Planning Authorities*", 2018 (Draft), the various elements relate to water (surface and ground), as well as those systems which are reliant on water (natural heritage system). The section which follows, focuses on water management (surface and ground) for both quantity and quality.

4.2.1.1 Water Quantity

Flood Control

Through review of the available reporting and legacy data sets, it was found that there was a general lack of hydrologic modelling to assess the impacts of land use changes and establish flood control SWM criteria from the completed watershed plans. Of the watershed plans reviewed, only two (2) studies included a hydrologic assessment and provided a summary of peak flow results, these included:

- Fort Erie Creeks - Watershed Plan, Philips Engineering, 2008
  - SWMHYMO model developed to assess land use changes and quantify hydrologic impacts.
- Niagara-on-the-Lake Watershed Study, Aquafor Beech Ltd, 2008
  - Flows estimated using the Index Flood Method – for use in hydraulic modelling update.

This suggests major gaps in the remaining watershed planning areas (at all scales), which currently have no existing or current hydrologic modelling completed for the surface water systems (as outlined in the available watershed plans). Hydrologic modelling is the primary input for determining flood risks through hydraulic modelling/floodplain mapping; the hydrologic modelling software used for these types of assessments may vary based upon the information available through associated study (i.e. subwatershed studies); example software includes models such as HEC-HMS, SWMHYMO, Visual OTTHYMO, SWMM based models, among others. While it is acknowledged that there are several local scale hydrologic models in the various communities across Niagara, few of these are contemporary nor have the required spatial coverage to fully inform an impact assessment to establish flood control criteria at a quaternary scale.

Given the foregoing, there is a corresponding lack of guidance regarding the quantifiable impacts of new urban land uses to surface water peak flows and the resulting flood risks (with the exception of Fort Erie Creeks). As such, the completed and available watershed plans largely do not provide any indication regarding unitary release rates or volumetric sizing which can inform the management requirements for mitigating the impacts from proposed future land uses.

The completed watershed plans outline general BMPs (related to watershed management), which include maintaining pre-development conditions, with minimal direction or measurable criteria for implementation or management planning. Some of

the watershed plans and separate studies such as the Niagara Water Quality Protection Strategy (NWQPS, 2003), outline flood sensitive locations including flood damage centers, properties at risk, deficient hydraulic structures, etc., all of which are important components to include in the future watershed management strategies. Notably the NWQPS established local management areas (LMAs) which are currently lacking SWM for quality and flood control; while these areas are delineated at a scale between quaternary and subwatershed mapping, the findings from these previous studies can serve as a good basis for identifying opportunities and locations ideal for retroactive SWM as part of subsequent studies, should infill/intensification be proposed. Subsequent sections provide more insights related to these areas and approaches for management.

Niagara Region SWM Guidelines

Based on the *Niagara Region Stormwater Management Guidelines (DRAFT - 2022)*, the requirements for future development include the requirement for flood control in accordance with the specified level of control outlined within a governing Subwatershed Study (SWS), Master Drainage Plan (MDP), or Master Environmental Servicing Plan (MESP) that encompasses the proponent's site (if available); notably this guidance is for both greenfield and infill/intensification forms of development.

Where a SWS, MDP, or MESP does not exist, the following flood control is typically required as a minimum:

- Where a site discharges to a watercourse system: post-development to pre-development peak flow control for the 2 through 100-year return periods;
- Where a site discharges to a storm sewer (typically infill/intensification): 100-year return period post-development to allotted capacity of storm sewer;
  - Where the allotted capacity of storm sewer is unknown: 100-year return period post-development to 5-year return period pre-development peak flow.
- Regional Storm Controls (i.e. Hurricane Hazel) may also be required at the discretion of the Niagara Region and its partners (i.e. local area municipalities and NPCA), however in most locations the 100 year event is considered Regulatory in Niagara, hence flood control would be addressed through municipal stormwater management to the 100 year standard, with due consideration to climate change influences (ref. Section 4.3).

Proponents are required to consult with the Region and Agencies (including NPCA) regarding the acceptable level of flood controls to be applied to the proponent's site, including special cases (receivers with limited capacity, lack of overland flow route, etcetera).

Erosion Control

Of the watershed plans reviewed, approximately half of the completed studies make reference to a separate stream morphology / geomorphology study, in which the focus was to characterize the physical stream systems, identify problem areas (erosion/stability) and recommend capital works and/or further monitoring programs. This information can be used to identify erosion prone receivers which may be more sensitive to urbanization, thus requiring more extensive erosion control criteria.

However, most of these studies lack the detailed determination of erosion thresholds (measurable stream flows), through continuous hydrologic studies, which would be required in order to establish appropriate erosion control and extended detention volumetric sizing for erosion prone receivers. The majority of the watershed plans identify general BMPs (structural and non-structural), which included mention of extended detention of 25 mm for 24-48 hours, to address off-site impacts. This current level of guidance is considered to be inadequate to inform future management needs for urbanizing areas, and as such would be required to be advanced as part of future watershed and subwatershed plans, as proposed land uses, and planning objectives become further refined.

Niagara Region SWM Guidelines

Based on the *Niagara Region Stormwater Management Guidelines (DRAFT - 2022),* the requirements for development include that erosion control be provided in accordance with the specified level of control outlined within a SWS, MDP, or MESP that encompasses the proponent's site (if available).

Where a SWS, MDP, or MESP does not exist, proponents should provide extended detention control (detention of the runoff generated from the developed site for a 4-hour, 25 mm storm event over at least 24 hours, with a preference for 48 hours). Proponents are required to consult with the Region, NPCA and Agencies regarding the acceptable level of erosion controls to be applied to the proponent's site prior to initiating the requisite studies.

Water Balance / Budget

The maintenance of a water balance / budget post-development is a vital component of the hydrologic system, involving both surface water and groundwater systems, and their interactions. A water budget is a general accounting for the amount of rainfall/snowmelt which becomes runoff, is infiltrated, or is lost through evapotranspiration for a subject area. The primary water quantity studies which consider the water budget completed for Niagara Region include the Water Availability Studies (WAS), completed in 2009, which included HEC-HMS modelling and existing water balance/budget characterization, and the Tier 1 Water Budget and Water Quantity Stress Assessment, completed in 2010, which identified the water quantity stress level of both the surface water and groundwater systems relative to demand and supply. As such, depending on the year of completion for the local watershed plans, there is no explicit discussion regarding the current water balance / budget characterization for the plans completed prior to 2010.

These water quantity studies provide a detailed characterization of Niagara's water budget and available water quantity under existing land uses and can thereby provide targets and/or identify sensitive areas currently under hydrologic stress. Through these studies, stress levels were assigned to each of the watershed planning areas for both the surface water and groundwater systems to identify "significant", "moderate" or "low" stress levels, based upon monthly demand and supply. These classifications can help identify both at-risk areas, and those areas considered less sensitive to impacts associated with urban development. Although, it should be noted that the potential growth areas are all proposed to be serviced with municipal water and are therefore not

expected to contribute to annual/seasonal water demand through local wells, permits to take water or irrigation needs.

The impacts of the urban growth areas are primarily associated with the local hydrologic cycle which would influence water availability in the respective systems (surface runoff and infiltration / groundwater recharge). A summary of the surface water and groundwater quantity stress levels with reference to Niagara's quaternary watersheds, is presented in Table 4-1.

Table 4-1: Water Quantity Stress Levels by Old Quaternary Watershed (ref. AquaResource, 2010)

Old Watershed Name[1]	Surface Water Stress Level	Groundwater Stress Level
Beaverdams and Shriners Creeks	Significant	Low
Big Forks Creek	Significant	Low
Central Welland River	Moderate	Low
Fifteen, Sixteen, Eighteen Mile Creeks	Significant	Moderate
Fort Erie	Moderate	Moderate
Grimsby	Significant	Low
Lake Erie North Shore	Moderate	Significant
Lincoln	Significant	Low
Lower Welland River	Moderate	Low
Niagara Falls Urban	Low	Low
Niagara-on-the-Lake	Significant	Low
South Niagara Falls	Moderate	Low
St. Catharines Urban	Low	Low
Twelve Mile Creek	Low	Low
Twenty Mile Creek	Significant	Low
Upper Welland River	Moderate	Low

Note: [1] Currently summarized by old watersheds as per the mapping/reporting available as part of the Tier 1 Water Budget and Water Quantity Stress Assessment, AquaResource, 2010.

The water budgets resulting from the WAS and water quantity assessments should be reviewed further as part of future quaternary and/or subwatershed studies to establish the specific management needs for these systems. Notably lands identified as either Highly Vulnerable Aquifers (HVAs) or Significant Groundwater Recharge Areas (SGRAs), or other drinking water threats (i.e., IPZ, ECA, IBA, etc.) identified through the Source Water Protection Plan (NPCA, 2013) will require management in accordance with policies laid out by the Niagara Peninsula Source Protection Plan, which includes consideration for both water budget (i.e. recharge or infiltration through on-site controls) as well as contaminant management plans in accordance with the Conservation Authorities Moraine Colaition (CAMC) (ref. Ogilvie, Ogilvie & Company and Anthony Usher Planning Consultant, 2005) and the Nutrient Management Act, 2002. Inclusion of both water quantity and water quality management for vulnerable lands as part of the

development approval process, will thereby minimize the impacts of development on the local water budget and source water protection.

Niagara Region SWM Guidelines

A water budget analysis ensures that other functions beyond peak flow control are considered as part of a stormwater management (SWM) system, in particular the maintenance of an overall water budget, including pre-development infiltration and runoff volumes.

Based on the Niagara Region Stormwater Management Guidelines (DRAFT - 2022), the requirements for future development include maintaining an infiltration-based water budget in accordance with the specified level of control outlined within a SWS, MDP, or MESP that encompasses the proponent's site (if available).

Where a SWS, MDP, or MESP does not exist, proponents are required to ensure that pre-development infiltration volumes calculated on a site basis are maintained under post-development conditions. The Niagara Region supports the application of Green Infrastructure (GI) and Low Impact Development Best Management Practices (LID BMPs) to achieve these requirements, however it does not credit its benefit with respect to runoff quantity control requirements, specific to flood control; erosion credits remain under discussion as of the time of writing. At a minimum, the Niagara Region recommends that the proponent ensure that the first 5 mm of rainfall which lands on the site is retained and infiltrated and/or used (i.e. rainwater harvesting) on site (i.e. zero runoff for the first 5 mm of rainfall).

4.2.1.2 Water Quality

As outlined in the water quality monitoring summary presented as part of the *Characterization of Existing Conditions* (ref. Volume 1: Characterization), NPCA operates an extensive surface water quality monitoring network throughout the Niagara Region, with monitoring summaries published on an annual basis, and condensed summaries prepared as part of Watershed Report Cards. This monitoring provides a high-level characterization of existing conditions on a watershed scale, and allows for the identification of potential water quality issues in reference to the existing land uses present within the respective watershed systems. The monitored and reported exceedances of various contaminants of concern can also identify existing sensitivities which may be incorporated into future development management plans.

For water quality SWM criteria, watercourse habitat designation is required in order to determine the level of control required (i.e. enhanced, normal, basic). Some of the watershed plans discuss the habitat designation for the receiving watercourses, but not all include this detail in the characterization. The watercourse mapping provided for use in this study included MNRF fish habitat designation, which identifies features as either Type 1 – Critical, Type 2 – Important, Type 3 – Marginal, or "Other" (for non-classified watercourses). It should be noted that there are concerns among Region staff regarding the accuracy and intended use of these designations with respect to protection and/or remediation potential; as such, it is recommended that additional sources for sensitive fish habitat (as available) be reviewed with municipalities and NPCA as part of the land use planning, design and approval process. This information can be used for guidance

in future watershed and subwatershed studies to determine the level of control for volumetric sizing criteria required for water quality management, based on the level of sensitivity for the receiving systems, as well as required setbacks for adjacent development.

However, as noted earlier the completed watershed plans in Niagara are largely lacking an assessment of future land uses and analyses of the resulting impacts on surface water quality to develop measurable water quality SWM criteria. It is expected that this level of study would be warranted in future quaternary and/or subwatershed plans, as proposed land uses, and planning objectives become further refined.

Niagara Region SWM Guidelines

Based on the *Niagara Region Stormwater Management Guidelines (DRAFT - 2022)*, the Niagara Region, consistent with the Province of Ontario, requires the application of the "treatment train" approach for water quality treatment of runoff from urban development. This approach requires that at least two (2) separate forms of water quality treatment are provided in series in order to achieve the Region's minimum required target of 80% average annual removal of Total Suspended Solids (TSS) – i.e. the Ministry of the Environment, Conservation and Park's (MECP) "Enhanced" criteria.

Proponents are to provide TSS removal calculations for each proposed form of water quality treatment, as well as the combined removal, in order to verify that this minimum requirement is met. Treatment from engineered systems such as oil/grit separators shall be credited at 50% only, following the lead of several others in southern Ontario including the City of Toronto and the TRCA.

More stringent criteria may be applied in special cases, or where an existing higher-level study (i.e. SWS, MDP or MESP) or other applicable study (EIS or EIA) have been completed. This may include (but is not limited to) areas of known concern with respect to salt, phosphorus, nitrates, and/or thermal impacts. The proponent is to consult with the Niagara Region, NPCA and other Agencies accordingly.

For re-development applications, the Niagara Region requires that proponents provide treatment for the entire redevelopment site, regardless of its current use or the proportion being re-developed. As noted, this will allow for an improvement to runoff conditions through redevelopment, by retroactively applying SWM measures to lands designated for infill/intensification.

In these settings, rooftop areas may be considered as "clean" impervious area for the purposes of calculating water quality treatment requirements (removed from the calculations), provided the flows are separated from runoff from other non-roof areas.

4.2.2 Water Management Guidance – Growth Area Opportunities

The water management guidance outlined in the previous section will have different levels of applicability and/or standing depending upon the category and status of identified growth. The following sections outline various restrictions and opportunities for water management guidance, with respect to the three (3) general categories of identified growth: Potential Growth Areas, Planned Growth Areas, and Infill/Intensification.

4.2.2.1 Potential Growth Areas

The Region has identified potential growth areas which generally represent areas where development interest has been expressed for consideration during review and analysis for urban boundary expansion, in order to meet the Regional growth requirements. These are considered to be areas for urban expansion, with no current “status” and as such, no established policy or guidance with respect to water management exists. Therefore, these areas are expected to follow the guidance and recommendations of the current NWP (E), followed by, and refined through, subsequent quaternary and subwatershed studies to inform detailed management strategies for proposed growth. Further discussion and analysis in relation to the potential growth areas identified by the Niagara Region is presented in the NWP (E) – Volume 3: Growth Analysis.

4.2.2.2 Planned Growth Areas

Planned growth areas refers to those growth areas which are identified at the Regional / municipal level with some level of status (i.e. Adopted, Approved, In Process or Draft, etc.), these may include lands such as District Plans, Secondary Plans, Draft Employment Lands, etc. For the most part, these areas are noted to be guided by established policy and requirements set out by the local municipality and regulatory agencies in their OPs, which have been supported by the studies required to establish these growth areas. As such, depending upon the timing and stage of study, these areas will inherently not be explicitly guided by the recommendations of the current NWP (E), although there may be opportunities to implement BMPs and associated recommendations throughout the planning process.

As noted, the timing and/or status for these land use planning initiatives may provide flexibility with regards to potential refinements in the area-specific management strategy requirements which may be a direct outcome of the subsequent watershed and resource planning initiatives. As new and/or updated information becomes available through subsequent watershed planning initiatives (i.e. quaternary and subwatershed studies), refinements to local management strategies for lands identified for these planned growth areas can be opportunistically considered through the subsequent development application and review process.

4.2.2.3 Infill / Intensification (Re-development)

Areas identified for potential infill/intensification are those lands within the designated “built-up” area, within the existing urban boundaries. Based on the new NOP, these areas are expected to generate approximately 50% of future urban and residential growth and can therefore provide a significant and unique opportunity for retroactive stormwater management (SWM) practices, in areas which currently have no stormwater management. Retroactive SWM practices can provide SWM benefit to existing urban areas across the Region, some of which have been found to be largely uncontrolled for both quantity and quality of urban stormwater, as identified in the *Niagara Water Quality Protection Strategy* (ref. NWQPS, 2003). Areas for re-development can be strategically controlled for quantity and quality of urban stormwater through on-site controls such as LID BMPs, storage facilities, etc. designed to meet the relative control criteria set by the sensitivity of the local and regional off-site receivers (i.e. storm sewer capacity, sensitive watercourse receivers, flood prone receivers, etc.). A review of identified sensitivities

and/or known issues should be completed through municipal master plans to identify opportunities for retroactive SWM, as part of infill/intensification development.

4.2.3 Other Large-Scale Projects

In addition to urban development, other large-scale projects may have an impact on watershed health in the Niagara Region. These types of projects may include the construction of major highways and proposed quarry works (either new or expansions), which represent large changes in land use, form and function; these would also need to be assessed at the local and watershed scale, in order to be planned and managed appropriately.

There are currently two (2) known major proposed quarry projects within the Region, both of which are in the pre-consultation phase, these include:

- Uppers Quarry (New) – Niagara Falls
- Port Colborne Quarry (Expansion) – Port Colborne

Should these or other projects of this nature continue to advance, detailed study and evaluation of the potential impacts would need to be completed.

4.3 Climate Change Guidance

4.3.1 Niagara Region Climate Change Work Program

As part of the new NOP, Niagara Region's Planning and Development Services division has completed and/or initiated a number of climate change initiatives, in order to establish future trends, demonstrate provincial policy conformity, and advance greening initiatives to mitigate current and emerging impacts of climate change. Further details regarding the components of the Niagara Region's Climate Change Work Program (CCWP) have been outlined in subsequent sections.

4.3.1.1 Climate Change Discussion Paper

The Niagara Region's Planning and Development Services division has prepared a Climate Change Discussion Paper (CCDP) in November 2019, to identify past work, future trends and policy conformity requirements, as part of the new Niagara Official Plan. Based on this work, the notable impacts of climate change within the Niagara Region include increasing flood risks (severe storms, winter storms, ice storms), extreme temperatures and drought, deteriorating water quality and increasing occurrence of vector borne diseases.

Land use planning provides an opportunity to minimize climate change risks to communities through mitigation and adaptation, in order to increase resiliency to the impacts associated with climate change. The following have been identified as a subset of possible opportunities, related to SWM and natural systems, to achieve mitigation and adaptation through future planning initiatives in Niagara Region (ref. Climate Change Discussion Paper, 2019):

- Encouraging the use of green infrastructure and low impact development;
- Incorporating urban heat island mitigation strategies;
- Prohibiting development in hazardous lands and natural areas;

- Stormwater management plans that assess extreme weather and encourage or require low-impact development and green infrastructure;
- Watershed and subwatershed planning that considers climate change scenarios (e.g. how extreme storm events may impact/change floodplains).

The recommendations presented as part of the CCDP, future policy development, and climate change modelling and projections have been evaluated and are proposed to be incorporated into the requirements and recommendations for future studies.

4.3.1.2 Climate Change Modelling and Projections Data

As part of the CCWP update in early 2021, a climate change modelling and projections project has been initiated by the Niagara Region in conjunction with the Toronto Region Conservation Authority (TRCA) and the Ontario Climate Consortium (OCC) (ref. Climate Change Work Program Update, PDS 6-2021). This modelling and projection work will be based upon the latest climate science and information, following the best practices approach for climate change analysis outlined in the "*Guide to Conducting a Climate Change Analysis: Lessons Learned from Durham Region*" as completed for the Region of Durham, by TRCA and OCC in 2020.

The work plan includes historical and future climate data collection from the NA-CORDEX climate portal, as well as data collection from climate stations within the Niagara Region with a complete 30-year record of historical data. Subsequently, through consultation with Niagara Region staff and stakeholders, the climate parameters selected for analysis and summary are to be confirmed (i.e. average temperature, precipitation, growing season length, etc.) (ref. Climate Change Work Program Update – Appendix I, PDS 6-2021).

Following the data collection, TRCA and OCC will analyze climate trends for a baseline historical period (1971-2000), in order to complete a spatial, seasonal and temporal characterization of trends. Future climate projects will be examined for spatial, seasonal and temporal trends under two (2) emission scenarios. This analysis will allow for climate data summary tables to be produced for each of the agreed climate parameters, for historical, as well as short, medium and long-term future time periods. The results will produce a Region-wide climate summary, as well as three (3) additional climate summaries to further distinguish climate trends for the varying geographic zones of the Niagara Region [(north, central and southern) ref. Climate Change Work Program Update – Appendix I, PDS 6-2021].

The following are expected to be delivered through the completion of this work (ref. Climate Change Work Program Update, PDS 6-2021):

- A climate projections report, which includes a detailed methodology, analysis of climate projections and its impact on various economic sectors;
- Climate variable mapping, which is categorized into Niagara north, central and south as climatic conditions vary in these geographies; and
- Training sessions for Region staff to effectively understand and integrate the above-referenced knowledge and data into future Regional Climate Change Planning projects, strategies and initiatives.

The results of this analysis will provide the Region with historical and future data on how the climate is changing specific to the Niagara Region; this can help support the development and implementation of climate change adaptation initiatives, vulnerability assessments and will be instrumental in informing future quaternary watershed and/or subwatershed plans by identifying climate based adjustments and Intensity-Duration-Frequency (IDF) relationships which can be used as inputs for modelling initiatives to determine watershed stressors for flow rates and seasonal hydrologic impacts, including extremes such as floods and droughts. Upon Council endorsement, these data will be made accessible to NPCA and local area municipalities for expanded use and inclusion in additional study.

4.3.1.3 Regional Greening Initiative

The Regional Greening Initiative is the third pillar of the updated CCWP and will contain climate change research into municipal practices and initiatives with a core focus on mitigation and adaptation to climate change impacts (ref. Climate Change Work Program Update, PDS 6-2021). This includes research into methods for increasing tree planting efforts across the Region, as a method for mitigating climate change; this work will be completed by the Region in coordination with local municipalities, as well as the NPCA, which has re-launched the tree planting restoration program to reduce forest fragmentation and increase forest cover. The Regional Greening Initiative is expected to continue beyond 2021 to facilitate consultation regarding best practices and restoration objectives in accordance with the future Natural Environment Official Plan policies and strategies (ref. Climate Change Work Program update, PDS 6-2021). It is expected that the outcomes of this initiative will be reflected in future watershed planning in the Region.

4.3.2 Climate Change & Infrastructure Planning

4.3.2.1 Municipal Examples

The consideration of climate change trends and associated impacts is becoming increasingly important to incorporate into infrastructure management and land use planning. Several municipalities are addressing climate change through conducting specialized studies and analyses to determine the impacts of climate change projections on flood risk and infrastructure level of service (LOS), as well as adopting climate change requirements into their SWM design criteria. The following local Niagara initiatives (from the City of Welland) are provided as examples for context.

City of Welland Climate Change Studies

As a local Niagara Region example, the City of Welland has been investigating the effects of climate change on its sewer systems since 2010. The City of Welland engaged the services of AMEC Environment & Infrastructure (now Wood) to assess the City's stormwater and wastewater systems vulnerability to climate change. This was completed with the application of the Engineers Canada / PIEVC, climate change vulnerability assessment protocol (the "Protocol"). This assessment also included the City's wastewater treatment plant. This study, completed in 2012, produced new IDF rainfall data, which are used for storm sewer design and included more than forty (40) recommendations for the City, two of which were to update the City's Municipal Design

Guidelines standards and application of a new IDF curve. Analyses establishing recommendations for the City to update its Municipal Design Standards with regard to stormwater infrastructure were completed in 2014, as a follow-on project to the 2012 vulnerability assessment study.

In the years since, the City of Welland has continued various project initiatives to assess the influence of climate change-altered rainfall scenarios on the performance and design of existing stormwater management facilities (SWMFs) and the storm sewer collector system. In 2016 the City contracted with Wood to develop detailed major/minor system dynamic modelling to assess various rainfall events to better understand the potential impacts and adaptation options available to the City using a local sub-community (South Pelham residential area) as the focus study area, essentially serving as a pilot. Through this analysis, it was determined that the SWMF included in the assessment would need to be up to 2 to 3 times the existing volume to achieve the quantity control targets specified in the original design (LOS) under climate change rainfall scenarios.

As an extension of the work completed in 2016, a funding application was submitted by the City of Welland to the Natural Disaster Mitigation Program (NDMP), which is part of the Public Safety Canada Department of the Federal Government, for continued effort in this theme. The purpose of this program is to address rising flood risks and costs, and to build the foundation for informed mitigation investments that could reduce, or even negate, the effects of flood events. City staff applied for and were approved funding to focus on the climate resilience assessment of Welland's remaining ten (10) stormwater management facilities (ref. Welland Stormwater Management Facility Risk Assessment, Wood, 2019).

The Welland SWMF Risk Assessment clearly demonstrated that if climate change continues to influence rainfall as currently projected, end of pipe SWM controls (quantity & quality ponds, and Oil Grit Seporators (OGSs)) will no longer provide the designed LOS. This assessment clearly demonstrates that SWMFs would need larger volumes (and associated footprints) to accommodate the runoff and maintain the designed LOS. The options to mitigate these impacts on LOS can prove to be difficult when limited opportunities are available to expand the volume (and footprint) of existing facilities which are surrounded by development, hence should be proactively considered at the land use planning stages.

Dain City Flood Risk Assessment

The City of Welland has also completed additional studies relating to the understanding of flood risk areas, including additional risks associated with more intense rainfall associated with climate change; this type of work was recently completed for the community of Dain City in the City of Welland, which is known to have existing drainage system deficiencies and is currently experiencing heightened development pressures through infill/intensification (ref. Dain City Stormwater Risk Assessment, Wood, 2020).

The Dain City Stormwater Risk Assessment was undertaken to better understand flood risk areas and deficiencies in the existing drainage system, including the risks associated with rainfall impacted by climate change. The focus of this study was on pluvial (urban based) surface runoff, rather than fluvial (watercourse based) flooding

and included the development of an integrated hydrologic-hydraulic model (PCSWMM) for use in the study. Given the flat topography of the Dain City study area, a 2-dimensional (2D) hydraulic model of surface drainage was developed, in order to best assess spills and surface flows in the study area and indicate the areas of concern under existing conditions.

A Climate Change Rainfall Scenario was completed for the Dain City study (consistent with the work completed for the City of Welland's Stormwater Management Facility Risk Assessment) which generated adjusted rainfall intensity-duration-frequency (IDF) data for the projected 2050 horizon for a variety of statistical ranges. To provide a range of expected impacts, both the 2050 Mean and 2050 90th Percentile were assessed. The results suggested that existing low-lying/depressed areas and watercourses would experience the largest simulated increases in depth under climate change altered rainfall conditions. Urban areas (other than low-lying rear yard areas) typically indicate flood depth increases for the 100-year storm event in the range of 0.02 to 0.10 m, with results varying by location and scenario.

An initial assessment of the potential impacts of future re-development in the Dain City area was also undertaken, both based on existing flood risk and also the potential hydrologic changes associated with the planned developments (based on the currently available information at the time of study). Overall, the greatest flood risk appeared to be to some of the developments themselves from flood inundation in adjacent deficient drainage features, under both current and future climate conditions. The results of this study demonstrated the need for the identification of at-risk problem areas through the assessment of municipal drainage system capacity, and the need to build additional resiliency into future designs.Flood risks to future and existing development include both pluvial (runoff) and fluvial (watercourses – i.e. floodplain mapping), both of which are important considerations to land use planning.

4.3.2.2 Policies and Guidelines

Climate Change Resiliency is considered a key and contemporary policy objective of most Southern Ontario municipalities which relates to numerous public services, and stormwater in particular. Climate change resiliency and adaptation need to be factored into all components of the life cycle of existing and future drainage infrastructure, including stormwater management design, management and operation.

The Provincial Policy Statement (PPS) (2020) provides policy direction and sets the framework for regulating land use planning and development, in order to protect resources of provincial interest, public health and safety, and the quality of the natural and built environment.

The PPS provides policy directions regarding the management of infrastructure, and notes that it should be efficiently provided, prepare for the impacts due to climate change, and optimize existing infrastructure. The PPS identifies that planning authorities should promote green infrastructure to complement grey infrastructure.

The PPS identifies applicable policies for incorporating the assessment of climate change-related risks as part of watershed planning. The following are relevant PPS

policy themes that have been outlined as part of the 2018 Provincial Watershed Planning Guidance (Draft):

- Encourage the use of green infrastructure and require stronger stormwater management practices during development (PPS 1.6.2, 1.6.6.7);
- Mandate that energy conservation, including improved energy efficiency, reduced emissions of GHG, and adaptation to climate change be considered (PPS 1.8); and
- Require that the increased risks of the potential effects of climate change, primarily those associated with natural hazards be considered during development (PPS 3.1.3).

Further guidance relating to the consideration of climate change as part of future quaternary watershed and subwatershed plans can be found in Section 5.0.

In addition to the PPS, climate change considerations have been adopted through other provincial and federal guidance documents relating to infrastructure management and the planning process, including:

- Government of Canada – Infrastructure: Climate Lens, 2019
  - *The Climate Lens is a requirement applicable to Infrastructure Canada's Investing in Canada Infrastructure Program (ICIP), Disaster Mitigation and Adaptation Fund (DMAF) and Smart Cities Challenge. It has two components: a GHG mitigation assessment, which measures the anticipated GHG emissions impacts of an infrastructure project, and the climate change resiliency assessment which employs a risk management approach to anticipate, prevent, withstand, respond to, and recover and adapt from climate change related disruptions or impacts.*
- MECP – Considering Climate Change in the Environmental Assessment Process (Updated 2021)
  - *This guide is a companion to the codes of practice and sets out the ministry's expectations for considering climate change in the preparation, execution and documentation of environmental assessment studies and processes. This guide also supports the province's Climate Change Action Plan by outlining how environmental assessment processes and studies can incorporate climate change impact considerations. This guide covers the consideration of:*
    - *The impacts of a project on climate change.*
    - *The impacts of climate change on a project.*
    - *Various means of identifying and minimizing negative impacts during project implementation.*

In an effort to consider the effects of climate change through policy and guidance at a municipal level, the following policy recommendations related to climate change were advanced for an update to the City of Ottawa's OP, though its Stormwater Master Plan (Policy Review) (ref. Wood, 2021). These have been outlined for information purposes for the Niagara Region and its partners, as insights into how other communities are addressing the policy needs of climate change resiliency.

- *Development proponents are to implement stormwater management infrastructure that is durable, adaptive and resilient to the current climate and future climate, including extreme weather events, and the infrastructure must be consistent with the Infrastructure Master Plan and Stormwater Master Plan.*
- *The terms of reference for a watershed and/or subwatershed plan as well as an environmental management plan will address:*
  - *Assessment of potential climate change impacts to the subwatershed including identification of any future development areas vulnerable to increased flood risk due to climate change. The assessment will include recommendations for mitigation measures including criteria for development.*
- *Community design plans and other area-specific plans in developed areas will include:*
  - *An assessment of climate resilient design including identification of any future development areas vulnerable to increased flood risk due to climate change. The assessment will include recommendations for mitigation measures including criteria for development.*
- *The City will work with the Conservation Authorities to identify a fluvial climate change scenario flood limit to be identified in CDP or secondary planning studies for future development or major redevelopment areas adjacent to regulated riverine systems.*
- *Develop guidelines regarding climate adjusted rainfall patterns in order to ensure effective and consistent application, based off updated Intensity Duration Frequency (IDF) curves.*

4.4 Natural Hazards

4.4.1 Natural Hazard Definition

The identification of natural hazards is a vital component of watershed planning, in order to manage the exposure to public health and safety risks through informed growth planning and decision-making processes. As described in Volume 1: Characterization, natural hazards include hazardous lands associated with naturally occurring processes associated with surface and subsurface drainage systems, flooding, erosion and unstable lands. The identification of these natural hazard lands within Niagara Region, and associated development of management plans to limit the risks to the public, is an important component for municipal planning as part of the NOP.

The natural hazards identified across the Niagara Region have been summarized at both tertiary and quaternary watershed scales as part of the *Characterization of Existing Conditions* (ref. NWP (E) – Volume 1: Characterization). This summary has been based upon regulatory mapping provided by the NPCA and other publicly available information from the Ontario Geological Survey (OGS) for the following natural hazards:

- Karst Topography
- Regulated Floodplains
- Regulated Shorelines
- Top of Slope (NPCA Allowance)

Additional definitions and/or descriptions of each natural hazard category are provided in the subsequent sections.

4.4.1.1 Karst Topography

As outlined in Volume 1: Characterization, the OGS is a provincial government organization responsible for the collection, interpretation, documentation and dissemination of public geoscience data and information; this includes a focus on Ontario's bedrock geology, surficial geology, geological processes which shape the landscape, and the Earth resources (groundwater, minerals, metals, aggregates, hydrocarbons) that occur within the geological framework (ref. Ontario Geological Survey: Update of Strategic Perspective for 2019-2020).

Part of the activities completed by OGS include mapping of karst topography across southern Ontario, which depicts the nature and regional distributions of karstification of Paleozoic bedrock units within thin drift and exposed bedrock regions; these areas can include features such as caves, sinkholes, and karren which are formed through water sinking and circulating underground, resulting in chemical erosion of bedrock. These landforms are indications of vulnerable/susceptible areas which may pose constraints to urban development and/or have specific management requirements.

The mapping of karst topography across southern Ontario was completed by the OGS in 2008, with updates to the mapping proposed to be completed in the coming years (ref. Project SO-19-006 Karst Map of Southern Ontario: An Update, OGS, 2019).

Based upon the available karst mapping published in 2008, the data are divided into three (3) main karst features or categories (ref. Southern Ontario Karst Map, OGS, 2008):

- **Known Karst** – *Observed, measured field data or data from published reports. Key features include: karren, cave types and associated precipitates, sinkholes and disappearing streams.*
- **Inferred Karst** – *Regions of carbonate bedrock units highlighted as most vulnerable or susceptible to karstification, where direct field observations have not been made by OGS staff or other sources. A natural extrapolation of the known karst areas for given rock units.*
- **Potential Karst** – *Areas of carbonate rock units identified as most susceptible to karst processes*.

The presence of *known, inferred* and *potential* karst landforms provides further indication of potentially vulnerable areas which can be used to identify potential constraints to future development and potential growth areas within the Niagara Region (ref. NWP (E) – Volume 3: Growth Analysis). The scale of the data presented through the current OGS dataset represents an initial screening tool for potential constraints to be used at a high-level for land use planning within the Niagara Region. Given the high occurrence of potential or inferred karst landforms across the Region, karst features will need to be confirmed through supplementary analysis at a local scale (i.e. review of historical aerial photography, field reconnaissance, site surveys, surface and subsurface water feature identification, etc.), as part of subsequent watershed and subwatershed

planning initiatives to characterize the karst features and functions at a local scale and identify the potential vulnerability and associated management requirements for future growth.

4.4.1.2 Regulated Floodplains

The existing watercourse systems can result in constraints and/or hazards to potential development due to their physical traits (drainage area, steep banks, watercourse width, ecological value etc.), but also due to their hydrologic/hydraulic processes including the limits of the regulated floodplains which are prone to inundation during major storm events and thereby represent formal hazards due to their associated flood risks.

The floodplain delineations are typically based upon hydrologic modelling for determining surface water flows, followed by hydraulic modelling analyses to determine the flood inundation limits associated with the Regulatory event, which for most of the NPCA jurisdiction is the 100-year event, with some systems within the Niagara Falls municipal boundary managed by the Regional Storm event (Hurricane Hazel) (ref. Riverine Floodplain Mapping (shapefile), NPCA, May 2020).

It should be noted that technical criteria from MNRF dictate that surface water reaches draining greater than 125 hectares be considered as part of the riverine flood hazard, therefore not all watercourses within the Niagara Region would fall under this regulation. Based upon mapping published by the NPCA in 2019, there is approximately 2,330 km (+/-) of watercourse length which falls within this criterion, of which approximately 20% (+/-) of these reach lengths do not currently (2020) have published floodplain mapping.

4.4.1.3 Regulated Shorelines

Regulated shorelines are mapped and managed by the NPCA; these regulated features represent the associated natural hazards associated with dynamic beaches and shorelines through the application of the greater of either the shoreline erosion (100-year erosion rate, dynamic beach) or shoreline flood (100-year flood level, wave uprush) hazards. These regulated lands are limited to the Lake Ontario and Lake Erie shorelines within the Niagara Region, and would not apply to the majority of the inland areas proposed for growth, including along the Niagara River.

4.4.1.4 Erosion Hazards

The delineation of natural erosion hazard limits associated with river and valley systems allows for the natural processes of lateral and downstream channel migration for unconfined features through the floodplain, and the estimated top of slope for confined valleys, based upon apparent valley wall criteria. Planning around such hazards allows for natural stream form and function to continue, while avoiding erosion risk to adjacent property or infrastructure. The top of slope (TOS), plus associated setbacks (15 m) represent an initial constraint to development and guides land use planning and is largely integrated in the development of the Natural Heritage System (NHS). It should be noted, that since TOS is often associated with open watercourse systems, it can often be found in the same areas designated for flood risk (i.e. floodplains); while some of these hazard areas may overlap, they are both important to consider as part of natural hazard management and land use planning.

4.4.1.5 Natural Hazards Distribution in Niagara Region

The natural hazards outlined in the previous sections have been analyzed and summarized on a quaternary watershed scale as part of the *Characterization of Existing Conditions* (ref. NWP (E) – Volume 1: Characterization). The findings have been compiled in Table 4-2 to present a region-wide summary of the natural hazard distribution for the quaternary watersheds identified within the Niagara Region.

Table 4-2: Natural Hazard Distribution within the Region

Tertiary	Quaternary	Karst [1] K (%)	Karst [1] I (%)	Karst [1] P (%)	Floodplain[2] (%)	Shoreline (%)	TOS[2] (%)
Lake Ontario	Fifteen and Sixteen Mile Creeks	0.6	0	71.0	5.8	0.6	3.7
Lake Ontario	Four Mile Creek and NOTL	0.2	0	4.8	4.8	1.3	2
Lake Ontario	Jordan Harbour - Twenty Mile Creek	1.9	0	95.7	8.1	<0.1	1.3
Lake Ontario	Twelve Mile Creek	0.3	0	42.3	2.3	0.6	3.1
Lake Ontario	Welland Canal North	0	0	82.7	2.9	<0.1	0.7
Lake Ontario	Welland Canal South	1.8	27.7	2.1	4.1	0.2	<0.1
Lake Ontario	West Lake Ontario Shoreline	4.9	0	31.5	1.2	0.5	0.6
Lake Ontario	**AVERAGE**	**2.0**	**1.8**	**53.1**	**4.4**	**0.4**	**1.6**
Niagara River	Niagara River North	0.8	0	76.3	0.6	<0.1	0.6
Niagara River	Niagara River South	0.7	21	12.5	5.4	0.1	0.5
Niagara River	Welland River East	0	0	21.4	7.5	-	1.8
Niagara River	Welland River West	0	2.6	31.8	2.9	-	1.5
Niagara River	**AVERAGE**	**0.1**	**4.9**	**30.0**	**3.7**	**<0.1**	**1.3**
Lake Erie	Northeast Lake Erie Shoreline	0.1	10.4	71.7	5.9	3	<0.1
Lake Erie	**AVERAGE**	**0.1**	**10.4**	**71.7**	**5.9**	**3**	**<0.1**

Note: [1] Karst mapping sourced from Ontario Geological Survey (OGS) publication in 2008 – Known (K), Inferred (I), Potential (P) Karst.
[2] Natural hazard mapping for flooding and erosion risks may overlap as a result of the respective association with watercourse features. As such, the floodplain and TOS distributions are reported independently.

As demonstrated in Table 4-2, the identification of natural hazards demonstrates significant karst topography (known, inferred, potential) across the Niagara Region, and to a lesser degree flooding and erosion hazards. The potential growth areas have been assessed further to identify the natural hazards within the proposed development lands; further details regarding this assessment and the associated findings are presented in NWP (E) – Volume 3: Growth Analysis.

4.4.2 Pending Updates & Gaps

As part of various on-going programs and/or future initiatives, natural hazard identification and mapping is expected to be refined and/or expanded to better characterize and incorporate the existing hazards into future planning initiatives. The following outlines several of the on-going efforts and identified gaps in the current natural hazard compilation which may need to be addressed through future study:

- **NPCA Floodplain Mapping Program**: The NPCA operates a floodplain mapping program through which floodplain limits are delineated for regulated features as part of the Riverine Flood Hazard under the Generic Regulation of the Conservation Authorities Act (Ontario Regulation 97/04). These studies are completed for unmapped systems, as well as updates to existing mapping when warranted; situations where existing mapping may need to be reviewed, include updated information becoming available or significant hydrologic changes warranting a review. Through consultation with the NPCA, the following drainage systems are proposed to have floodplain mapping studies completed in the near future:
  - Beaver Creek (in the Township of West Lincoln) – a major tributary of the Welland River.
  - Big Forks Creek (in the Township of Wainfleet) – a major tributary of the Welland River.
  - NPCA is currently working on developing new flood line mapping for many of the regulated watercourses in the Town of Grimsby.
- ***Updated Shoreline Management plans to be developed in (proposed for 2022 / 2023).*** This initiative will prepare updated plans for management of shoreline areas regulated by NPCA considering flooding, wave uprush, erosion and natural heritage (e.g., dune systems, including backshore dunes). This work will provide additional information for the mapping of features and functions for the NES (captured within the NHS and/or the WRS). NPCA has completed a preliminary gap analysis on existing management plans to inform scoping of this work program and updates to the management plans.
- **Karst Topography Mapping**: The mapping of karst topography across southern Ontario was completed by the OGS in 2008, with updates to the mapping proposed to be completed in the coming years (ref. Project SO-19-006 Karst Map of Southern Ontario: An Update, OGS, 2019). As updated mapping becomes available, any changes to the known, inferred or potential karst topography should be reviewed and incorporated into the appropriate hazard class and management strategy.
  - Through subsequent quaternary and/or subwatershed planning initiatives, karst features and functions can be confirmed through supplementary analysis at a local scale, including detailed review of historical aerial photography, field

reconnaissance, site surveys, surface and subsurface water feature identification, etc. to identify the prescence and function of the hydrogeological karst features within the study area.

- **Meander Belt Delineation**: It should be noted that a meander belt delineation has not been completed for the watercourses within the NPCA jurisdiction and is a notable gap to be addressed in addition to continuous improvements to the Riverine Erosion Hazard decision support dataset via the updated DTM data, and future studies at the quaternary and/or subwatershed scale.

4.5 Cumulative Impacts (CI)

The *Draft Watershed Planning Guidance, 2018* defines cumulative environmental effects as accumulated changes in the environment occurring over time as a result of land use changes, urban developments, infrastructure, climate change etc. The assessment of these cumulative effects is typically completed at a watershed and/or subwatershed scale, so as to provide logical boundaries for assessment of the environmental, social and economic impacts of proposed land use changes within a system. This type of assessment provides an indication of how much change the watershed system has undergone due to past and present influences and can allow for a prediction of future stresses to inform decision-making, including growth and watershed planning.

For the current study, a framework for the cumulative impact assessment has been completed using available land use mapping provided by the Region in the *Characterization of Existing Conditions* (ref. Volume 1: Characterization), in order to identify, at the scale of the quaternary watersheds, the most potentially impacted areas. It should be noted that the current assessment has been completed at a high-level using area-based mapping only, and does not reflect the density of features or their respective sensitivity to change, however this work provides an overall summary of the land use changes which have occurred and are currently proposed, across the quaternary watersheds.

The available mapping provided for use in this study has been used to generate the following categories and measures for this assessment:

- ***Existing Land Use Cover:***
  - **Existing Natural Feature Area:** Ecological Land Classification (ELC) mapping for woodlands and wetlands (sourced from the Region, NAI project (NPCA, 2011) and MNR datasets).
    - Note: Natural cover mapping is distributed throughout the Niagara Region, including overlapping areas within the higher level “built-up” areas and “agricultural land base” areas. As such, the resulting urban and agricultural cover has been adjusted to accurately reflect the natural cover.
  - **Existing Urban Area:** Sourced from the “Built-up” Area mapping minus the “Natural Feature Areas”.
  - **Existing Agricultural Area**: Sourced from the “Agricultural Land Base” mapping minus the “Natural Feature Areas”.

    - Includes all agricultural land designations (prime agriculture, specialty crop and candidate area lands); further discussion on these categories can be found in Volume 1: Characterization.
    - It should be noted that different types of farming practices will have different levels of impact within a watershed system, and as such, different management needs.
  - **Other (N/A):** Land which does not qualify as either natural, urban or agricultural.

- ***Future Land Use Changes:***
  - **Total Potential Growth (Outside Existing Urban Built-Up Boundary):** This assessment category is intended to summarize potential growth, including all identified potential growth areas provided by the Region through the NOP, including the following land use designations:
    - Urban Growth Centre, Major Transit Station Areas, District Plan & Secondary Plan Areas, Greenfield Areas, Draft Employment Areas, Potential Areas of Growth.
    - The summary and analysis of the potential future growth identified within the Niagara Region has been presented as part of Volume 3: Growth Analysis. However, this category and subsequent analysis is introduced in the current volume for context and understanding between the separate volumes.

- ***Change in Proposed Land Conversions:***
  - As part of Volume 3: Growth Analysis, the total change in proposed land use conversions has been reported in terms of both:
    - Urban Land Use Changes – demonstrating the proposed rate of urbanization (existing plus future urban areas) in comparison to the existing urban land cover.
    - Agricultural / Other Land Use Changes – demonstrating the proportion of agricultural / other lands lost and/or converted to accommodate proposed growth.

The analysis of these various land use changes overtime allows for the total proposed and/or potential land use changes to be quantified at a high level and can help to identify the respective stress levels for the quaternary watershed systems, and thereby bring perspective to the potential cumulative impacts. Each of these land categories have been summarized on a quaternary watershed basis (absolute potential area and as a percentage of total drainage area) and are presented in Table 4-3.

Table 4-3: Cumulative Impact Assessment - Land Use Categories by Quaternary Watershed

Tertiary	Quaternary Watershed	Drainage Area (km^2)	Existing Land Use Cover Natural Features km^2	Existing Land Use Cover Natural Features % of WS	Existing Land Use Cover Urban km^2	Existing Land Use Cover Urban % of WS	Existing Land Use Cover Agricultural km^2	Existing Land Use Cover Agricultural % of WS	Existing Land Use Cover Other (N/A) km^2	Existing Land Use Cover Other (N/A) % of WS	Total Potential Growth (Outside Built-Up) km^2 *	Total Potential Growth (Outside Built-Up) % of WS *	Change in Potential Land Conversion (%) Urban *	Change in Potential Land Conversion (%) Agriculture + Other *
Lake Ontario	Fifteen and Sixteen Mile Creeks	136.5	29.9	22%	2.0	1%	103.7	76%	0.9	1%				
Lake Ontario	Four Mile Creek and NOTL	126.4	17.3	14%	12.6	10%	95.6	76%	0.9	1%				
Lake Ontario	Jordan Harbour - Twenty Mile Creek	303.5	62.3	21%	6.1	2%	217.1	72%	18.0	6%				
Lake Ontario	Twelve Mile Creek	148.4	36.8	25%	58.3	39%	50.6	34%	2.7	2%				
Lake Ontario	Welland Canal North	92.4	20.6	22%	38.3	42%	27.8	30%	5.6	6%				
Lake Ontario	Welland Canal South	77.4	32.5	42%	22.1	29%	17.1	22%	5.7	7%				
Lake Ontario	West Lake Ontario Shoreline	300.1	43.5	14%	19.6	7%	135.9	45%	101.1	34%				
Niagara River	Niagara River North	62.2	11.8	19%	33.7	54%	9.3	15%	7.4	12%				
Niagara River	Niagara River South	185.4	70.2	38%	20.2	11%	87.6	47%	7.4	4%				
Niagara River	Welland River East	136.6	57.4	42%	21.2	16%	56.5	41%	1.4	1%				
Niagara River	Welland River West	868.5	209.3	24%	15.8	2%	615.4	71%	28.0	3%				
Lake Erie	Northeast Lake Erie Shoreline	137.0	46.5	34%	22.8	17%	40.7	30%	27.0	20%				
Total for Niagara Region		***2574.4***	***638.0***	***25%***	***272.9***	***11%***	***1457.5***	***57%***	***206.0***	***8%***				

Note: * Total Potential Growth and the resulting changes in potential land conversion have been presented and analyzed as part of NWP (E) – Volume 3: Growth Analysis.

As demonstrated in Table 4-3, the existing land use distribution across the Niagara Region is represented by most lands being designated for agricultural use (57%), followed by natural feature area (25%), existing urban built-up areas (11%) and other lands (8%). As expected, this demonstrates that the most significant past land use change has related to the conversion of natural and/or open lands to agricultural land designations, which now dominates the existing land base across the Region.

These proposed and potential cumulative changes through potential growth and land conversions have been presented and assessed as part of Volume 3: Growth Analysis. It should be noted that these potential cumulative changes as a result of potential growth and the additional impacts of climate change will result in watershed scale implications, if not managed appropriately. The environmental response indicators are noted to be represented by the natural features and watershed functions themselves, which respond to environmental stressors, demonstrating the impacts of urbanization and climate change through functions such as increased flooding, erosion, water quality deterioration, habitat loss, etc.

In order to mitigate and manage the impacts of these environmental stressors, sensitive and/or critical areas are to be identified as those with sensitive and/or critical features and watershed functions (i.e. feature habitat, source water, vulnerable systems, etc.), in conjunction with those proposed to have the greatest potential future change in land use through urbanization. As part of future growth planning, monitoring of the natural features through the various stages of development can allow for adaptive management opportunities to minimize the impacts of land use changes, and climate change, as a function of future growth objectives. Further discussion regarding monitoring and adaptive management practices is provided in Section 5.

4.6 Land Use Impact Management & Preliminary Guidance

The characterization of the existing natural and water-based systems has proceeded on a discipline-specific basis, focused on land uses, physical features and properties, water (ground and surface), and natural systems (terrestrial and aquatic). The objective has been to work towards an integrated characterization and assessment at a watershed plan “equivalent” basis premised on the tertiary scale. This higher-level integration has allowed for a fuller understanding of the fundamental environmental components and systems within the Niagara Region. An integrated characterization and assessment provides a framework and a basis for establishing guidance for management opportunities and requirements based on future land uses.

Primary environmental elements stemming from the discipline-specific characterization work described in the previous report sections included:

- Natural Heritage (including wetland/woodland features/areas)
- Water Resource System
  - Surface water features (watercourses and HDFs)
  - Recharge and Discharge Areas

Each of these elements to varying degrees has required an integrated assessment, in order to establish their significance and associated sensitivity of the areas and features, particularly in the context of the proposed urbanizing areas as outlined in Volume 3:

Growth Analysis; the following provides some associated guidance of various considerations to be addressed through future study, in this regard:

i. Natural Heritage
   - diversity and significance of species (flora and fauna)
   - potential for corridor linkage and benefits to key biota
   - presence/absence of fluvial unit
   - local catchment areas (size and land use)
   - groundwater influence to sustainability of habitats and functions
   - feature size, plant community diversity, and proximity to other features

ii. Watercourses and Headwater Drainage Features (HDFs)
   - presence/absence of form/stability
   - baseflow /intermittent/permanent
   - groundwater discharge (reach specific)
   - presence/absence of riparian corridor vegetation
   - bankfull/riparian/flood flows
   - floodplain
   - erosion sensitivity
   - fish habitat (direct/indirect)
   - benthic invertebrates
   - temperature/water quality

iii. Recharge and Discharge Areas
   - rate of infiltration/recharge
   - location of functional recharge areas
   - functional relationship to watercourses, wetlands or terrestrial features
   - quantity of groundwater flux

The following sections provide insight regarding these systems, areas, and features, which are to be considered in subsequent studies (quaternary and/or subwatershed) to inform the preliminary and future land use planning process.

4.6.1 Natural Heritage System

In a land use planning context, policy largely drives protection of natural heritage features. The P.P.S. (s. 2.1.1) states that ‘Natural features and areas shall be protected for the long term’ and that (s. 2.1.2) ‘the diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.’ These fundamental policies drive the protection of features and the N.H.S. and should be used to inform management of the system.

The N.H.S. for Niagara Region will provide definitions and criteria for identifying features and areas important for the long-term maintenance, and where appropriate enhancement of, Niagara’s natural heritage. Niagara’s N.H.S. will be comprised of the following categories:

- **Natural Heritage Features and Areas** includes features and areas that meet the minimum requirements set out in the P.P.S., Growth Plan, Greenbelt Plan and N.E.P., as applicable.
- **Other Natural Heritage Features and Areas** includes optional features which may be considered part of the N.H.S. (e.g., other woodlands)
- **Supporting Features and Areas** includes additional features and areas which support the N.H.S. form and function (e.g., enhancement areas, other valleylands).
- **Linkages** which connect the components of the system.
- **Buffers / Vegetation Protection Zones** to protect features and functions through land use change(s)

While many of these will be mapped in the Official Plan schedule(s), some features and areas, linkages and buffers are determined, and all are to be confirmed and potentially refined, through additional study. Section 5 outlines the studies through which this process of confirmation and refinement is to occur. The following sections speak to protection and management of the system and features.

Policy Protection and Regulation

Natural heritage features and systems are provided protection through provincial and municipal policies. Individual features and components of Niagara's N.H.S. are to be protected in accordance with applicable policies. The New Niagara Official Plan will act as the primary policy document for providing direction for the protection and management of the N.H.S. Policies of the plan shall comply with applicable provincial plans, including the Provincial Policy Statement (P.P.S), the Growth Plan for the Greater Golden Horseshoe (The Growth Plan), the Greenbelt Plan, and the Niagara Escarpment Plan. Each of these provincial plans provides direction for protection of natural heritage and wise use of natural heritage resources in a land use planning context. Planning, including for the N.H.S. and its management, are to be in compliance with applicable municipal and provincial plans.

In addition to policy-based protections, some features of the N.H.S. (and / or the W.R.S.), including wetlands, watercourses, hazard lands (including floodplain) and lands adjacent to wetlands, are regulated by the Niagara Peninsula Conservation Authority under Ontario Regulation 155/06: Regulation of development, interference with wetlands and alterations to shorelines and watercourses.

Taking Guidance from the Mitigation Hierarchy

Management of the N.H.S. is achieved across the breadth of the planning process, from growth area selection through to site-specific design and should be guided by the mitigation hierarchy, scaled to the level of planning being pursued. The mitigation hierarchy is a sequential approach to protecting and managing the natural environment with the objective of no negative impact, or to the extent feasible, resulting in an improvement in condition. This is achieved through:

1. **Avoid Creating the Impact** –This can be achieved through all steps of land-use planning from selection of growth areas through to site-specific design. Avoidance can include siting, management techniques and design (e.g., linkages).
2. **Minimize and Mitigate the Impact(s)** – Recognizing impacts cannot always be avoided, effort should be placed in minimizing anticipated impacts associate with development to the extent feasible. Like avoidance, this can be applied at all stages of planning from the selection of growth areas through to site-specific design. Minimizing and mitigating impacts become blended and iterative efforts to address impacts through siting, design and implementation of mitigation measures (e.g., buffers).
3. **Enhance / Restore** – Land use planning processes provide opportunities to enhance the system. Guidance should be taken from studies which identify system-level opportunities as well as being informed by site-specific assessment and opportunities.
4. **Replication / Compensation** – in very limited circumstances, such as for an infrastructure project where impacts cannot be avoided and efforts to minimize and mitigate have been completed, replication of features (i.e., moving the feature from one location to another by replicating its form and function), or compensation for impacts may be considered. Compensation (a.k.a. offsetting) is **not** a tool being considered in the new NOP for planning applications. The Region will not support replication / compensation as a way to support or meet the test of 'no negative impact' for any project type.

As a hierarchical approach, emphasis is on avoidance, followed by minimizing / mitigating of impacts in managing land use planning impacts. Weight is placed on early stages and decision-making (planning and design) as key mechanisms to address potential impacts associated with development and changes in land use. Features are to be protected and managed in accordance with applicable Municipal and Provincial policies. Consideration for replication or compensation are generally not permitted; their inclusion is to recognize that in very limited circumstances replication may create a better outcome for the system and compensation should be considered where efforts to avoid and minimize have been exercised and impacts are required / cannot be avoided. All decisions regarding protection and management of features and the system must be made in discussion with, and with the approval of, the appropriate agencies and authorities.

Direction and Mechanisms for Managing the N.H.S.

Definitions and criteria of the Region's N.H.S. are to be applied in the assessment of features and areas through quaternary, subwatershed or comparable study where more detailed assessment is completed, to comprehensively identify the NHS within the study area. Through these detailed studies, the N.H.S. as mapped in the Official Plan can be confirmed, and as appropriate, refined. Generally, this is accomplished through a detailed study which:

- Documents existing conditions through on-site surveys (e.g., birds, vegetation, feature boundary confirmation, fisheries, geomorphology, hydrogeology).

- Evaluates and assesses feature functions and interrelationships on the landscape (e.g., ecologically significant recharge areas, sensitive features and functions).
- Confirms or, as appropriate, refines feature assessments and categorization in accordance with Municipal and Provincial policies.
- Consider the natural feature as green infrastructure to identify the service(s) and functions provided (e.g., flood attenuation, carbon sequestration, climate change resilience), services lost in the event a feature is removed from the landscape and potential cost of replacing these services with an engineered solution.
- Identifies and provides direction for linkages, enhancement areas, and buffers, in accordance with the overall system that has been defined and selected as part of the new NOP.

Direction provided through these studies continues to address the system at an ecologically functional scale (i.e., the watershed or subwatershed), but bridges the gap between the Regional-scale and the site scale, translating direction to one which can be implemented through more detailed planning (e.g., Area Specific Plans or site-specific planning). Through these processes, comprehensive understanding of the N.H.S. is established, and adequate direction is given to plan for and protect the N.H.S. through land use planning. The mitigation hierarchy informs this process and is applied through the identification of features and sensitivities and providing direction for avoiding and minimizing impacts, as well as recommendations for enhancement and, if applicable, replication. Mechanisms and opportunities for protecting, managing, and enhancing the system are outlined below.

Linkages

Linkages are critical components of the N.H.S, maintaining functional interactions between features and areas on the landscape through the flow and movement of materials and wildlife. Preserving these functions are critical to biodiverse, sustainable and resilient systems in the long-term.

Under pre-development conditions, landscape connectivity may exist within and across natural and open spaces and along rivers and streams. Under post-development conditions, these connections become constrained, restricted or may be lost, requiring that linkages be identified and established on the landscape to maintain the flow and movement of materials and wildlife.

A system of linkages within the N.H.S. must support the dynamic flow and movement of materials and species across the landscape in a dispersed fashion. To achieve this, linkages at multiple scales are required and where possible, redundancy should be built in to ensure the form and function of the system are maintained, and where possible enhanced. Climate change will exacerbate the need for strong connections and species mobility on the landscape as species ranges change in response to climatic changes.

Major landscape linkages, such as those identified in the province's N.H.S. connect the landscape broadly. These major linkages are generally very wide, providing for long and slow movement of materials and species across the landscape. These should be

implemented and designed, as appropriate, to support long residency times for species as they move across the broader landscape. These broad scale connections must be supported by linkages at more refined scales. Linkages at the subwatershed and the site-scale are important for the maintenance of local system functions (e.g., a linkage connecting amphibian pond breeding habitat with upland foraging habitat), material and species exchange and movement.

Additional linkages (i.e., beyond those in the province's NHS) are to be identified through quaternary, subwatershed, or comparable studies. Implementation of linkages is generally achieved at the time of land use planning and development; however, opportunities also exist for voluntary action(s) to support landscape connectivity through private land restoration / enhancement or land acquisition by conservation-oriented groups (e.g., Land Trusts).

Enhancement Areas

Enhancement areas provide opportunities to improve the form and/or function of the NHS. These enhancements can be achieved through multiple means, including:

- **Improving the shape** of features and areas of the N.H.S. through filling 'bays', 'inlets' or 'holes' within a feature can enhance the system by increasing the functional capacity of features and areas (e.g., how many breeding pairs it can support), creating or increasing interior habitat area, reducing edge effects / impacts, etc.
- Where features occur in close proximity to one another, enhancement opportunities may exist to **connect features** by naturalizing the connecting land and creating a contiguous matrix of features within the N.H.S. Naturalizing these intervening areas creates opportunities to increase habitat diversity, create habitat complexity and support a resilient and connected system.
- **Habitat or function-based enhancements** are used to address under-representation of habitat types, support maintenance of habitats commonly lost through land conversion, address past losses in features or functions, or support or enhance existing functions (e.g., in areas of ecologically significant groundwater recharge). These are identified based on an assessment of existing habitat composition, functions on the landscape.

Identification of enhancement areas is to be completed through quaternary, subwatershed or comparable studies and informed by opportunities, targets or other guidance as set out in those studies (ref. Section 5). The NWP (E) includes a review and summary of management direction and opportunities for restoration provided through existing watershed plans and reports (ref. NWP (E) – Volume 1: Characterization and NWP (E) – Volume 3: Growth Analysis) which can assist in informing some enhancement opportunities.

Buffers

Buffers, also called vegetation protection zones, are a common and often a primary mitigation measure used in the management of natural heritage features and natural heritage systems. In an ecological context, buffers act to avoid, minimize, or provide

passive actions to mitigate impacts associated with development planned to occur on adjacent lands. Ecological buffers are typically vegetated (and in the case of VPZs shall be vegetated), including vegetation through natural regeneration or planting. Vegetated buffers improve the overall function of the buffer resulting in enhanced protection of the natural feature. Vegetated buffers can provide habitat for wildlife, however, the buffer should not be identified or managed as part of the feature, instead it should be treated as separate entity, which supports and mitigates potential negative impacts.

Direction on buffer widths should be established through quaternary, subwatershed or comparable studies. Generally, at this stage minimum widths should be established to ensure planning through subsequent stages accommodates these requirements. As some detailed land use information may not be known at the stage of subwatershed planning, confirmation or refinement of buffer widths and design may be permitted through further stages (e.g., block plan or an environmental impact study). However, minimum widths are to be upheld.

How a buffer is utilized, including permitted activities within them (e.g., trails), should be informed by feature significance and sensitivity and the feature's role in long-term ecosystem function. Direction with regard to permitted uses may be determined through the subwatershed process.

Through the development of buffer guidance and recommendations, the size and design of buffers should be informed by several factors including:

Features Form, Function and Sensitivity:

The form and functions supported by a feature will inform its relative sensitivity to development on adjacent lands. Feature sensitivity can be based on a number of factors and buffers should be considered individually based on its specific conditions, such as:

- Water quantity and quality – features, their structure and species which occupy them may have varying degrees of reliance on or sensitivity to hydrologic change. Consideration should be given to the source(s) of contributing sources, their quantity and quality and how buffers can or need to support or maintain these functions.
- Habitat requirements – species assemblage(s) under existing conditions will inform the habitat requirements of the species residing in or utilizing the feature (or complex of features). Species with specialist habitat requirements are generally more sensitive to changes in habitat conditions. Buffers may provide opportunities to support species needs (e.g., foraging habitat for amphibians).
- Species behavior – different species have different behavioral traits which can influence their sensitivity or tolerance to human activities. Behavioral traits that may be affected by changes in lands adjacent to or in proximity to habitat include communication (e.g., vocalizations), altered patterns of movement (to or away from certain areas), subsidization of predators (e.g., raccoons), etc.
- Fragmentation – as fragmentation increases across a landscape, sensitivity to new pressures and impacts increases.

Type and Design of Adjacent Development:

The type, magnitude, extent, duration and frequency of impacts will vary based on the type, form and design of the development being proposed. Based on the understanding of feature sensitivities (above), buffer width and design should consider a range of factors related to anticipated impacts including, but not limited to:

- Post-development water quality and quantity as influenced by impermeable surfaces, stormwater management approach and the needs of the feature (discussed above).
- Occupancy-related impacts such as light, noise, domestic pets, dumping, trails, etc. and the influence of the proposed development on the magnitude of the impact, as well as its temporal influence and the potential impacts to the feature (e.g., time of day, duration, etc.).

Opportunities to address impacts (avoid, minimize) 'at-source' through siting and design for land uses should be encouraged. Examples include placing more 'impactful' uses away from sensitive features of the N.H.S, integration of a range of Low Impact Development (LID) measures and approaches, Dark Sky friendly lighting, etc. Where used, these approaches can support more sustainable design practices, reduce reliance on buffers to address all impacts, and support Niagara's N.H.S. and W.R.S.

Policy-Driven Minimums:
Within the Growth Plan and the Greenbelt Plan areas, policies pertaining to the Natural Heritage System and/or specific features (e.g., wetlands, fish habitat, significant woodlands) stipulate minimum vegetation protection zones. Similarly, NPCA policies and procedures may also stipulate minimum buffers or V.P.Z. for features regulated under the Conservation Authorities Act. These policies are to be applied where applicable and represent **minimum** feature buffers. Considerations discussed through preceding sections are to additionally inform buffer width and inform buffer design, with potential for recommendations of buffers which are greater than the policy-driven minimums.

Where policy does not prescribe minimum buffers, buffer widths should be developed in accordance with best practice in mitigating anticipated impacts and as informed by considerations discussed through preceding sections.

It is recommended that where policy dictates a minimum vegetation protection zone, that these be mapped as part of the WRS to address this required component of the WRS. Through detailed, site-specific study, buffers will be established where policy does not drive a minimum width and should also be mapped as components of the WRS.

4.6.2 Drainage Features – Watercourses and HDFs

The following provides an overview of industry-based management guidance for watercourses and headwater drainage features, which will need to be considered at subsequent planning stages associated with Quaternary and Subwatershed scale studies, related to the growth areas identified in Niagara Region. Notably, the guidance provided at these scales will need to consider those BMPs which support systems-

based cumulative impacts. The guidance at this stage is generic and generally subject to the findings of locally-based fieldwork and modelling at future more local scales.

Feature Classification and Management Strategies

Watercourses and HDFs form an intricate surface water network that primarily conveys water and sediment, but also provides functional processes which drive the ecological health of riparian and aquatic systems including direct and indirect habitat, linkages, thermal regime and water quality. Management of these drainage features requires integration between each technical discipline to determine current function, and future requirements for protection, mitigation, and/or enhancement at the reach and site-specific scales.

Key management practices, in terms of stream morphology, are recommended according to the geomorphic constraint rating, or HDF management recommendation. Management strategies may include several options, or specific guidance. It should be noted that HDF assessments are required through future study, and only then may management recommendations be determined.

Generally, watercourse features are protected and regulated by the Conservation Authority, while HDFs are not generally regulated. Both Watercourses and HDFs may provide important functions that should be considered when evaluating impacts from development and identifying management opportunities. Regulation of watercourses does not preclude them from modification through development, but substantial rationale would be required to complete channel design works and realignments, to the satisfaction of applicable review agencies. Therefore, it is prudent to determine appropriate management opportunities and constraints for area drainage features that seek to maintain, mitigate, or enhance the form and function required for each feature.

An integration of key characteristics and functions for each technical discipline can be applied through the development of a watercourse constraint ranking, and through the application of a Headwater Drainage Feature Assessment (e.g. CVC/TRCA, 2014). This work requires detailed analysis including field observations to evaluate form and function on a feature-by-feature basis; once the constraint rankings are developed, management options may be determined based upon the resulting classification. The following sections provide some additional guidance regarding the options and factors related to each watercourse constraint level.

Watercourse Feature Constraints – Classification & Management

An integration of key characteristics and functions, for each techncial discipline should be applied in the development of a constraint ranking for watercourses within the Niagara Region. Each watercourse should be assessed and be provided a ranking of high, medium or low, on a reach-by-reach basis, based upon various environmental factors and considerations, with individual rankings per discipline.

The following summarizes, the general definitions/ criteria to be applied by discipline, in developing the individual constraint rankings for the area watercourses at a scoped, desktop level of study.

High Constraint Watercourses

High constraint watercourses are features that have attributes (e.g. floodplains, unstable banks) that attract Conservation Authority regulations, and have usually been deemed high-quality systems that should not be re-located and replicated in a post-development scenario. They must remain open and protected in their present condition and locations, with the exception of select localized sites where rehabilitation may be of benefit to the system.

High-constraint watercourses and their corridors are to be protected in current form and location, with appropriate regulatory setbacks and ecological buffers. Minor modification through localized rehabilitation/enhancement may be acceptable at select locations where it provides an enhancement to the system, given sufficient rationale.

Medium Constraint Watercourses

Medium constraint watercourses have attributes (e.g. floodplains, unstable banks) that attract Conservation Authority regulation, but are typically highly impacted and therefore may be realigned using natural channel design and other principles of environmental design.

Most Municipal Drains would likely qualify as medium constraint watercourses, as re-alignment or maintenance may occur to maintain its function. The presence of Municipal / Constructed Drains throughout the Niagara Region has been summarized in Volume 1: Characterization. The Department of Fisheries and Oceans (DFO), with support from Drainage Superintendents and Conservation Authorities, has developed a classification and guidelines for maintenance of Municipal Drains, which should be used to determine the necessary management practices for these drainage features as enabled through the Drainage Act (ref. Guidance of Maintaining and Repairing Municipal Drains in Ontario, 2017).

Medium Constraint watercourses are to remain open and protected with applicable hazard corridors, regulatory setbacks, and ecological buffers. Channel/corridor realignment (horizontal and vertical) may occur where restoration and enhancement is included in design options using natural channel design principles.

Low Constraint Watercourses

These features are ephemeral in nature and are typically poorly defined, lacking function or quality as defined by each discipline for High and Medium constraint features when completing a desktop assessment. If constraint analysis does not designate a watercourse as having high or medium constraint, it can be classified as a low constraint. However, if their feature type and presence cannot be confirmed at the desktop scale, future studies, further analysis and field confirmation is required to confirm feature presence and type, and then undertake the appropriate assessments to determine the feature constraint and management opportunities. These systems are typically aligned with the definition of a headwater drainage system.

Headwater Drainage Features

As noted in earlier sections, Headwater Drainage Features (HDFs) have not yet been comprehensively mapped or identified throughout the Niagara Region, however there is an interest in standardizing the identification and management of these features within NPCA's jurisdiction. As such, future work through subsequent planning stages is required to confirm these features and evaluate them following the CVC/TRCA (2014) guidelines (ref. Table 4-4) which will allow for management recommendations to be mapped similarly to the constraint rankings presented for watercourses.

Table 4-4: Recommended HDF Management Classifications (TRCA/CVC 2014)

HDF	Description/Management
Protection	Important Functions: e.g. swamps with amphibian breeding habitat; perennial headwater drainage features; seeps and springs; SAR habitat; permanent fish habitat with woody riparian cover • Protect and/or enhance the existing feature and its riparian zone corridor, and groundwater discharge or wetland in-situ; • Maintain hydroperiod; • Incorporate shallow groundwater and base flow protection techniques such as infiltration treatment; • Use natural channel design techniques or wetland design to restore and enhance existing habitat features, if necessary; realignment not generally permitted; • Design and locate the stormwater management system (e.g. extended detention outfalls) are to be designed and located to avoid impacts (i.e. sediment, temperature) to the feature.
Conservation	Valued Functions: e.g. seasonal fish habitat with woody riparian cover; marshes with amphibian breeding habitat; or general amphibian habitat with woody riparian cover. • Maintain, relocate, and/or enhance drainage feature and its riparian zone corridor; • If catchment drainage has been previously removed or will be removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage), as feasible; • Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary; • Maintain or replace external flows,

HDF Classification	Description/Management
	• Use natural channel design techniques to maintain or enhance overall productivity of the reach; • Drainage feature must connect to downstream.
Mitigation	Contributing Functions: e.g. contributing fish habitat with meadow vegetation or limited cover • Replicate or enhance functions through enhanced lot level conveyance measures, such as well-vegetated swales (herbaceous, shrub and tree material) to mimic online wet vegetation pockets, or replicate through constructed wetland features connected to downstream; • Replicate on-site flow and outlet flows at the top end of system to maintain feature functions with vegetated swales, bioswales, etc. If catchment drainage has been previously removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage); • Replicate functions by lot level conveyance measures (e.g. vegetated swales) connected to the natural heritage system, as feasible and/or Low Impact Development (LID) stormwater practices (refer to Conservation Authority Water Management Guidelines for details);
Recharge Protection (recharge protection is recommended to be incorporated into the 'mitigation' classification)	Recharge Functions: e.g. features with no flow with sandy or gravelly soils • Maintain overall water balance by providing mitigation measures to infiltrate clean stormwater, unless the area qualifies as an Area of High Aquifer Vulnerability or Significant Recharge Areas under the Source Water Protection Act. These areas will be subject to specific policies under their respective legislation. • Terrestrial features may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with them.
Maintain or Replicate Terrestrial Linkage (terrestrial linkages are recommended to be incorporated	Terrestrial Functions: e.g. features with no flow with woody riparian vegetation and connects two other natural features identified for protection • Maintain the corridor between the other features through in-situ protection or if the other features require protection, replicate and enhance the corridor elsewhere

HDF Classification	Description/Management
into the 'Conservation' classification)	• If the feature is wider than 20 m, it may need to be assessed separately through an Environmental Impact Study to determine whether there are other terrestrial functions associated with it.
No Management Required	Limited Functions: e.g. features with no or minimal flow; cropped land or no riparian vegetation; no fish or fish habitat; and no amphibian habitat. • The feature that was identified during desktop pre-screening has been field verified to confirm that no feature and/or functions associated with headwater drainage features are present on the ground and/or there is no connection downstream. These features are generally characterized by lack of flow, evidence of cultivation, furrowing, presence of a seasonal crop, and lack of natural vegetation. No management recommendations required.

HDFs identified as Protection and Conservation are considered required components of the WRS. It is recommended that mitigation HDFs also be considered part of the WRS for their contributory functions (water quality, quantity and supporting downstream aquatic and terrestrial natural heritage). In this way, mitigation HDFs are not considered protected features, however it is imperative that their function(s) be addressed adequately, and in a manner that maintains critical functions. Replication of these functions through green infrastructure or engineered systems, fully integrated with local land uses may be used, as appropriate, to achieve this objective. This assessment and related management recommendations are to be established through detailed site-specific study.

Erosion Hazard Corridors

Watercourse features and associated hazard limits (i.e. meander belts for unconfined systems, and stable top of slopes for confined systems) should be incorporated into the development of the NHS in order to protect the feature and habitat, as well as to mitigate risks associated with the hazard. Following designation of geomorphic constraint rankings to each watercourse reach, should a medium constraint watercourse be realigned or relocated, a design meander belt and appropriate setbacks should be developed and then incorporated into the NHS; this would be done in a hierarchical manner, in which the initial framework would be determined through quaternary watershed level study, and further refined through Secondary Plans and subwatershed studies, with designation of features completed to the satisfaction of the NPCA and any setbacks as per NPCA's regulation 155/06.

Corridor Enhancements and Rehabilitation

Enhancements of watercourse corridors should include the removal of barriers to the movement of water and sediment in the downstream direction, and fish in the upstream direction (e.g. severe debris jams/dams, weirs), provided they do not serve a necessary function (e.g. grade control). In the case of grade control weirs, opportunities to replace these structures with natural channel design features (e.g. a series of riffles) should be explored.

Maintenance of Channel Length and Sediment Supply

Stream length and sinuosity should be maintained at a minimum, unless rationale is provided where a balance cannot be maintained between pre- and post- development. Drainage density targets have historically been applied to maintain stream length and were historically determined through subwatershed scale studies. It should be noted that the trend towards a feature by feature evaluation of headwaters through the application of TRCA/CVC (2014) guidelines provides a more comprehensive and detailed approach to managing drainage features than a drainage density target has historically. It is recommended to apply the constraint ranking methodology for watercourses and HDF evaluations to determine appropriate strategies to manage surface water features that maintains or enhances the function of each feature.

Road Crossings

A poorly sited road crossing can result in negative impacts to the channel and higher risk to the structure itself. There are a number of factors which should be considered when identifying the most appropriate location for a road crossing through integrated land use and transportation planning. For a large development area, it is important to minimize the number of times the proposed road network crosses important and sensitive watercourse valleys. This will reduce impacts to the watercourse as well as the surrounding natural heritage features. Road crossings should not be located within close succession to each other. Providing an adequate distance between crossings allows for an area of potential adjustment, if there are negative impacts to the watercourse as a result of the subject crossing structure. This minimizes the risk of compromising any additional structures located downstream. Analysis of the configuration of proposed watercourse crossings should be completed when a Land Use Plan has been developed.

On a local, site-specific scale, there are several risk factors which need to be considered for the individual crossings with respect to geomorphic function; these include channel size, valley setting, meander belt width, meander amplitude, rapid geomorphic assessment (RGA) score, and 100-year migration rates. In addition to geomorphic considerations, fish and wildlife provisions should also be incorporated to minimize ecological impacts of proposed crossings. These risk factors would be used to assess both crossing locations and determine the appropriate structure type.

Erosion Thresholds and SWM

Critical discharges should be applied as SWM targets (ref. Section 4.6.3) to mitigate adverse erosion downstream following development and potential alteration to system hydrology. Future studies should identify potential SWM discharge locations and

erosion thresholds should be determined for receiving watercourses, and then compared to values adjacent and downstream for representativeness and sensitivity.

4.6.3 Water System (Surface & Ground)

It is widely understood and anticpitated that uncontrolled development would increase the risk of flooding and erosion along receiving drainage features within the development areas and further downstream, as well as degrading the quality of surface runoff to aquatic habitat and terrestrial features and the supply of surface water and potentially groundwater to sensitive features. Previous studies have been completed for the watershed areas within the Niagara Region; these include recommendations for stormwater management, which serve as an indication of the stormwater management requirements for future development, subject to further assessment as part of subsequent studies (quaternary and subwatershed). The following provides an overview of stormwater management criteria for flood control, erosion control, water quality control, and water budget management.

Flood Control

The end-of-pipe facility storage volume requirements for flood control, above extended detention storage volume requirements, vary according to soil type, surface slopes, and land use conditions (pre- and post-development). No stormwater management facility sizing criteria (unitary sizing) has been provided for any future development, as part of the existing watershed plans for the Niagara Region (ref. Section 4.2.1). However, it should be noted that there is currently (2021-2022) a Subwatershed Study being conducted for the Smithville Master Community Plan located within the Township of West Lincoln; once this study is completed, it will represent the most current unitary sizing guidance, which can be considered a contemporary example for a subwatershed within the Niagara Region.

A literature review has been completed for various subwatershed studies in municipalities across the GTA (i.e. Mississauga, Brampton, Markham, and Milton) to determine the potential range of unitary storage volume typicially required for quantity control for the 100 year storm event (Regulatory event in Niagara Region). The range of incremental detention storage volumes within end-of-pipe facilities for the 100 year event based upon a literature review of subwatershed study recommendations through the GTA, is summarized in Table 4-5.

In order to provide a more local example of unitary sizing generated as part of a study within the Niagara Region, unitary sizing produced as part of the Port Robinson West Scoped Subwatershed Study (Phase 2 & 3) completed by Aquafor Beech in 2014, has been summarized in Table 4-5. As part of this study, stormwater detention facility targets were developed from hydrologic modelling for flood and erosion control as part of the impact assessment and implementation plan for the proposed development (located in the Lake Ontario tertiary watershed). In the absence of quaternary watershed level criteria, the recommendations from this subwatershed study have been summarized to provide a Niagara Region example for SWM sizing and related recommendations.

It should be noted that as part of the Port Robinson West Subwatershed Study, stormwater management facilities discharging *directly* to the Welland Canal via a direct outfall (i.e. not to a tribuary) were reported to not require extended detention for erosion and flood control, seeing as the drainage area of the proposed development are considered to be minor in comparison to the capacity of the Welland Canal (ref. Aquafor Beech, 2014). All development lands discharging to a tributary of the Welland Canal (i.e. Singers Drain, Towpath Drain, etc.) required SWM which included extended detention for both erosion and flood control.

Table 4-5: Range of Detention Storage Requirements for 100 Year Event Flood Controls in Niagara Region and Across the GTA

Operating Condition	Unitary Storage Volume (m^3/imp ha) Port Robinson SWS [2]	Unitary Storage Volume (m^3/imp ha) GTA Examples
100 Year	450 – 810	400 – 1250

Note: [1] Unitary 100 year storage volumes are exclusive of extended detention storage requirements for erosion and/or stormwater quality control (i.e. additive).
[2] Storage volumes reported in the Port Robinson SWS were reported as m^3/ha, assumed to be in reference to the total development area. These volume requirements have been converted to m^3/imp ha based upon the catchment area and impervious coverage for the future land use in the Port Robinson SWS report. This provides a more meaningful and consistent summary and comparison to the unitary storage volumes presented in the GTA literature review.

The examples presented in Table 4-5 are for information purposes only, as specific requirements for mitigating flooding impacts will need to be determined as part of future studies. It is also important as part of future studies to not only assess the impacts locally but also on a subwatershed basis, to consider downstream impacts, to ensure that hydrograph timing effects are considered when establishing the levels of control warranted by the proposed development. Furthermore, as noted previously, the sizing of flood control facilities should consider the influence of climate change, and should therefore assess stormwater management facility performance for climate adjusted storm events (ref. Welland SWMF Risk Assessments, Wood 2019).

Erosion Control

Similar to flood control volume requirements within end-of-pipe facilities, the extended detention storage volume requirements for erosion control vary according to soil type, surface slopes, and land use conditions. No stormwater management facility sizing criteria (unitary sizing) has been provided for any development as part of the existing watershed plans for the Niagara Region (ref. Section 4.2.1). However, as noted previouly, the Smithville Subwatershed Study being conducted for the Township of West Lincoln will represent the most current unitary sizing guidance available within the Niagara Region upon study completion.

As outlined in the previous Flood Control section, the Port Robinson West Scoped Subwatershed Study (Phase 2 & 3) (ref. Aquafor Beech, 2014) is being summarized to present a local study available for the Niagara Region, which completed hydrologic

modelling to determine prelimary stormwater detention facility targets for flood and erosion control as part of the impact assessment and implementation plan for the proposed development (in the Lake Ontario tertiary watershed). In absence of quaternary watershed level criteria, the recommendations from this subwatershed study have been summarized to represent a Niagara Region example for SWM control sizing.

The erosion control sizing approach applied in the Port Robinson West SWS followed the "distributed runoff control" approach, as outlined in the 2003 MOE SWM Guidelines, which required the following (ref. Aquafor Beech, 2014):

- *Outflows from the detention facilities for the 2-year storm were controlled to pre-development rates; and*
- *Outflows from smaller storm events were over controlled to a target equal to 15% of the 2-year release rate in order to minimize potential in-stream erosion from these more frequent storm events.*

Similar to the flood control volumetric sizing example, a literature review has been completed for subwatershed studies in various municipalities across the GTA (i.e. Mississauga, Brampton, Markham, and Milton) to determine the potential range of unitary extended detention storage volume required for erosion control. The approaches to erosion control sizing applied in these subwatershed studies followed industry standard approaches, including the determination of erosion thresholds through field work which were applied to provide insight regarding the capacity of each watercourse system to accommodate an altered land use and associated flow regime. Application of appropriate thresholds as stormwater best management practice targets were used to limit rates of erosion to pre-development conditions.

The range of incremental extended detention storage volumes within end-of-pipe facilities for erosion control based upon a literature review of subwatershed study recommendations within Niagara Region and the GTA, is summarized in Table 4-6.

Table 4-6: Range of Extended Detention Storage Requirements for Erosion Control in Niagara Region and Across the GTA

Operating Condition	Unitary Storage Volume (m^3/imp ha) Port Robinson SWS [1]	Unitary Storage Volume (m^3/imp ha) GTA Examples
Extended Detention/ Erosion	197 – 243	150 - 500

Note: [1] Storage volumes reported in the Port Robinson SWS were reported as m^3/ha, assumed to be in reference to the total development area. These volume requirements have been converted to m^3/imp ha based upon the catchment area and impervious coverage for the future land use in the Port Robinson SWS report. This provides a more meaningful and consistent summary and comparison to the unitary storage volumes presented in the GTA literature review.

Erosion thresholds should be determined for receiving watercourses in future studies to inform initial SWM planning. As plans develop, and SWM locations are defined, erosion thresholds should be determined for sensitive and/or representative areas downstream

of potential outfalls. These values should be compared to existing thresholds and those for sensitive locations to determine the most representative. Erosion threshold evaluation for SWM is to be evaluated through future studies.

As noted, the examples presented in Table 4-6 are for information purposes only, as the specific requirements for mitigating erosion impacts will need to be determined as part of future studies and should be consistent with the most current design criteria adopted by the Niagara Region (ref. Draft Niagara Region SWM Guidelines).

Water Budget (LID BMPs)

For water budget protection/managment, measures to promote groundwater recharge through the application of LID BMPs will be required to mitigate impacts related to urbanization. The implementation of these measures will require infiltration of clean runoff (i.e. rootop runoff) and pre-treatment of surface runoff from other paved surfaces (i.e. roads, parking lots, driveways), and application of practices that promote evapotranspiration to maintain the quality of infiltrated surface runoff and achieve area-based water budgets.

The Port Robinson West Scoped Subwatershed Study (ref. Aquafor Beech, 2014) included a hydrologic assessment under a typical range of annual rainfall events to determine the required capture volume to maintain existing groundwater recharge rates. The results of the analysis included a recommendation for a 2 mm capture volume (over the total catchment area) via LID source and conveyance control measures in order to achieve the groundwater recharge target within the predominantly silt/clay study area (ref. Aquafor Beech, 2014).

Studies completed for other municipalities within the GTA have demonstrated that a relatively modest capture rate (i.e. 1 mm/impervious ha – 6 mm/impervious ha) would be sufficient in many low permeability environments to maintain groundwater recharge for relatively impermeable soils (such as the Port Robinson study area), whereas larger capture volumes (i.e. 10 mm / impervious ha – 15 mm / impervious ha or more) may be required for more permeable soils. The sizing of LID infiltration/evapotranspiration BMPs should also consider requirements to sustain or augment baseflow within receiving watercourses, hence should include a holistic assessment of the existing groundwater and aquatic systems, potentially requiring a spatially varied sizing criteria for LID infiltration/evapotranspiration BMPs.

Based on the *Niagara Region Stormwater Management Guidelines (DRAFT)* (ref. Section 4.2.1), the Niagara Region recommends that at a minimum, the development proponents ensure that the first 5 mm of rainfall which lands on the site is retained and infiltrated on site (i.e. zero runoff for the first 5 mm of rainfall). This is a minimum criterion to achieve water balance criteria in absence of a SWS, MDP, or MESP that encompasses the proponent's site. Further, current draft guidelines from MECP (ref. February 2022) are advocating for the management of the 90th percentile of runoff.

Water Quality

In terms of water quality, the stormwater quality control targets are determined based upon the type of facility, contributing land use (imperviousness) and the level of control required (basic, normal, enhanced); volumetric requirements are to be determined via

the Provincial SWM guidelines (ref. MOE, 2003). Through the development of the *Niagara Region Stormwater Management Guidelines (DRAFT)*, the regional guidance is requiring quality control be provided to an "Enhanced" standard of treatment (i.e. 80% TSS removal) which should be achieved through a treatment train approach. There are currently no explicit requirements for thermal mitigation, however an assessment of sensitive watercourses and natural features (i.e. coldwater watercourses in Twelve Mile Creek) should be completed as part of future studies to identify and incorporate measures to mitigate thermal enrichment of runoff to receiving systems.

General SWM Practices

Recognizing the above requirements, the following technologies and practices, among others including potentially emerging technology, are available to address the anticipated stormwater management criteria for flood and erosion control, stormwater quality and thermal contol, and maintaining the water budget:

- ***Stormwater quantity controls for flooding and/or erosion:***
  - End-of-pipe facilities (i.e. wetlands, wet ponds, hybrid facilities, dry ponds).
  - Source controls (i.e. underground tanks, pipe storage, surface storage in parking lots, rooftop storage).
  - LID infiltration/evapotranspiration BMPs.
- ***Water Budget/Infiltration:***
  - Bioswales/biofilters.
  - Infiltration trenches.
  - Rain gardens.
  - Bumpouts.
  - Rain barrels.
  - Increased topsoil thickness.
  - Perforated pipes/exfiltration systems.
  - Exfiltration tanks.
- ***TSS removal as per current (2003) MOE criteria:***
  - Wet end-of-pipe facilities (i.e. wetlands, wet ponds, hybrid facilities).
  - Vegetated technologies (i.e. grassed swales, buffer strips, etc.).
  - Oil/grit separators.
  - Bioswales/biofilters.
  - Infiltration trenches.
- ***Thermal control:***
  - LID infiltration/evapotranspiration BMPs
  - Urban terrestrial canopy (also NHS)
  - Facility shading (includes orientation and length/width ratio)
  - Facility cooling trenches
  - Facility bottom draws
  - Concrete Sewer System
  - Underground Storage Facilities
  - Green & White roofs
  - Floating Islands

The specific measures applied will need to be established as part of future detailed studies (quaternary and subwatershed plans), based upon the land use condition of the contributing drainage area, and subject to approval by the respective municipality and Conservation Authority, and Provincial ministries including MECP.

As indicated in the foregoing, it is anticipated that LID BMPs will form a component of the stormwater management plan specifically to maintain groundwater recharge and manage water budget, and potentially to augment erosion protection for the receiving watercourses. This may also include source controls to provide stormwater quantity control for development areas which are too small to support wet end-of-pipe facilities. Several technologies and techniques are available for incorporation into the stormwater management plan for future development areas, however it is recognized that each LID BMP provides different functional benefits; further details regarding approved SWM technologies for the Niagara Region can be found in the *Niagara Region Stormwater Management Guidelines (DRAFT)*, which is currently under development. A summary of the function for common LID BMPs and source controls is provided in Table 4-7.

Table 4-7: Stormwater Management Function Provided by Selected LID Stormwater BMP's and Stormwater Source Control Practices

Practice	Flood Control	Erosion Control	Quality Control	Runoff Volume Reduction	Groundwater Recharge
Rooftop Storage	X				
Parking Lot Storage	X				
Amended Topsoil		X	X	X	X
Green Roofs		X	X	X	
Oil/Grit Separators			X		
Rainwater Harvesting		X		X	
Pervious Pipes		X	X	X	X
Oversized Pipes	X				
Permeable Pavement		X	X	X	X
Soakaway Pits		X	X	X	X
Infiltration Trenches		X	X	X	X
Bumpouts		X	X	X	X
Grassed Swales			X		
Biofilters/Bioswales		X	X	X	X

In addition to the foregoing practices, the stormwater management system should be established with consideration for the influence of climate change. In this regard, the performance of the stormwater management systems and practices should be assessed for climate adjusted storm events (once available and adopted by the Niagara Region). The planning of quantity controls for these events should apply an appropriate methodology, consistant with the climate projections work being completed by the

Niagara Region (ref. Section 4.3.1) and following the design guidance set out by the *Niagara Region Stormwater Management Guidelines (DRAFT),* which is currently underway.

4.6.4 Shorelines

The NPCA policy document titled “POLICIES FOR THE ADMINISTRATION OF ONTARIO REGULATION 155/06 AND THE PLANNING ACT”, September 2018, describes the role which NPCA has in the management of its shorelines specific to Lake Ontario, Lake Erie and the Niagara River. As noted in that document, the shorelines along Lake Ontario, Lake Erie and the Niagara River are dynamic and in a state of constant flux. These changes to shorelines can appear in a period of hours to days or even years and decades in response to the changes in system factors. The NPCA is responsible for regulating activities, including various forms of new development and re-development within the Lake Ontario, Lake Erie and Niagara River shoreline hazard areas. The objective is to minimize risks to life, property damage, social disruption and adverse environmental impacts. The shoreline hazard area includes the following natural hazards:

a) Shoreline flooding hazard;
b) Shoreline erosion and slope stability hazard; and,
c) Dynamic beach hazard

In general, development is restricted within the shoreline flood hazard and is subject to mitigation measures. Certain forms of development are prohibited. The flood hazard within NPCA’s regulated areas shall be mitigated prior to development approval. The flooding hazard limit considers the cumulative impact of the 100-year flood level, wave uprush and other water related hazards. Specifically, the flooding hazard combines the 100-year flood level (i.e., static water level, storm surge, and wind setup), and a flood allowance for wave uprush and other water related hazards. In the absence of a site-specific wave uprush assessment, a 15 m horizontal setback shall be applied as a conservative estimate of wave uprush. A reduction to this setback shall only be considered if an engineering analysis (completed by the applicant and approved by the NPCA) justifies the reduction.

The objectives for the shoreline hazard policies are to:

a) Prevent loss of life and minimize potential for property damage and social disruption;
b) Reduce the potential for incurring public costs associated with the impacts of shoreline hazards;
c) Manage existing risks and reduce the potential for future risks;
d) Promote the conservation of land and a coordinated approach to the management of the shoreline; and,
e) Reduce the potential for adverse impacts, including pollution, on the ecological function of shorelines

Shoreline protection works are generally defined as a combination of structural works with landform modifications designed, and constructed, to address the impacts of flooding and other water related hazards and to arrest the landward retreat of shorelines subject to erosion.

The shoreline zone is characterized by a complex interaction of short-term and long-term water level variations, waves and currents, morphology, sediments and protection structures. A proponent may have to demonstrate how shoreline treatment considers ecological function and features to address the conservation of land. Shoreline protection works shall consider natural coastal processes and be effective against long-term erosion, preserve cobble/shingle beaches, protect/regenerate aquatic and terrestrial habitat, and not adversely impact neighbouring shoreline. There may be circumstances when ecological considerations may require either specialized shore protection methods or consideration for zones of no shoreline protection to allow for natural processes to occur (ecological function). Many species (including some that are species at risk) depend upon changing dynamic beach processes and therefore, shoreline protection alternatives which allow for these beach processes to continue shall be considered. In Niagara, wherever possible, proposed shoreline protection works shall conform to the recommendations of the Lake Erie and Lake Ontario Shoreline Management Plans, as amended from time to time.

The following outlines the requirements for applicants proposing shoreline protection works:

a) *The purpose or objective of the proposed works must be clearly defined;*
b) *The shoreline works must be designed according to accepted scientific coastal engineering principles, and shall conform to the recommendations of the appropriate Shoreline Management Plans;*
c) *The works may be required to be designed and the installation supervised by a professional engineer with experience and qualifications in coastal engineering;*
d) *Slope stability may be required to be assessed by a professional geotechnical engineer;*
e) *The ownership of land, where the protection works are proposed, must be clearly established by the applicant;*
f) *Where the applicant does not own the land, written permission shall be obtained from the landowner (be it a private citizen, corporation, municipality or the Crown) allowing for the construction of the proposed shore protection; The design and installation of protection works must allow for a 5.0m wide access corridor to and along the protection works for equipment and machinery in order to undertake maintenance and repair of the protection works should failure occur (where shore protection works are shared across properties, a shared access route may be provided);*
g) *The proponent shall demonstrate how the conservation of land has been achieved;*
h) *The works should not aggravate existing hazards and/or create new hazards at updrift or downdrift properties;*
i) *In areas of existing development, protection works should be coordinated with adjacent properties; and,*

j) All works should be located above the 80th percentile of the High Water Mark as defined by Fisheries and Oceans Canada: Lake Erie 174.62m and Lake Ontario 75.32m (IGLD 1985). The NPCA will endeavour to provide copies of all shore work permits to the relevant municipality.

There are various approaches to shoreline management; typically, recommendations are developed for each project reach (shoreline segment) systematically. Based on recent literature (ref. Lake Ontario Shoreline Management Plan DRAFT FINAL Prepared for: Central Lake Ontario Conservation Authority Ganaraska Region Conservation Authority Lower Trent Region Conservation Authority June 10, 2020), four general themes were selected to develop coastal management approaches; including Avoid, Accommodate, Retreat, and Protect. The rationale and approach to the four themes is summarized as follows:

- **Avoid:** reduce exposure by ensuring that new development does not occur on hazardous land. Development setbacks for erosion and flooding embrace the principles of 'avoid' and are based on a 100-year planning horizon, as per provincial policy. Adopting a longer planning horizon would increase the longevity of the "avoid" strategy and the overall resilience of the shoreline. This is a highly effective strategy for new development but does not address legacy development, where vulnerability to coastal hazards can be significant.
- **Accommodate:** an adaptive strategy that allows for continued occupation of coastal properties while changes to human activities or infrastructure are made to reduce coastal hazards and vulnerability. For example, raising the foundation of a flood-prone building will reduce vulnerability and may enable continued occupation of the site.
- **Retreat:** a strategic decision to withdraw or relocate public and private assets exposed to coastal hazards when the costs to accommodate or protect are either not affordable, fail to produce a positive benefit-cost ratio, fail to adequately reduce the risk, or are not permitted due to regulations or legislation. For this strategy to be successful, voluntary property acquisition programs with participation and contributions from senior levels of government may be required.
- **Protect:** a reactive strategy to protect people, property, and infrastructure. This is the traditional approach used in the Great Lakes and often the first considered. Examples include grey infrastructure such as armour stone revetments and seawalls, and nature-based solutions such as building coastal dunes, planting vegetation or nourishing beaches. For this strategy to be successful it must be shown that the site-specific risks can be effectively mitigated for the duration of the planning horizon, as per provincial policy.

Examples of the four broad categories (avoid, accommodate, retreat, and protect) include regulatory mapping, natural buffers for eroding shorelines, flood proofing by raising grades around buildings, re-locating buildings and infrastructure further inland, artificially nourished beaches, and grey shore protection such as armour stone revetments and breakwaters. The PPS (2020) hierarchy directs an avoidance approach for new development. Accommodate and protect strategies are only permitted where safe access can be maintained and generally require one or more regulatory approvals.

5.0 FUTURE STUDIES AND MONITORING

5.1 Future Studies/Priorities

The NWP (E) has included a review of available secondary source information to identify current information gaps and characterize existing conditions based on the information currently available. The study has reviewed Niagara Region at the tertiary watershed scale and, to the extent possible, summarized information by quaternary watersheds. The outcomes of this study provide a good understanding of needs and opportunities to inform and refine the WRS through future studies. The following sections outline the environmental planning study process in support of municipal land use planning, to provide additional context regarding the various study phases and content expected to be included and developed as part of future studies.

5.1.1 Growth & Land Use Planning

The following descriptions of the required studies associated with environmental resource management as a part of growth and land use planning are consistent with the guidance provided as part of the *Niagara Region SWM Guidelines (DRAFT),* which is currently in development with Niagara Region, NPCA and the LAMs, as well as other stakeholders.

5.1.1.1 General Process

Stormwater management planning and design generally occurs through a multi-phase process which is completed in conjunction with the land use planning process. Figure 5-1 illustrates the relationship between environmental planning studies and the local municipal planning process, together with the corresponding approval agencies for new greenfield development, such as that contemplated in the Growth Areas outlined and considered herein. Specific stormwater management considerations at various stages of the land use planning processes are presented in Table 5.1.

Figure 5-1: Watershed and Municipal Planning Sequence
(ref. Adapted from Figure 6-1 in Watershed Planning Discussion Paper, 2019)

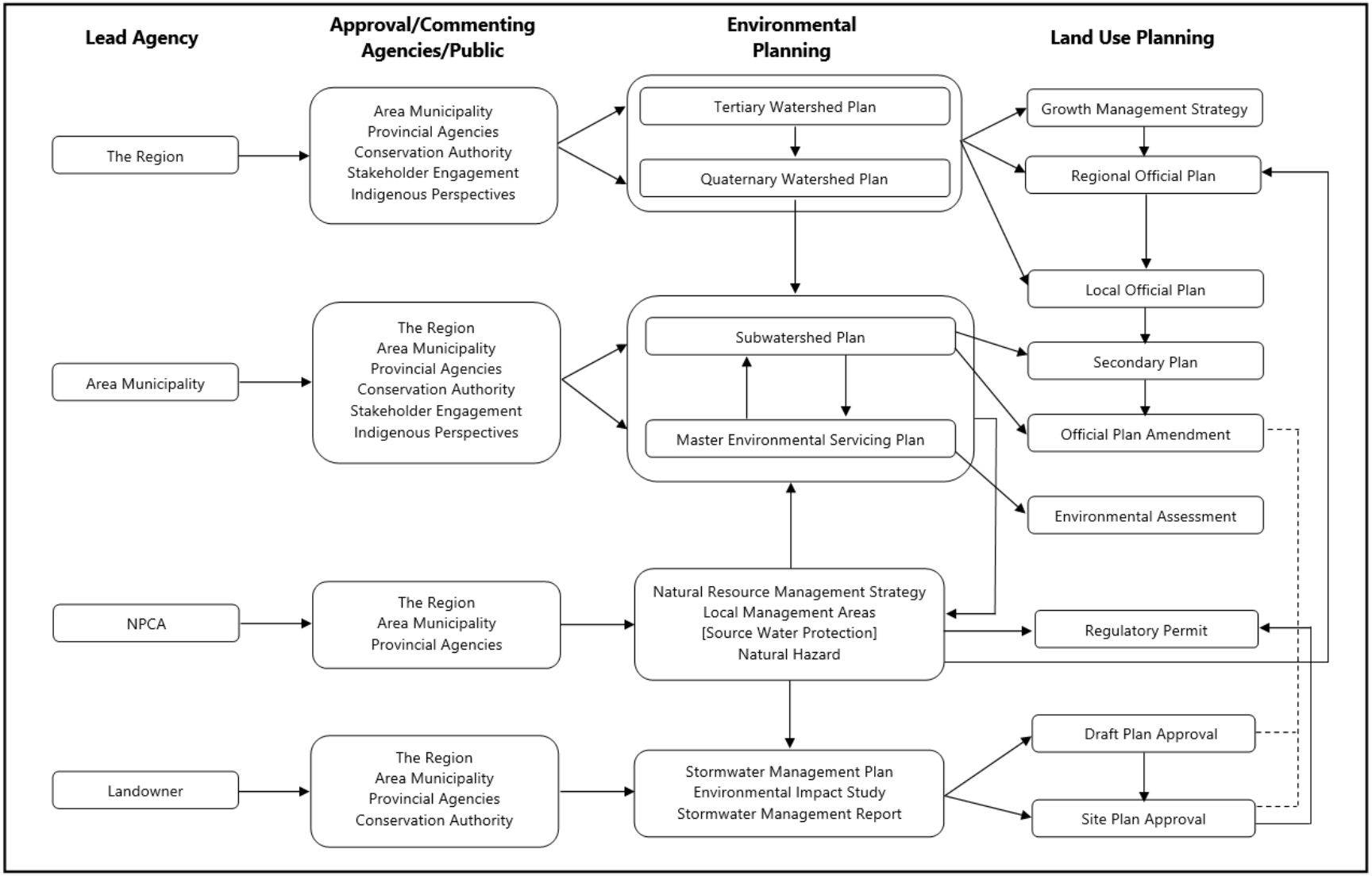


Table 5-1: SWM Considerations at Various Stages of the Land Use Planning Process

Planning Stage	Description
Regional Official Plan (OP)	OP identifies land use type, density, and mitigation requirements to meet watershed objectives, including protection of sensitive features through land use designations. It is at this stage where a natural heritage system (N.H.S.) and Water Resource System (W.R.S.) is established. The new NOP is informed by the Niagara Watershed Plan (NWP) which is being completed at the tertiary-level. Applicable Watershed Plans (Quaternary) represent resource documents for development of Official Plans and completion of future Subwatershed Studies. Confirmation or refinement of the N.H.S. and W.R.S. occurs through the preparation of Subwatershed Studies.
Local Official Plan/Secondary Plan/Official Plan Amendment (OPA)	Full range of opportunities to achieve stormwater management and environmental objectives are identified, establishing a template for the more detailed resolution of the site-specific design of stormwater management facilities at subsequent stages in the planning and design process. The N.H.S. is refined and the limits of specific features are established.
Environmental Assessment/ Environmental Impact Study / Draft Plan Approval	The location of lots, roads, parks and open space blocks, and stormwater management facilities, and detailed natural heritage protection, management and/or mitigation measures (buffers) are defined or confirmed. The approach to achieve stormwater management objectives and how these objectives influence the location and configuration of each of the components listed above must be defined.
Site Plan Approval	Opportunities are presented to integrate stormwater management facilities into all of the components of a development including landscaped areas, parking lots, roof tops and subsurface infrastructure. Solutions must be considered in the context of the overall stormwater management strategy for the block or secondary plan area to ensure that functional requirements are achieved. Recommendations and outcomes from Environmental Assessments, Environmental Impact Studies are implemented with final details resolved.

The preceding considerations focus upon greenfield developments (the conversion of rural, undeveloped land). Infill and intensification development also requires consideration. As noted, the new NOP is planning for 50% of new growth to take place within existing built boundaries (at a Region-wide level). Land use and environmental planning studies are also necessary for these types of development and their requirements are informed by the location, features present and potential impacts (positive or negative) that may occur.

Environmental planning studies such as Watershed/Subwatershed Studies (SWS), Regional Master Servicing Plans (RMSPs), Functional Servicing Reports (FSRs) and Stormwater Management (SWM) Reports are prepared in support of municipal land use studies and plans at various stages of the planning and development process, to help guide land use decisions and ensure that practical and effective plans are prepared which manage impacts to natural resources. Depending on the stage of development, the study and documentation process will effectively need to address the needs of the respective plan requirements. The basic objectives and deliverables for each of these various studies are discussed in the New Niagara Official Plan, and the following sub-sections.

5.1.1.2 Quaternary Watershed / Subwatershed Studies

Environmental planning studies completed on a quaternary watershed scale are expected and recommended to be the major priority for study across the Niagara Region following the current NWP (E). The future quaternary watershed studies are to be completed, in order to support the planning of new development areas for the Region and help to further inform the subwatershed scale studies to support local development. While the preferred study hierarchy is for quaternary watershed plans to be completed first, followed by local subwatershed studies, it is recognized that it will take the Region and its stakeholders a considerable amount of time to complete watershed studies for the respective twelve (12) quaternary watersheds. As such, it is possible for local subwatershed studies to be initiated in advance of the respective quaternary watershed plan, should there be local drivers (i.e. secondary plans, major development proposals, etc.) indicating the need for advanced subwatershed studies.

Quaternary Watershed/Subwatershed studies essentially implement the high-level recommendations from tertiary watershed plans and related policies which would ultimately provide environmental and water resources input into the Local Official Plans, Secondary Plans and Official Plan Amendments process for local communities. Quaternary Watershed studies are proposed to be led by the Region, and Subwatershed studies are most often driven by urban development and thereby led by local area municipalities; both the Quaternary Watershed and Subwatershed studies are to be completed collaboratively with direct involvement from the Region, Local Area Municipalities, NPCA, proponent landowners, and other stakeholders. The following sections outline the components and/or phases of both Quaternary Watershed Studies and Subwatershed Studies.

Quaternary Watershed Studies

As indicated in the previous section, quaternary watershed studies are proposed to be led by the Niagara Region, with direct involvement from the Local Area Municipalities, NPCA, and other stakeholders. Quaternary watershed studies are intended to refine and enhance the high-level recommendations from the tertiary watershed plans (i.e. the current NWP (E)), and the NOP and continue to build upon and refine the data sets and assessments through more localized study scale. Quaternary watershed studies are largely intended to follow the “draft” provincial Watershed Planning Guidance framework, as outlined in Figure 5-2.

Figure 5-2: Quaternary Watershed Study Framework (ref. *Draft Watershed Planning Guidance, 2018*)

Quaternary Watershed Study	**Phase 1** Existing Conditions	Watershed Delineation & Characterization	Delineation, Identification of WRS, Existing Conditions Characterization
		Setting the Vision, Goals, Objectives & Targets	Aligned with Provincial Policies, Plans and reflects Local Conditions
	Phase 2 Impacts, Scenarios and Directions	Watershed Planning Elements & Best Practices	Includes Water Quantity, Water Quality, Natural Hazards, Climate Change, Connections to Natural Systems, Cumulative Impacts, Assessment of Land Use Scenarios & Management
	Phase 3 Watershed Plan Implementation	Implementation	Plan Development, Informing Land Use Planning (Water, Wastewater, Stormwater)
		Monitoring & Adaptive Management	Environmental Monitoring, Performance Monitoring, Update / Adapt Plans and Management

- **Phase 1 "Existing Conditions".** This phase is intended to build upon and refine the data gathering and characterization completed as part of previous watershed plans (i.e. current NWP (E)) and other relevant environmental planning studies; refinement can be accomplished through additional field work, mapping and water based modelling to outline the characteristics of current/existing land uses, as well as the location, extent, sensitivity and significance of all components of the natural systems, including land/water features, linkages and processes. Characterization of existing conditions can help to identify significant factors and influences on the components of the environment, and therefore identify opportunities for protection, enhancement, rehabilitation and development as part of quaternary scale watershed goals, objectives and targets.
- **Phase 2 "Impacts, Scenarios and Directions".** This phase will undertake an evaluation and assessment of the quaternary watershed conditions in accordance with the requirements outlined in the NOP, Growth Plan, Greenbelt Plan, and the Niagara Escarpment Plan. This will involve additional hydrologic/hydraulic modelling (developed through Phase 1) to evaluate and develop a watershed understanding of sensitivities to land use changes across the watershed, and evaluate management opportunities which consider the following elements:
  - Water Quantity, Water Budget & Water Conservation Plans
  - Water Quality & Nutrient Load Assessment
  - Natural Hazards in Watershed Planning & Subwatershed Plans
  - Climate Change & Watershed Management

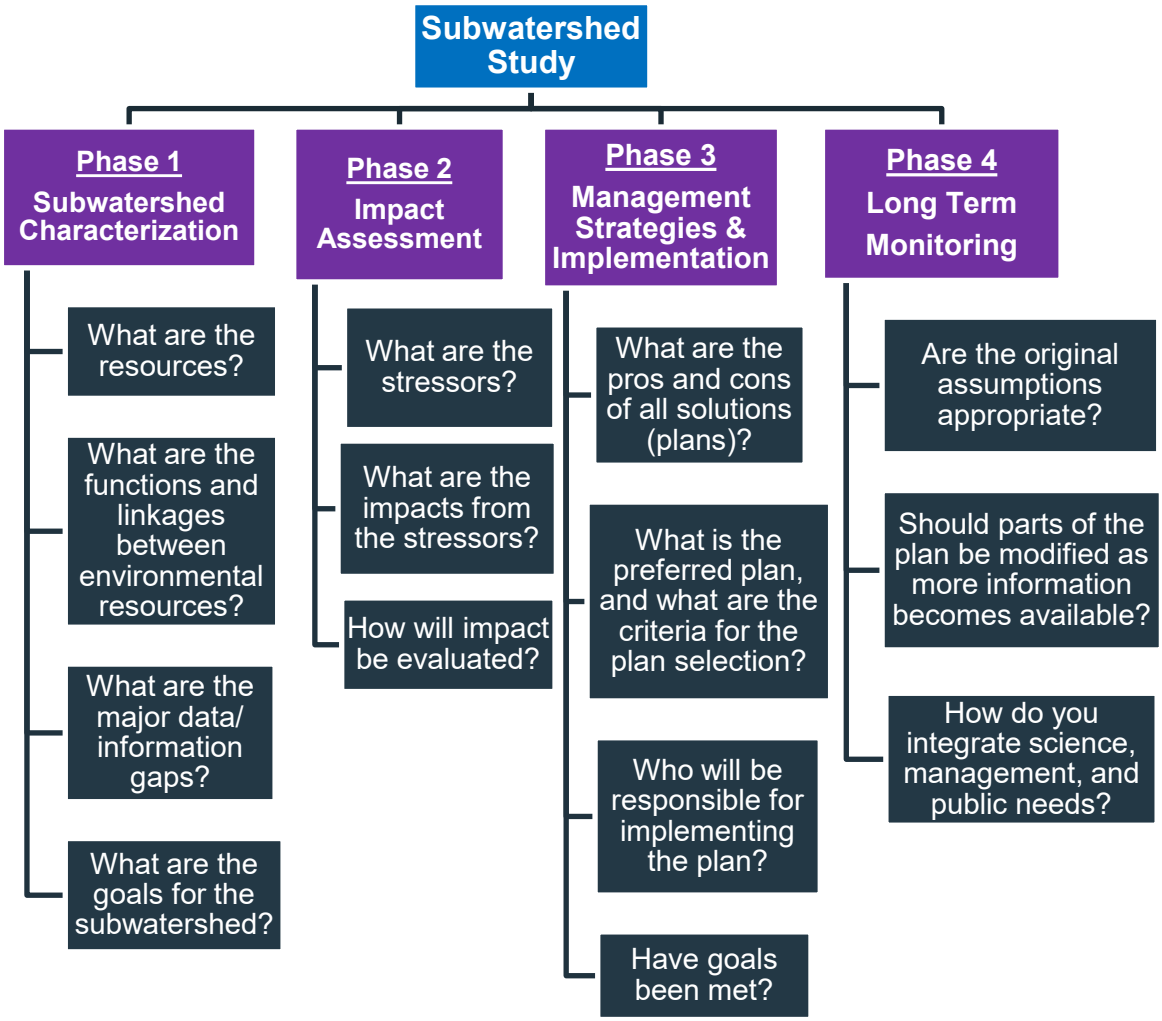
  - Connections to Natural Systems
  - Cumulative Effects Assessment
  - Assessment of NOP Land Use & Management Scenarios

- **Phase 3 "Watershed Plan Implementation".** This phase will develop a management plan based upon the findings from Phase 2, by identifying proposed development areas (types/intensities), best management practices and design requirements for quantity and quality of both surface water and groundwater, servicing requirements (water, wastewater, stormwater), land and water management practices and performance measures (targets) and areas to be protected, enhanced and rehabilitated across the quaternary watershed. Direction for implementation relating to timing, responsibilities, and requirements for future studies (Subwatershed) and monitoring will also be developed. The findings from each of these phases will be used to inform land use planning (future Secondary plans) and subsequent watershed planning studies at the local scale (i.e. subwatershed studies).

Subwatershed Studies

As indicated in the previous sections, subwatershed studies are ideally completed subsequent to quaternary watershed studies and are most often driven by urban development, as companions to local OPA (Secondary Plans); they are thereby led by local area municipalities, with direct involvement from the Region, NPCA, proponent landowners, and other stakeholders. An example of such a process and collaboration is the current Smithville Community Subwatershed Study, which is underway in the Township of West Lincoln. The Subwatershed study process generally consists of the four phases as shown in Figure 5-3.

Figure 5-3: Subwatershed Study Process



- **Phase 1 "Subwatershed Characterization."** This phase involves an integrated assessment of the resources of the subwatershed by various study disciplines including hydrology and hydraulics, hydrogeology, water quality, stream morphology, aquatic and terrestrial ecology. Background and supplemental field data are collected for each discipline and then considered across disciplines in an integrated manner to establish an understanding of the form, function, and linkages of the environmental resources. Notably, at the subwatershed study level, a comprehensive suite of natural heritage surveys is undertaken to confirm the natural features and areas of the N.H.S, including those not mapped in the Official Plan (e.g., Significant Wildlife Habitat). It is important that this is done at this stage so that planning, design, and management can take the system, and its sensitivities into consideration. During this phase, preliminary "working" goals and objectives are developed to guide future development and management in the subwatershed.

- **Phase 2 "Impact Assessment."** In this phase, the future impacts of various potential future land use scenarios are determined and assessed related to multiple subwatershed scale parameters. It is during this phase that the assessment considers a range of appropriate avoidance, minimization and mitigation strategies to meet the preliminary working goals and objectives established during Phase 1.
- **Phase 3 "Management Strategies & Implementation".** This phase finalizes the alternative mitigation strategies and establishes the preferred management strategy by taking direction from Phase 2. By considering the potential impacts and predicted effectiveness of various management strategies and based on a finalized form of land use, a set of management strategies is established to achieve the identified goals and objectives. The implementation plan for the subwatershed study and its associated recommendations provides input on:
  - buffers, linkages and enhancement areas for the N.H.S;
  - priorities;
  - performance targets for overall system function (e.g. high level SWM objectives, Natural Heritage System targets);
  - staging/phasing;
  - monitoring; and
  - future study requirements.
- **Phase 4 "Long Term Monitoring".** This phase of the Subwatershed Study follows substantial implementation of the development and associated management; this phase is traditionally executed by the Local Municipality or local Conservation Authority or a partnership and funded by development. The purpose of the monitoring is to evaluate the effectiveness of the Proposed Management Strategy over time (both locally and holistically) and adjust or adapt the plan as possible and as required.

As part of the above study phases, the impacts and effects of climate change are to be considered as part of subsequent watershed planning initiatives; the provincial Watershed Planning Guidance (Draft, 2018) outlines the following steps for consideration:

- *Step 1: Consider the Potential Effects of Climate Change on Existing and Proposed Land Uses, Infrastructure and Developments*
- *Step 2: Consider the Effects of Existing and Proposed Land Uses and Water/Wastewater/Stormwater Management Infrastructure on Exacerbating Climate Change Impacts*
- *Step 3: Determine Impacts of Alternative Land Use and Management Scenarios Under Various Climate Models*
- *Step 4: Document Climate Effects on Water Use and Management within the Watershed or Subwatershed Plan*

5.1.1.3 Master Environmental Servicing Plans

Master Environmental Servicing Plans (MESPs) are typically led by local area municipalities, with involvement from the Region, NPCA, proponent landowners, and other stakeholders in order to support new development as part of secondary plan areas. MESPs are typically completed in two (2) phases:

- **Phase 1 "Characterization of the Natural System".** This phase is to include a review of existing environmental studies and projects relative to the study area (i.e., quaternary watershed plans, subwatershed studies, monitoring programs, fish management plans, natural heritage inventories, flooding and erosion studies, etc.), and completion of a baseline monitoring program for a minimum of 1 to 3 years of continuous monitoring. The baseline monitoring program is to provide baseline data necessary to further characterize the elements of the natural system, including:
  - Surface Water (Hydrology & Hydraulics)
  - Erosion (Fluvial Geomorphology & Geotechnical)
  - Groundwater (Hydrogeological Investigations)
  - Natural Heritage (Natural Feature Identification & Enhancement Areas / Buffering)
  - Water Balance (Groundwater Recharge / Discharge, Surface and Groundwater Contributions, Feature-Based Assessments);

  Durations and locations of monitoring are to be selected in consultation with the local municipality and NPCA. The monitoring results will then be used to outline how these elements of the natural system are interconnected, and support detailed analysis and modelling (i.e. hydrologic/hydraulic) to identify overall SWM criteria, extent of natural hazards (flooding/erosion), extent of natural features and enhancement areas, develop targets and management requirements for subsequent study phases, and identify the needs for additional monitoring or studies required through subsequent planning stages.
- **Phase 2 "Impact of the Proposed Development and Management Strategies"**. This phase is to build upon the findings from Phase 1 and identify the connections between each of the natural system elements, through multi-disciplinary analysis of the interactions between all features and functions of the natural system. This phase is to further analyze the impacts of the proposed development plan, establish management strategies according to the criteria or targets established as part of Phase 1, as well as develop preliminary servicing designs for water, wastewater and stormwater infrastructure. The impact assessment and management plan are to include the following elements:
  - Natural System Protection and Enhancement
  - Preliminary Servicing Designs Including:
    - Stormwater Management Strategy (LIDs, SWM Facilities)
    - Storm Sewer System
    - Water Distribution System
    - Wastewater / Sanitary Servicing
    - Preliminary Grading Plans

- ♦ Transportation Assessments
- ♦ Valley and Stream Corridor Crossings and Trails
- ♦ Non-Municipal Utilities
- ♦ Preliminary Servicing Cost Estimates

- Implementation and Development Phasing Strategy
- Environmental Monitoring Plan
- Future Study Requirements

5.1.1.4 Functional Servicing Report

Functional Servicing Reports (FSRs) provide details specific to the functional serviceability for a proposed development related to the water, wastewater, and stormwater network ensuring that it can function to Municipal, Regional, and Provincial criteria. The FSR describes the location and nature of existing municipal water, wastewater, and stormwater infrastructure that may be available to provide servicing for the proposed development. It should outline in detail the proposed servicing requirements for the development and indicate the capacity of the existing infrastructure to support the development. It should also identify the necessity to dedicate lands to proposed stormwater infrastructure, and the extents/area of land required for this purpose, as appropriate.

FSRs are prepared in support of development/re-zoning and intensification projects to identify how servicing will be provided while meeting approved environmental targets from preceding studies (i.e. MESP). For large developments with significant environmental considerations, a three-step process may be appropriate, requiring an MSP followed by underlying FSRs and Functional Stormwater Management Reports for individual subdivisions and servicing facilities, respectively. In some instances where the extent of land use change is limited, it may be appropriate to complete only an FSR and single Stormwater Management Report. If the proposed development does not include a stormwater management facility, then a separate Stormwater Management Report may not be required, although the FSR will be required to document the stormwater management strategy for the site (e.g. stormwater management within an off-site facility). However, if a stormwater management facility is proposed for the development, then a Preliminary Stormwater Management Report shall be submitted.

5.1.1.5 Stormwater Management Reports

Detailed SWM reports need to be prepared to support detailed site design. As such, they are required in order to meet the conditions set at, the Draft Plan of the subdivision stage, Draft Plan of condominium stage, or as part of a Site Plan approval process. The preparation, review and approval of the SWM Report should be the final step in the approval of the proposed SWM plan. The SWM Report must provide the required design and detailed supporting calculations for all component elements of the proposed stormwater management system. The SWM Report should contain the detailed design of stormwater controls, delineation/confirmation of constraint boundaries, and hydraulic and hydrologic analyses. The report should include and/or reference supporting geotechnical/ hydrogeological studies, environmental restoration reports, preservation and restoration/ remediation plans, sediment/erosion control plans, monitoring plans, and long-term operations and maintenance. The components of the SWM Report may

vary depending upon whether a MESP and/or Subwatershed Study have been completed.

5.1.1.6 Environmental Impact Studies

An Environmental Impact Study (E.I.S.) can be prepared in support of a range of Planning Act applications where a proposed development wholly or partially contains features of the N.H.S. or other regulated feature or occurs on lands adjacent to such feature(s) or area(s). An EIS generally includes a characterization of existing biophysical conditions, constraints and sensitivities assessment in accordance with applicable policies, guidance documents and best practices, an assessment of impacts based on a proposed design and recommends measures to avoid, minimize, mitigate or otherwise address impacts through appropriate measures, An EIS will also provide recommendations for monitoring, where appropriate to measure efficacy of the suite of measures used to address impacts. Some final details may be addressed through detailed design.

The purpose for, and requirements of, an EIS may be determined through the completion of a subwatershed study. Generally, an EIS should continue to be required where: the time period since preparation of the subwatershed study is such that updated characterization of features is required (generally >5 years), policy pertaining to the natural heritage have changed substantively, a property was not surveyed comprehensively through the subwatershed study (e.g., permission to access the site was not granted) or where gaps or need for further study are identified through the subwatershed study to be addressed through site-specific planning.

5.1.2 Other Studies

In addition to the future environmental studies as part of the land use planning process, there are several potential and on-going studies or initiatives which may be used to refine the WRS and provide updated data for use and to inform future watershed planning initiatives. These studies and/or initiatives have been outlined and/or mentioned as part of previous report sections, and have been reiterated below given their importance in the overall watershed planning process:

- **Niagara Peninsula Conservation Authority (NPCA)** has identified numerous planned and potential initiatives which would support refinement to mapping, identification and delineation of features and areas of the WRS. These include:
  - ***NPCA Watershed Natural Areas ELC Mapping Update[3] (approved for 2021)***. This is planned to include softcopy interpretation updates to existing NAI and ELC mapping using 2020 imagery at 1:2000 scale. To the extent possible, this will integrate available attributes associated with NAI site coding, available age and species information.
  - ***NPCA Watershed Digital Terrain Model (DTM) Update (approved for 2021)***. This is planned to include updated planimetric feature coded breaklines and topographic mapping derivatives. The DTM is to be completed at a 1m contour

[3] Note: Niagara Region completed an updated ELC layer for the Region in its entirety in 2020. It is anticipated that this updated Regional dataset will continue to be used as the primary ELC data within its jurisdiction.

interval and 1:2000 scale. Completion of this work will support additional technical studies listed below.

- ***Enhanced NPCA Watershed Restoration Program Design (approved for 2021)***. This initiative will conduct a market-based gap and needs analysis and consultation with local municipalities to identify opportunities to enhance and better leverage opportunities for watershed restoration. This program review and is planned to result in an enhanced restoration program that capitalizes on NPCAs knowledge of the watershed and provide value to a range of potential clients and partners by providing coordinated services that support broad watershed-level targets and opportunities, including mitigation for existing and future pressures, such as climate change.
- ***NPCA Watershed Surface Water Inventory Update (planned for 2022, pending approval)***. Using the DTM prepared in the preceding study, this work is intended to create an updated inventory of surface water features including feature type, identify candidate headwater drainage features, regulated watercourse refinements and integrate Ontario Hydro Network information. Consistent with preceding studies, this will be completed at a 1:2000 scale and be completed through interpretation of 2020 imagery. Headwater drainage features will not be classified into management regimes through this work; however, NPCA has regulatory needs to proactively identify management classification to support their core mandate
- ***NPCA Water Resources Spatial Framework (planned for 2023)***. This continues to build on preceding work and will include updates and further integration. Anticipated elements include delineation of the drainage hierarchy (catchment, subwatershed, watershed), local stream code development, labelling / integration of common names / local names for features and watercourses, hydrologic digital elevation model and analysis surfaces. This work is primarily to establish the information architecture for NPCAs hydrologic and hydraulic modelling needs. However, through this work, additional opportunities to support land use planning and impact assessment are anticipated, including the ability to derive anticipated catchment areas of wetlands.
- ***Updated Shoreline Management plans to be developed in (proposed for 2022 / 2023)***. This initiative will prepare updated plans for management of shoreline areas regulated by NPCA considering flooding, wave uprush, erosion and natural heritage (e.g., dune systems, including backshore dunes). This work will provide additional information for the mapping of features and functions for the NES (captured within the NHS and/or the WRS). NPCA has completed a preliminary gap analysis on existing management plans to inform scoping of this work program and updates to the management plans.
- ***Floodplain Mapping Updates (on-going).*** The NPCA operates a floodplain mapping program through which floodplain limits are delineated for regulated features as part of the Riverine Flood Hazard under the Generic Regulation of the Conservation Authorities Act (Ontario Regulation 97/04). These studies are completed for unmapped systems, as well as updates to existing mapping when warranted; situations where existing mapping may need to be reviewed, include updated information becoming available or significant hydrologic changes

warranting a review. Through consultation with the NPCA, the following drainage systems are proposed to have floodplain mapping studies completed in the near future:

- Beaver Creek (in the Township of West Lincoln) – a major tributary of the Welland River.
- Big Forks Creek (in the Township of Wainfleet) – a major tributary of the Welland River.
- NPCA is currently working on developing new flood line mapping for many of the regulated watercourses in the Town of Grimsby.

- **Karst Topography Mapping**: The mapping of karst topography across southern Ontario was completed by the OGS in 2008, with updates to the mapping proposed to be completed in the coming years (ref. Project SO-19-006 Karst Map of Southern Ontario: An Update, OGS, 2019). As updated mapping becomes available, any changes to the known, inferred or potential karst topography should be reviewed and incorporated into the appropriate hazard class and management strategy.
  - Through subsequent quaternary and subwatershed planning initiatives, karst features and functions can be confirmed through supplementary analysis at a local scale, including detailed review of historical aerial photography, field reconnaissance, site surveys, surface and subsurface water feature identification, etc. to identify the prescence and function of the hydrogeological karst features within the study area.
- **Climate Change Modelling and Projections Data.** As part of the CCWP update in early 2021, a climate change modeling and projections project has been initiated by the Niagara Region in conjunction with the TRCA and the OCC. The work is to include climate modeling, projections and trend summaries for both historical and future climate conditions. The results of this analysis will provide the Region with historical and future data on how the climate is changing specific to the Niagara Region; this can help support the development and implementation of climate change adaptation initiatives, vulnerability assessments and will be instrumental in informing future quaternary watershed and subwatershed plans. Upon Council endorsement, this data will be made accessible to NPCA and local area municipalities for expanded use and inclusion in additional study.

5.1.3 Watershed Planning Goals & Objectives – Next Steps & Future Actions

As outlined in Section 2.0, several Goals and Objectives have been identified as part of the NWP (E) to support land-use planning processes and natural resource management, with respect to the WRS, NHS, Planning and Resiliency, as well as Engagement. The NWP (E) has developed the framework for land use planning in relation to watershed management within the Niagara Region and identifies a number of opportunities as part of future actions and initiatives, including the future studies identified in the previous section. To support the continuous refinement of data and processes to support integrated land use planning and watershed management, the Goals and Objectives identified in Section 2.2.1 have been inventoried in Table 5-2 to identify the current status with respect to the NWP (E) and have outlined the opportunities for refinement as part of the future stages of land use planning processes.

Table 5-2: NWP (E) Goals & Objectives – Current Inventory and Next Steps & Future Actions

NWP (E) Goals	NWP (E) Objectives	Current Status with NWP (E)	Next Steps & Future Actions
Goal 1: Establish and Maintain Contemporary and Accurate Understanding and Mapping of the Watershed	a. Identify the WRS b. Support the development of WRS Mapping	• Preliminary mapping at a tertiary scale has been prepared.	• Need to update as part of Quaternary Watershed Plans (QWP) and Subwatershed Plans
Goal 2: Protect Water Quality & Water Quantity	a. Develop a Water Budget for respective systems, building from a tertiary level of data b. Identify best practices for water conservation and maintaining water quality in order to plan for efficient and sustainable use of water resources	• High-level water budget established as part of Source Water Protection Plans. • Initial best practices identified building from regional and provincial guidance.	• Need to update as part of Quaternary Watershed Plans and Subwatershed Plans
Goal 3: Adaptively Manage and Monitor the Watershed	a. Monitoring and Adaptive Management b. Future Studies / Priorities	• Inventory of current monitoring conducted based on type and location and related protocols; gaps identified specific to planned growth, and associated need for data.	• Plan to fill gaps based on growth priorities
Goal 4: Protect and Enhance Interactions Between the NHS and WRS	a. Identify the NHS b. Identify, preserve and enhance interactions between the WRS and the NHS	• Preliminary mapping at a tertiary scale has been prepared; guidance principles and policy-based input provided for consideration at next levels of planning.	• Need to update as part of Quaternary Watershed Plans and Subwatershed Plans; consider as part of local secondary plans
Goal 5: Ensure Land Use Planning is Informed by Watershed Planning	a. Review Growth Scenarios to Inform Land Use Planning b. Provide Best Practices / Recommendations c. Provide Best Practices for protecting, enhancing and	• Potential growth areas assessed comparatively against natural heritage and water resource system metrics. • Industry-based best practices and related recommendations for	• Further strategic assessments required at QWP scale. • Further details and assessment of locally specific best practices to be developed through

NWP (E) Goals	NWP (E) Objectives	Current Status with NWP (E)	Next Steps & Future Actions
	restoring the WRS related to, among others	impact management have been tabled.	Subwatershed Studies (SWS) supporting secondary plans
Goal 6: Create Resilient Communities to Protect Human Health and Safety, and the Natural Environment	a. Manage Natural Hazards b. Identify climate considerations and potential impacts to the WRS and NHS to improve resilience and inform land use and environmental planning c. Develop Cumulative Impact Considerations	• Currently identified natural hazards have been mapped. • Regional and provincial guidance with respect to climate change considerations have been tabled at a high-level. • Cumulative impact considerations have been documented in terms of development (existing and planned) and agriculture at quaternary scale.	• NPCA to continue to update and refine natural hazards. • Additional locally-based studies including QWP and SWS, to provide further insights to management of climate change impacts to WRS and NHS. • Cumulative Impact Assessments (CIA) to be conducted using numerical modelling at the QWP stage.
Goal 7: Engage communities to understand and reflect community-identified priorities and local conditions in the Niagara Watershed Plan (E)	a. NWP (E) Objectives (Stakeholder / Community Feedback) b. Future Actions & Recommendations (Partnerships, Outreach, etc.)	• Public and Stakeholders to Official Plan (OP) process have provided input on goals and objectives for Watershed Planning. • Input on Watershed Plan actions and recommendations pending/expected over the course of OP finalization.	• Locally based goals and objectives to be established through QWP and SWS. • Higher-level actions and recommendations to be vetted through future locally-based studies (QWP and SWS).

5.2 Monitoring and Adaptive Management

5.2.1 Niagara Region Monitoring

As outlined in Volume 1: Characterization, a review of information from NPCA has been completed to inventory the existing hydrometeorological datasets available for Niagara Region, which include climate stations, streamflow monitoring, water quality monitoring and groundwater monitoring across the various watersheds under NPCA jurisdiction. This summary of monitoring locations has allowed for the identification of potential information gaps or data deficiencies which may need to be addressed as part of future studies, particularly the quaternary-level watershed plans to be conducted by Niagara Region. Further discussion regarding the monitoring program details can be found in Volume 1: Characterization.

The following summary compiles all available information regarding the four (4) monitoring networks into a single high-level summary, in order to identify any key gaps with respect to the monitoring coverage across the Niagara Region. Further details regarding the monitoring station specifics (data type, status, time steps, period of record) can be found in the respective tertiary watershed characterization (ref. NWP (E) – Volume 1: Characterization); it should be noted that the NPCA is currently migrating its monitoring databases into a KISTERS system, which should improve network review and data availability for use by NPCA partners (i.e., Region, local municipalities, etc.) as part of future studies. The current monitoring inventory has been completed at the quaternary watershed scale.

Table 5-3: Niagara Region Existing Monitoring Network Inventory

Tertiary Watershed	Quaternary Watershed (QWS)	Drainage Area (km^2)	Subwatersheds (#)	Existing Monitoring Station Established (Count #) Climate	Existing Monitoring Station Established (Count #) Streamflow	Existing Monitoring Station Established (Count #) Water Quality	Existing Monitoring Station Established (Count #) Groundwater[1]
Lake Ontario	Fifteen and Sixteen Mile Creeks	136.5	10	0	0	3	2
Lake Ontario	Four Mile Creek and NOTL	126.4	15	1	1	6	1
Lake Ontario	Jordan Harbour - Twenty Mile Creek	303.5	6	3	4	10	1
Lake Ontario	Twelve Mile Creek	148.4	9	2	4	13	5
Lake Ontario	Welland Canal North	92.4	5	1	0	2	3
Lake Ontario	Welland Canal South	77.4	4	1	0	1	2
Lake Ontario	West Lake Ontario Shoreline	300.1	38	1	0	4	2
Niagara River	Niagara River North	62.2	8	0	0	1	1
Niagara River	Niagara River South	185.4	22	1	1	7	4
Niagara River	Welland River East	136.6	7	2	1	7	3
Niagara River	Welland River West	868.5	38	8	8	13	15
Lake Erie	Northeast Lake Erie Shoreline	137.0	38	2	0	8	0

Note: [1] The groundwater monitoring network is comprised of both the PGMN and OGS program networks (further discussion in NWP (E) – Volume 1: Characterization). The OGS program has several wells/stations in the same geographic location (i.e. recording at varying depths); as such, the count applied in this summary is based upon the different monitoring station IDs, and does not account for additional depth recordings.

As part of Volume 3: Growth Analysis, this monitoring summary has also been summarized with respect to the potential future growth across the Region, in order to demonstrate the monitoring data available in connection to the water systems with the largest amount and/or proportion of future/proposed growth (i.e. stressed watersheds). This summary outlined in Volume 3: Growth Analysis, provides a basis for prioritizing action and can identify gaps related to the data needs for long-term monitoring, in order to characterize the impacts of future development and provide an opportunity for adaptive management; further discussion regarding opportunities for adaptive management are provided in subsequent sections.

It needs to be clearly understood that as growth proceeds, depending on the level of study supporting that growth (quaternary and/or subwatershed), watershed / subwatershed response indicators (and associated monitoring data support) need to be tailored to the resource sensitivities in those systems at the appropriate scale. A hierarchal approach to setting and assessing targets is needed, with the higher-level study (quaternary) considering more system-based indicators, while the more local study (subwatershed) focusing more on feature-based considerations. These targets and indicators also need to be developed in close consultation with area stakeholders to ensure that they align with regional and local requirements and expectations.

5.2.2 Monitoring Framework

Monitoring and Adaptive Management Plans are generally developed as part of, or following, Local Subwatershed Studies and associated Environmental Impact Studies, and as conditions of approval for stormwater management plans and watercourse reconstruction/realignment. The information collected as part of these monitoring plans is intended to verify the performance of the environmental and stormwater management system, against a set of targets and objectives set at earlier planning stages, as well as to use this information as guidance for adapting environmental management systems and thereby improving local environmental conditions.

These various monitoring programs require corroboration of various levels of government, agencies, and stakeholders to ensure successful and efficient data collection and analysis. The purpose and objectives of monitoring programs vary at different stages and scales, in order to meet the overall watershed and environmental goals. In this setting, Table 5-3 outlines the relevant stages and scales of monitoring.

Table 5-4: Land Use Planning - Monitoring Stage, Scale and Purpose

Monitoring Stage	Scale and Purpose
Pre-development	This represents the broader subwatershed scale whereby the respective discipline systems are monitored for the purpose of better understanding functionality and significance, thereby leading to overall feature and system characterization of the subwatershed.
During-development	As development is proceeding with construction, grading and servicing operations for the installation of Municipal infrastructure and building construction, it is necessary to monitor the effectiveness of the various measures and practices designed and implemented to manage and control impacts due

Monitoring Stage	Scale and Purpose
	to construction, as well as to protect natural features and functions. This form of monitoring will most often translate into ensuring that all prescribed Sediment and Erosion Control measures are in-place and suitably functioning, protections are in place and functioning for feature edges, trees, etc.. Other aspects of this monitoring can relate to instream measurements of turbidity, temperature, and other parameters of concern. The scope and details of this monitoring is typically defined as part of detailed plans of subdivision as a condition of approval, hence the scale tends to be very localized.
Post-development	After the installation of servicing, the completion of grading and following the construction of the majority of the buildings in a community development plan, post-development monitoring is initiated. Typically, there are two (2) basic types of post-development monitoring at two (2) different scales: • Compliance → Local Scale • Performance → Holistic Scale Compliance monitoring has been the most common form of assessment which is often driven by the need to comply with a regulation or criteria associated with a system function (e.g. stormwater management to remove 80% of TSS, establishment of buffer plantings). Compliance monitoring is also typically prescribed as part of a permitting or approval process (i.e. DFO Authorization, MECP ECA, etc.) such as an alteration to natural features (i.e. realigned creek reach) or construction of infrastructure (i.e. new stormwater management facility). As such, and given its relationship to the local scale, this monitoring is largely proponent driven, and thereby taken on by the developer in most cases. Performance monitoring on the other hand, relates more to the integrated functionality of the overall environmental system. For instance, “do all of the stormwater management facilities within an overall development area combine to effectively reduce flood risk or erosion potential or meet subwatershed scale in-stream water quality targets?” or “are the mitigation measures being implemented achieving objectives in maintaining wetland water balances?”. These monitoring programs by their very nature tend to be of broader scale with a more holistic overview of the system, mirroring in part some of the initial investigations done pre-development at the subwatershed scale. Due to their need to address change in time, these programs also tend to be of longer duration. It is also common that more locally specific compliance monitoring programs feed into and inform the broader scale performance monitoring program.

Monitoring Stage	Scale and Purpose
Regional System	Upon completion of a post-development performance monitoring program (which usually involves a period of 5+ years resulting in a set of adaptive management recommendations), certain aspects of the program depending on their significance and value in the regional context, are transitioned to broader watershed or regional scale monitoring programs. These programs are usually executed and managed by Conservation Authorities given the mandate of those organizations, and used as part of an overall system to provide data on overall watershed health.

It should be noted that the details and specifics of the various monitoring programs are expected to be refined through subsequent quaternary watershed and subwatershed studies. However, the following sections outline general recommendations regarding the framework for various components of the monitoring and adaptive management plan proposed for the Niagara Region.

5.2.2.1 Water

Quantity

Rainfall

It is recommended that additional rainfall data be collected as part of future studies. This information would be used in conjunction with streamflow data, to characterize the meteorological conditions within the study area during the monitoring program, characterize the surface water hydrology and runoff response, and further validate the hydrologic models developed as part of future watershed planning initiatives. The data collected as part of this monitoring program should build upon the dataset currently operated by the NPCA, which has been compiled and summarized as part of the current NWP (E); expansions to the existing meteorological program should focus on quaternary watersheds and subwatersheds identified for future growth and lacking sufficient coverage.

Streamflow

As part of future studies, it is recommended that streamflow monitoring be conducted. The data would be used in combination with the rainfall data (discussed previously) to characterize the runoff response to receiving watercourses, as well as to verify the performance of the hydrologic models developed as part of future watershed planning initiatives. Hence it is recommended that the streamflow monitoring apply depth probes to obtain continuous depth data, and field reconnaissance be conducted to establish rating curves at each location to translate the continuous depth data to continuous flow data. The data collected as part of this monitoring program should build upon the dataset currently operated by the NPCA, which has been compiled and summarized as part of the current NWP (E); expansions to the existing streamflow monitoring program should focus on quaternary watersheds and subwatersheds identified for future growth and lacking sufficient coverage.

Groundwater

As part of future studies, an appropriate spatial discretization is needed to represent potential changes to groundwater levels and groundwater reliant ecological linkages and potential hydro-stratigraphic variation (i.e. surficial soils and deeper overburden/bedrock). The extent and type of long-term groundwater monitoring will depend on the monitoring programs carried out for further baseline assessment of the groundwater characterization and the groundwater / surface water connections as part of subsequent studies.

It is expected that there will be different spatial and temporal scales within these programs related to the location and type of development, the sensitivity of the groundwater function and the potential groundwater impacts. Site specific monitoring related to the long-term management of groundwater, as it relates to potential dewatering for subsurface infrastructure would also require a long-term groundwater monitoring program. The following provides a general groundwater monitoring program:

- A spatially representative network of water table monitors and multi-level monitoring wells to assess any potential change to the water table, vertical gradients and larger scale groundwater flow directions,
- A number of multi-level drive point piezometers to assess vertical gradient trends in wetland features and watercourses,
- Seasonal groundwater level measurements for monitoring locations intended to represent general conditions, with a number of other sites instrumented with data loggers to monitor shorter term trends,
- Groundwater level and vertical gradient monitoring at selected natural features where the need for post-construction mitigation is identified, such as the wetlands. Continuous data collection would also be important in these monitoring locations,
- Spot baseflow measurements,
- Assessing quantity and quality of flow from long term dewatering and
- Annual water quality sampling of selected monitoring wells and spot baseflow sites.

During development, groundwater monitoring associated with dewatering activities adjacent to, or within, watercourses or wetlands will develop monitoring programs assessing changes to groundwater levels, groundwater discharge, hydraulic gradients, baseflow and discharge quantity and quality. Monitoring related to dewatering is required to follow the MECP process with regards to obtaining a Permit To Take Water and the applicability to register in the Environmental Activity and Sector Registry as it relates to groundwater related monitoring.

It is expected that the groundwater monitoring program will be refined at later watershed planning stages (i.e. quaternary and subwatershed planning) where additional site-specific data will confirm or refine the existing hydrogeologic characterization.

Quality

Water quality monitoring is recommended to be incorporated into monitoring programs for future watershed planning studies, to characterize the surface water chemistry within the receiving watercourses, and to provide a baseline assessment for comparison against results from future holistic monitoring programs.

Water Chemistry

It is recommended that grab sampling be completed as part of future studies to characterize the surface water chemistry within the receiving watercourses. Instream monitoring is required to establish pre-development (i.e. baseline) conditions, and should typically be completed for two (2) years prior to development. The locations for instream monitoring should be coordinated with sites monitoring streamflow and fishery habitats and should be determined in consultation with the Conservation Authority (NPCA) and municipal staff.

The sampling should be conducted during wet weather (rainfall events over 15 mm depth are preferable) and dry weather conditions, and should include spring, summer, fall and winter sampling to verify any seasonal trends in contaminant loading and the surface water chemistry. The samples should be analyzed for a suite of water quality indices including:

- Oil and Grease
- Total Phosphorus
- Anions (Nitrate, Nitrite, Phosphate, Chloride)
- Ammonia
- Total Kjeldahl Nitrogen (TKN)
- Conductivity
- Total Solids (TS)
- Total Suspended Solids (TSS)
- Turbidity
- BOD5
- Dissolved Oxygen
- pH/alkalinity
- Salinity
- Total Coliforms
- Faecal Coliforms
- PAH
- Metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, Sn, Ti, W, U, V, Zn, Zr).

At later planning stages, water chemistry monitoring of post-developed conditions should also be completed for a minimum of three (3) years post-development. This monitoring should include monitoring of the inlet and outlet of each stormwater management facility after construction, as well as online the receiving watercourse at the same location identified for pre-development monitoring.

It is expected that the water quality monitoring program will be refined at later watershed planning stages (i.e. quaternary and subwatershed planning) where additional site-specific data will confirm or refine the existing surface water quality characterization.

Temperature

Water quality monitoring for the future studies is recommended to include continuous temperature monitoring. The locations of temperature monitoring should coincide with the locations for fish sampling, to characterize the in-stream water temperature coinciding with fish habitat. Should SWM facilities be proposed as part of the future management strategies, temperature monitoring should be completed post-construction, both upstream and downstream of the facility outlets throughout the summer season (June 1 to September 30), to monitor the effectiveness of measures to cool the effluent and mitigate the impacts of stream temperature.

5.2.2.2 Stream Systems

Stream Morphology

An overall, systems-based geomorphic monitoring program should be established for receiving, sensitive and/or representative sites downstream and within the anticipated development area. The collection of field data should establish a baseline condition from which continued monitoring during and post-development can determine channel response in terms of process and function, as upstream land use changes. Adaptive management strategies may be implemented when observations exceed targets, as determined during the baseline monitoring phase.

Despite typical water measures to maintain the hydrological regime and reduce impacts of runoff from impervious surfaces, there is the potential that a local land use change will result in some alteration in the hydrologic regime (i.e., increased flow volumes and/or altered seasonal timing) and sediment regime (i.e. initially more fine sediment being supplied to the channel followed by an overall decrease in loadings). These alterations can result in changes in the channel planform, bank erosion, cross sectional area and substrate composition, which, in turn, may locally affect aquatic habitat, riparian habitat and water quality.

Baseline monitoring should be established through future quaternary watershed and subwatershed studies; as land use plans and designs evolve, additional monitoring locations should be established, and baseline surveys completed for reaches downstream of headwater drainage features slated for removal and stormwater outfalls. Monitoring should subsequently take place annually to fulfill performance evaluation requirements through to the post-construction/development period. Specifically, the following steps should be taken to monitor development impacts:

- **Control Cross-sections**: Are to be monitored annually during periods of low flow. An additional site visit should be conducted at each site following a peak storm in excess of the 5 year storm event for the system. Cross section morphology from each visit should be overlaid and compared. Changes in cross-sectional area the context of acceptable ranges of adjustment will trigger a review of the need for mitigation in the form of restoration (based on professional review).
- **Substrate Composition**: A modified Wolman pebble count should be conducted at each control cross-section on an annual basis, the results of which will be tabulated in a particle size distribution chart. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. Grain size adjustments in excess of an order of magnitude will act as a trigger for investigation. Due to the dynamic nature of substrate composition, no action should be taken until Year 5 unless the adjustment is identified as a potential risk to the function of the channel by a qualified geomorphologist.
- **Lateral Migration**: A series of erosion pins (minimum of 5) installed in areas of active bank migration, as well as areas of anticipated migration should be measured on an annual basis during low flow conditions to determine rates of bank adjustment. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. Annual migration rates in

excess of 20 cm/year will trigger an assessment by a geomorphologist to determine whether the adjustment is localized or representative of broader site conditions. Mitigation measures would be recommended based on the extent and source of the issue.

- **Photographic Record**: Photographs from a known vantage point should be used to document general geomorphic site conditions on an annual basis. An additional site visit will be conducted at each site following a peak storm in excess of the 2 to 5 year storm event for the system. These photographs will be used as supplemental information to inform decisions regarding the need for mitigation.

Analysis of ongoing monitoring may be used for adaptive management of the study area; however, mitigation should only be applied following an investigation into the causes. The exception being major adjustments requiring immediate works where risk to property, human safety, or infrastructure is imminent. Mitigation measures would be recommended based on the extent and source of the issue. Table 5-4 summarizes monitoring parameters and example indicator thresholds for investigation.

Indicator targets should be developed appropriately based on existing/baseline conditions for each site. These targets and methods should be supported by a professional, qualified to practice fluvial geomorphology.

Table 5-5: Summary of Typical Fluvial Geomorphology Monitoring Targets

Monitoring Parameter	Indicator Monitoring Threshold*
Bankfull cross-sectional area (m^2)	Maintain bankfull cross-sectional area within acceptable tolerances based on continued measurements of the baseline condition.
Mean bankfull channel depth	Maintain bankfull depth within acceptable tolerances based on continued measurements of the baseline condition.
Bank migration rates (cm/yr.)	Normal migration rates within acceptable tolerances of bankfull width per year where migration is expected (i.e., cutbanks). As rates may vary due to extreme flood events; evaluate migration over the longer term (e.g., 3-5 years).
Substrate distribution, D_{50} and D_{90}	Maintain D_{50} and D_{90} particle sizes within acceptable tolerances based on continued measurements of the baseline condition . As sizes may vary due to extreme flood events; evaluate substrate trends over the longer term (e.g., 3-5 years).

Note: * Threshold exceedances, if documented, will require an interpretation of site conditions and trends by a qualified Professional Geomorphologist to explore if any adaptive management or remediation recommendations are appropriate.

This overall, system monitoring could be undertaken by a variety of parties, including the municipality or Conservation Authority. However, a fluvial geomorphologist should interpret the findings and assess whether substantial change has occurred. The geomorphologist should also be able to link any change with the causative factors and processes. For natural channel designs, it is recommended that the proponent responsible for the design develop and undertake an appropriate monitoring plan, similar to that proposed for overall system monitoring.

Additional consideration for new technologies and techniques can be made when developing and implementing a stream morphology monitoring program. New technologies, such as the use of UAV to capture aerial imagery of the watercourse for annual comparison, would enable for the capture of high resolution colour imagery or high definition video for analysis purposes.

Fish and Fish Habitat

Natural Systems

Fish community monitoring should be included in an ecological monitoring program where fish habitat has been identified through site-specific study or through available fish records. Ontario Stream Assessment Protocols (OSAP) should be used to ensure consistent methods and that results can be compared year-over year. Monitoring should include species assemblage and relative abundance. Fish community monitoring should include at least one year of pre-construction monitoring, occur every other year throughout construction (e.g., years 1, 3, 5, etc.) and include monitoring at 1 and 3 years post construction. In the event that impacts are identified, and adaptive management is required, the monitoring program should be modified and/or extended to assess the efficacy of the mitigation. Monitoring events should occur twice a year in spring and fall in each monitoring year.

Fish habitat monitoring should be undertaken coincidently with fish community monitoring where direct habitat is identified. Fish habitat monitoring should, at a minimum, include:

- Fish habitat mapping (channel morphology, bank condition, depth profile, substrates, instream barriers, etc.)
- Riparian cover and composition
- Flow conditions and general conditions of water (temperature, dissolved oxygen, visual assessment of turbidity)
- Photographic record of conditions, preferably from staked locations so condition can be tracked over time.

Some overlap with water quality or stream morphology may occur. Where appropriate, coordination in monitoring locations can reduce redundancy in the monitoring program.

In areas supporting brook trout, targeted spawning surveys should be used to monitor function of habitat and presence of the species in addition to basic monitoring outlined above. Monitoring for Species at Risk (presence / distribution) may be identified; this should be done in accordance with applicable governing agencies.

Reconstructed Streams

In the event that stream reconstruction occurs through land development(s), the monitoring program should be adapted to reflect the different needs for monitoring associated with constructed features. Generally, this will include an annual monitoring schedule for a period of at least 5 years after establishment of the reconstructed stream to monitor establishment and assess the return of or establishment of fish and fish habitat functions. Monitoring should then continue in schedule with natural systems, as applicable.

Benthic Invertebrates

Benthic invertebrates are used as water quality indicators and also inform biodiversity and stream health. Benthic invertebrate monitoring is recommended to occur as part of a coordinated monitoring cycle with fish community and habitat monitoring. Benthic invertebrate monitoring should include at least one year of pre-construction monitoring, occur every other year throughout construction (e.g., years 1, 3, 5, etc.) and include monitoring at 1, 3 and 5 years post construction. In the event that impacts are identified and adaptive management is required, the monitoring program should be modified and/or extended to assess the efficacy of the mitigation. Monitoring events should occur once a year in spring or fall in each monitoring year; a consistent monitoring time should be selected to allow year-over-year comparison of results. Benthic monitoring is to be undertaken in accordance with Ontario Benthos Biomonitoring Network (OBBN) protocols.

5.2.2.3 Natural Heritage System

Monitoring of the Natural Heritage System is comprised of multiple components, but should be placed into the context of the system in determining the efficacy of mitigation measures and in considering environmental change. Fish and fish habitat monitoring and benthic invertebrate monitoring, while nested under Stream Systems, are also contributing components to the monitoring of the N.H.S and should be considered in the context of both.

Generally, monitoring of the N.H.S. should:

- Employ measures and methods that will effectively monitor terrestrial and aquatic features and systems, with focus on those most likely to reflect changes in condition during the period of monitoring.
- Include pre-, during- and post-construction / development monitoring to ensure baseline and monitoring for short and longer-term impacts are captured (e.g., 5 years post-construction).
- Be structured and executed in a manner that captures appropriate timing and frequency to monitor change efficiently and effectively.

The monitoring program is to be designed for and include recommendations for adaptive management responses and how the proposed monitoring plan will inform or trigger adaptive management and inform the response to address issues or concerns as may be identified through the course of monitoring. This should include direction to amend and update the plan to reflect the change in mitigation and the need to re-assess

frequency, and duration of the monitoring plan. As appropriate, reference to legislation or regulation(s) should be made to support compliance.

Guidance on expected components is provided in the proceeding sections.

Vegetation

Vegetation monitoring should focus on change in conditions which may be attributed to impacts from or conditions resulting from development. Generally, this should include:

- Ecological Land Classification (Lee et al, 1998, or updated standards as may be developed) to monitor for changes in community type and boundaries, which may reflect changes in hydrology or other environmental conditions. Community monitoring should use a 'red-line' approach, demarking changes in community type, boundary or condition.
- Vegetation plot transects to monitor species composition over time. Transects should be placed to capture the range of communities present and placed, to the extent possible, perpendicular to feature boundaries to look at edge impacts, ingress of invasive species, etc. The same transects and interval distances are to be used for every monitoring event.

Ecological Land Classification should include at least one year of pre-construction monitoring and occur every other year throughout construction (e.g., years 1, 3, 5, etc.) and include monitoring at 1, 3, and 5 years post-construction. Monitoring should occur once, during the early to mid-summer in monitoring years. Timing of surveys should be consistent across monitoring years to facilitate comparison year-over-year.

Transect surveys should include at least one year of pre-construction monitoring and occur every other year throughout construction (e.g., years 1, 3, 5, etc.) and include monitoring at 1, 3, and 5 years post-construction. Monitoring should occur three times per year – spring, summer, fall – in monitoring years. Timing of surveys should be consistent across monitoring years to facilitate comparison year-over-year.

Breeding Birds

Breeding birds are to be monitored using 10-minute point count methods in accordance with the Ontario Breeding Bird Atlas (OBBA) protocols. Alternative, standardized methods, consistent or comparable to OBBA (e.g., Forest Bird Monitoring) may be appropriate in some site conditions. Any proposed method must include consideration for replication so that data can be compared year-over-year. Point count locations should be clearly identified and selected to permit their use across pre-, during-, and post-construction monitoring without the need to move (barring unforeseen circumstances).

Breeding Bird surveys should include at least one year of pre-construction monitoring and occur every year throughout construction and include monitoring at least 3 years post-construction monitoring. Monitoring should occur include two surveys during the breeding bird period and in accordance with OBBA protocols (time between surveys, time of day, weather, etc.).

Calling Amphibians

Where amphibian breeding habitat is identified, monitoring is to include surveys for calling amphibian species. Calling amphibian surveys are to be conducted using passive auditory point count method consistent with the Marsh Monitoring Program (Bird Studies Canada 2008). Modifications to the MMP protocol regarding habitat size, distance between survey stations, etc. are permitted to ensure coverage of features present is achieved. Monitoring stations should be identified and placed in a manner which provides coverage of the subject property for assessing presence / absence and relative abundance of amphibian species present.

Calling amphibian surveys should include at least one year of pre-construction monitoring and occur every year throughout construction (e.g., years 1, 3, 5, etc.) and include monitoring at least 3 years of annual post-construction monitoring. Three monitoring events are to occur per year in accordance with the MMP protocol (approximately April, May and June) of each monitoring year. Exact timing should be established based on conditions (temperature, weather) and focal species (e.g., chorus frog).

Other Terrestrial Monitoring

The monitoring components listed above include those most common to development and post-development monitoring. The terrestrial monitoring program may require additional surveys be included to address the following:

- **Buffers, enhancements or constructed features**: ecological monitoring of buffers, enhancements of constructed features may be required. It is recommended that enhancements and constructed features be monitored following their implementation / construction to assess efficacy of measures used and establishment of habitat functions compared to those identified as objectives. This may include transects, species-specific surveys, etc.
- **Habitat structures**: where habitat structures are proposed as part of a mitigation or compensation plan, it is recommended that they be monitored to assess use and efficacy. Monitoring approach will vary based on the type of structure and/or target species.
- **Specialized Species Surveys**: Additional species-specific or species-group specific surveys may be warranted based on conditions, species and functions present in pre-development conditions. This may include:
  - Bats (e.g., presence / absence)
  - Marsh Birds (presence / absence, breeding)
  - Salamanders (e.g., presence /absence, use of structures)
  - Snakes (e.g., presence / absence, use of habitat structures)
  - Turtles (e.g., for hibernation, nesting habitats or species presence / absence)
  - Insects (e.g., for target lepidoptera, odonates, bees)
  - Vegetation (for rare or uncommon species, transplants, etc.)
- **Species at Risk and/or Compliance Monitoring**: monitoring may include Species at Risk or be required as part of permits or authorizations. To the extent possible or

appropriate, coordination of efforts to create efficient monitoring programs should be considered.

Protocols and methods for additional monitoring types should be identified based on common or best practice, available standardized survey methods, and purpose of the monitoring (e.g., presence / absence or habitat function)

5.2.2.4 Other

Hydrologic Modelling

As part of the future quaternary and subwatershed studies, it is recommended that new hydrologic modelling developed for the watershed/subwatershed systems. Due to the need to assess flood control, erosion and water balance, it is highly recommended that models capable of long term continuous simulation be adopted. As noted previously, through review of the current watershed plans, there is a lack of hydrologic modelling and analysis of land use changes as part of the legacy watershed plans. Therefore, consultation with the local municipalities and NPCA is required to confirm the existence and/or status of available hydrologic models developed as separate studies/initiatives, subsequent to the respective legacy watershed plan. Rainfall and stream flow data collected as part of the local watershed monitoring programs should be used to further validate the performance of hydrologic models and re-establish the baseline conditions within the respective study areas as appropriate.

Hydraulic Modelling

As part of the future quaternary and subwatershed studies, it is recommended that hydraulic modelling and respective floodplain mapping, be reviewed and updated/refined as needed; updates may include incorporating updated information within, and proximate to, the corresponding study area (i.e. new roadway crossings, stormwater management facilities, grading/creekworks, hydrology). These initiatives should be completed in coordination with the NPCA's floodplain mapping program, to ensure the most up-to-date data, model and floodplain delineations are used as part of future land use planning.

5.2.2.5 Adaptive Management Practices

A fully integrated monitoring strategy includes specific tasks and parameters for each discipline based on the current quaternary watershed and/or subwatershed study targets, to be used in determining the level of performance and effectiveness of the respective subwatershed recommendations. A process for developing adaptive management measures based on monitoring results and levels of performance and effectiveness should be identified as part of the strategy.

The integrated monitoring program for future development areas should answer various questions principally focused on system performance (effectiveness). Adaptive management should also take into consideration climate change and climate resilience. Data collected through monitoring programs can be used in conjunction with other 'best available' information to reflect on how well systems are functioning in the context of a changing climate (e.g., precipitation, biodiversity, etc.), to build resiliency within the NHS and WRS of the Niagara Region watersheds.

As noted earlier, most (but not all) of the compliance monitoring is anticipated at a local-scale to be completed by the development proponent. The questions which follow provide a high-level indication of some of the primary outcomes from the monitoring program which will then offer guidance on next steps specific to adaptive management.

Terrestrial

Secondary Plan Scale

- Have identified terrestrial and NHS targets been achieved?
- Were the mitigation measures effective or adequate in protecting and managing the NHS? If not, what problems or deficiencies have been identified and in what locations? For example:
  - Have there been any significant changes in species composition or (as applicable) abundance? (e.g., loss of area sensitive species, shift in assemblage to urban-adapted species, amphibian diversity. etc.)
  - Has there been an increase in the presence or distribution of invasive species?
- Have restoration and enhancement efforts been successful? If not, what problems or deficiencies have been identified and in what locations?

Subwatershed Scale

- How do Secondary Plan outcomes compare to pre-development Subwatershed conditions?
- Has the development Natural Heritage System affected the extent of habitat for Species at Risk and Special Status Species? If habitat has been improved, what factors can be identified for extending/expanding habitat, and/or supporting existing habitat stability and diversity? If existing habitat has not been improved and/or adversely affected, what problems or deficiencies have been identified and in what locations?

Groundwater

- What changes have occurred in the water table hydrograph trends from pre to post development?
- What changes have occurred in shallow groundwater flow direction?
- What change has occurred in reach specific groundwater discharge/baseflow?

Fisheries

- Has there been a significant change in the fish community structure, fish abundance, or fish habitat in the permanently flowing reaches of respective watercourses as a consequence of development?
- How does the fish productive capacity of the system after development compare to before development?
- Did the Hilsenhoff Biotic Index in reaches that are permanently flowing now change as a result of development?
- Has there been a change in the reaches occupied by species at risk within the occupied reaches as a result of development?

Stream Morphology

- Has ongoing change in channel form been accelerated or modified post-development in comparison with pre-development conditions in receiving systems?
- Have rates of instream channel bank erosion increased post-development in comparison with pre-development conditions in receiving systems?
- Has bed composition changed significantly post-development in comparison with pre-development conditions?

Water Resources

Surface Water Quantity

- Are the flood control targets established in the quaternary watershed and/or subwatershed studies being satisfied by the constructed stormwater management facilities?
- Are the operating conditions of the stormwater management facilities (i.e. the observed storm events) consistent with the design conditions (i.e. the historic meteorological dataset)?
- What modifications (if any) to the design criteria established in the quaternary watershed and/or subwatershed studies could/should be applied for subsequent designs in order to provide full and complete flood control for possible atypical events?
- What benefit are the LID practices affording by way of reduction to surface runoff volume? Is this consistent with the expectations determined based upon the analyses completed in the quaternary watershed and/or subwatershed studies?
- Is the approved hydrologic model representative of the observed conditions (i.e. does the model reasonably reproduce the observed runoff response for the given meteorological input)?

Surface Water Quality

- Are the end-of-pipe stormwater quality control facilities functioning in accordance with the current Provincial standards?
- Are the contaminant loadings (concentrations) to the end-of-pipe facilities consistent with anticipated conditions for the given land use?
- What benefit to stormwater quality control are the LID practices providing?

Feature-Based Water Balance

- In considering the water resource system, what is the relationship between features (e.g., wetlands) and localized surface and ground water?
- How do they function under existing conditions and how can they be maintained on the landscape in the long-term?

Climate Change Considerations

- Are there observable broad-scale patterns or changes that should inform future management planning to avoid causing new issues or to avoid exacerbating existing ones?

- Is the management and mitigation measures serving to support, and where possible, enhance natural environment systems to ensure resilience to pressures and challenges of climate change?

Post-development monitoring (both compliance and performance based) provides insights into the effectiveness of management practices and thereby supports decision making related to adaptation and management. This provides the opportunity to review and make changes in the future to improve management performance and allow for flexibility, in order to achieve the desired management outcomes.

The US Department of the Interior (US DOI) Adaptive Management Working Group (AMWG) developed a Technical Guide to Adaptive Management in 2009, which outlined various components of adaptive resource management, including when and how adaptive management should be implemented, measures for success and operational issues.

The technical guide has outlined the process for adaptive management, consisting of nine (9) steps, including *stakeholder involvement, management objectives, management alternatives, predictive models, monitoring plans, decision making, monitoring responses to management and adjustment to management actions* (ref. US DOI, 2009).

The following key points have been highlighted from the technical guide in relation to the overall purpose, process and success of adaptive management (ref. US DOI, 2009):

- *Adaptive management is designed to improve understanding of how a resource system works, so as to achieve management objectives.*
- *Adaptive management makes use of management interventions and follow-up monitoring to promote understanding and improve subsequent decision making.*
- *The implementation of adaptive management can be facilitated by considering a series of questions related to the success criteria and the operational steps.*
- *Learning is advanced by the sequential comparison of model predictions against monitoring data, whereby confidence in an underlying hypothesis is based on the relative accuracy of model predictions.*
- *An adaptive management project is recognized as successful if:*
    1. *Stakeholders are involved and committed to the process;*
    2. *Progress is made toward achieving management objectives;*
    3. *Results from monitoring and assessment are used to adjust management decisions; and*
    4. *Implementation is consistent with applicable laws.*

Through the development of purposeful monitoring programs, the learning outcomes can be applied in the adaptive management cycle to assess the previous management decisions and allow for the opportunity for informed changes to be made as part of future decision-making processes. These opportunities for change will vary based upon the assessment outcomes, however, may include refinements such as, land use designations in certain areas (which may be subject to zoning amendments), design,

function and location of SWM controls, changes in protection measures (buffers) for natural areas, etc. The consideration for adaptive management opportunities at the initial planning scale (Quaternary and Subwatershed planning) can provide the greatest opportunity for protection and successful management of the natural resources within the Niagara Region. Further, the results of various monitoring programs and future training opportunities (i.e., in relation to monitoring, LID BMP design, long-term data collection, etc.), should be pooled together and shared amongst the various stakeholders to development and resource management (i.e., local municipalities and NPCA), so that there can be continuous improvements over time.

6.0 CONCLUSION & NWP (E) REPORTING

The contents of the current report pertain to **Volume 2: Niagara Watershed Management**, which has provided a review of the goals and objectives for the NWP (E), integration of the NHS & WRS, watershed planning equivalency guidance and the needs for future studies and monitoring, as outlined below:

- **Volume 2: Niagara Watershed Management**
  - Goals & Objectives
  - Integrating the Natural Heritage System (NHS) & Water Resource System (WRS)
  - Watershed Plan (Equivalency) Guidance
    - *Water Management Guidance (Quantity/Quality)*
    - *Climate Change Guidance*
    - *Natural Hazards*
    - *Cumulative Impacts*
    - *Land Use Impact Management & Preliminary Guidance*
  - Future Studies & Monitoring

The contents of this volume build upon Volume 1, which outlined the existing data sources as part of the existing conditions characterization of the three (3) tertiary watershed systems present within the Niagara Region. The findings from both Volume 1 and the current Volume 2 will help to support the analysis of potential growth across the Niagara Region, outlined in Volume 3. The contents of both the preceeding and subsequent report volumes have been outlined below for reference.

- **Volume 1: Characterization**
  - Niagara Watersheds Characterization (Lake Ontario, Niagara River, Lake Erie)
    - *Drainage Systems*
    - *Surficial Soils*
    - *Slopes / Topography*
    - *Groundwater System & Source Water Protection*
    - *Natural Hazards*
    - *Natural Heritage (Fish & Terrestrial)*
    - *Land Uses (Urban & Agricultural)*
    - *Watershed Monitoring (Climate, Streamflow, Water Quality and Groundwater)*
- **Volume 3: Growth Analysis**
  - Growth Scenarios / Priority Areas
    - *Total Potential Growth*
    - *Priority Areas*
    - *Growth Area Screening Matrix*

These report volumes, encompassing the final NWP (E), have been compiled to improve the understanding of the natural and water-based systems present within the Niagara Region. The information will help inform the new NOP and provides direction for the subsequent studies, which will be required to support future quaternary watershed planning and local subwatershed planning initiatives in the Niagara Region.

PROJECT: DA20-014-01

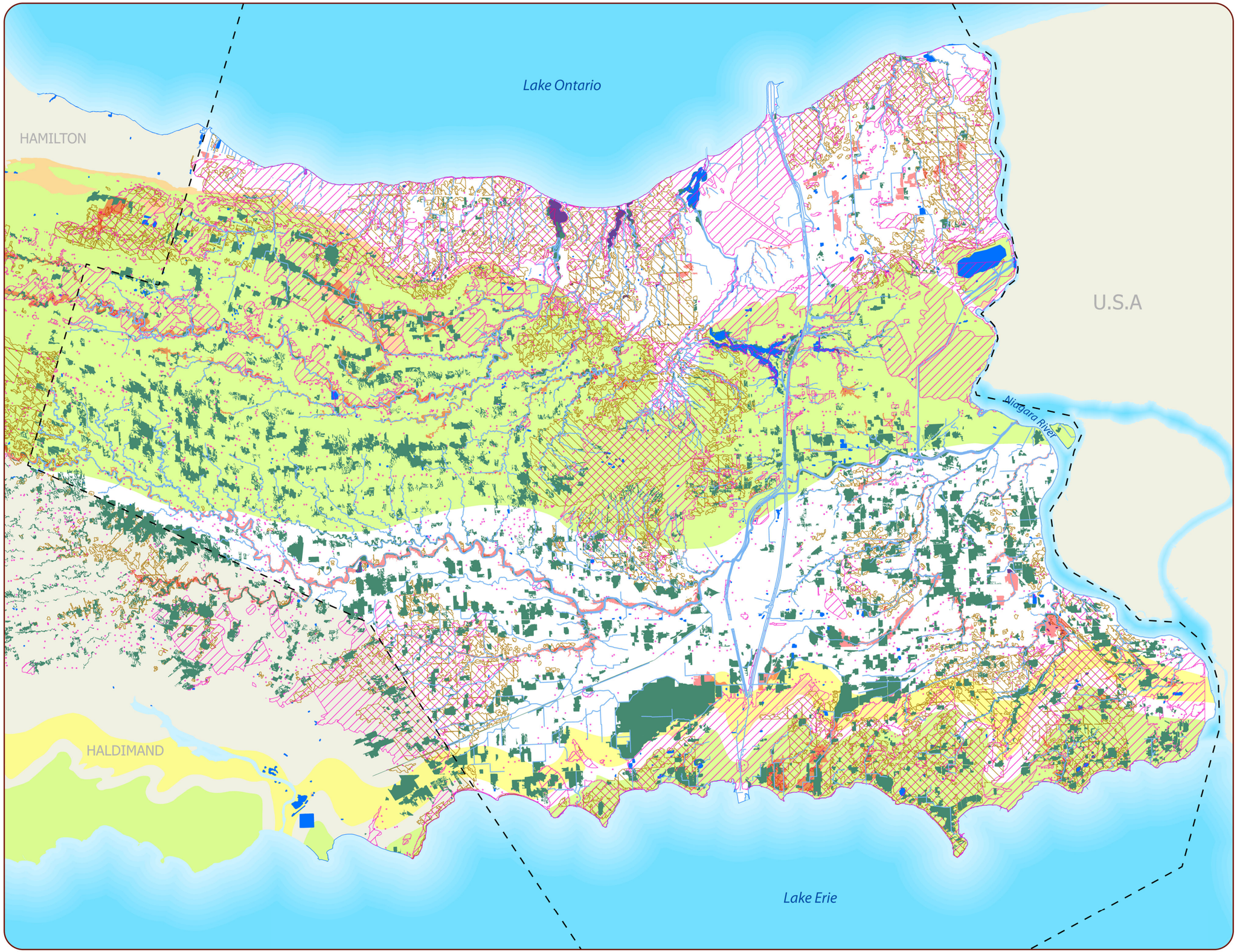
CLIENT: Regional Municipality of Niagara

DATE: 20, May 2021

DRAWN BY: J.Sauder

Drawing 3-1: Water Resource System

Niagara Watershed Plan (Equivalency)



- Niagara Boundary
- Regulated Floodplains [1]

Key Hydrologic Features

- Permanent and Intermittent Streams [2]
- Wetlands [3]
- Inland Lakes and their littoral zones [2]

Key Hydrologic Areas

- Highly Vulnerable Aquifers [2]
- Significant Groundwater Recharge Areas [2]

Karst Features [4]

- Known Karst
- Inferred Karst
- Potential Karst

Sources:
1) NPCA, 2020
2) Niagara Region, 2021
3) Consolidation of datasets. Niagara Region and MNRF, 2021 (MNRF data used to fill gaps outside Niagara Region)
4) Ontario Geologic Survey, 2008

0 2,500 5,000 10,000
Metres

SCALE: 1:210,000

N

NAD 1983 UTM Zone 17NCSRS

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

north-south ENVIRONMENTAL

APPENDIX A-2:

GOALS & OBJECTIVES

1.1 Goals and Objectives – Policy Review

1.1.1 Water Resource System

The following section identifies relevant policies, plans and guidance related to the Water Resource System, followed by a list of NWP (E) goals and objectives.

A Water Resource System per the Provincial Policy Statement (2020) is to consist of:

"A system consisting of ground water features and areas and surface water features (including shoreline areas), and hydrologic functions, which provide the water resources necessary to sustain healthy aquatic and terrestrial ecosystems and human water consumption. The water resource system will comprise key hydrologic features and key hydrologic areas."

1.1.1.1 Provincial Policies and Plans

Water Resource System

Provincial policies, plans and guidance were reviewed to identify key areas of conformity and to determine existing guidance related to the WRS in the context of watershed planning.

Section	Provincial Policy Statement (2020) Policies
1.2 Coordination **Subsection 1.2.1**	A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including: e) ecosystem, shoreline, watershed, and Great Lakes related issues
2.2 Water **Subsection 2.2.1**	Planning authorities shall protect, improve, or restore the quality and quantity of water by: a. using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development b. minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts c. evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level d. identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed e. maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas

Section	Provincial Policy Statement (2020) Policies
	g. planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
2.2.8 Settlement Area Boundary Expansions **Subsection 3**	Where the need for a settlement area boundary expansion has been justified in accordance with policy 2.2.8.2, the feasibility of the proposed expansion will be determined and the most appropriate location for the proposed expansion will be identified based on the comprehensive application of all of the policies in this Plan, including the following: d. the proposed expansion, including the associated water, wastewater and stormwater servicing, would be planned and demonstrated to avoid, or if avoidance is not possible, minimize and mitigate any potential negative impacts on watershed conditions and the water resource system, including the quality and quantity of water
4.2.1 Water Resource Systems **Subsection 1**	Upper-and single-tier municipalities, partnering with lower-tier municipalities and conservation authorities as appropriate, will ensure that watershed planning is undertaken to support a comprehensive, integrated, and long-term approach to the protection, enhancement, or restoration of the quality and quantity of water within a watershed.
Subsection 3	a. Watershed planning or equivalent will inform: a. the identification of water resource systems b. the protection, enhancement, or restoration of the quality and quantity of water c. decisions on allocation of growth d. planning for water, wastewater, and stormwater infrastructure
Subsection 5	b. Municipalities will consider the Great Lakes Strategy, the targets and goals of the Great Lakes Protection Act, 2015 and any applicable Great Lakes agreements as part of watershed planning and coastal or waterfront planning initiatives.
4.2.3 Key Hydrologic Features, Key Hydrologic Areas and Key Natural	c. Outside of settlement areas, proposals for large-scale development proceeding by way of plan of subdivision, vacant land plan of condominium or site plan may be permitted within a key hydrologic area where it is demonstrated that the hydrologic functions, including the quality and quantity of water,

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
Heritage Features **Subsection 2**	of these areas will be protected and, where possible, enhanced or restored through: b. meeting other criteria and direction set out in the applicable watershed planning or subwatershed plans
4.2.10 Climate Change **Subsection 1**	Upper- and single-tier municipalities will develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and address climate change adaptation goals, aligned with the Ontario Climate Change Strategy, 2015 and the Climate Change Action Plan, 2016 other provincial plans and policies for environmental protection that will include: e. recognizing the importance of watershed planning for the protection of the quality and quantity of water and the identification and protection of hydrologic features and areas f. Protecting the Natural Heritage System for the Growth Plan and water resource systems

Section	Greenbelt Plan (2017) Policies
1.2.2 Protected Countryside Goals **Subsection 6**	To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside: Climate Change: a. Integrating climate change considerations into planning and managing the Agricultural System, Natural Heritage System and Water Resource System to improve resilience and protect carbon sequestration potential, recognizing that the Natural Heritage System is also a component of green infrastructure b. Integrating climate change considerations into planning and managing growth that includes incorporating techniques to reduce greenhouse gas emissions, and increasing the resilience of settlement areas and infrastructure within the Greenbelt
3.2.3 Water Resource System Policies **Subsection 2**	d. Watersheds are the most meaningful scale for hydrological planning. Municipalities, partnering with conservation authorities as appropriate, shall ensure that watershed planning is undertaken to support a comprehensive, integrated, and long-term approach to the protection, enhancement or restoration of the quality and quantity of water within a watershed.
Subsection 5	e. Cross-jurisdictional and cross-watershed impacts need to be considered in the development of watershed plans. The

Section	Greenbelt Plan (2017) Policies
	development of watershed plans and watershed management approaches in the Protected Countryside shall be integrated with watershed planning and management in the NEP, the ORMCP and the Growth Plan.
Subsection 6	f. Municipalities shall consider the Great Lakes Strategy, the targets and goals of the Great Lakes Protection Act, 2015 and any applicable Great Lakes agreements as part of watershed planning and coastal or waterfront planning initiatives.
3.2.4 Key Hydrologic Areas **Subsection 1**	g. For lands within a key hydrologic area in the Protected Countryside, the following policies apply: 1. Major development may be permitted where it has been demonstrated that the hydrologic functions, including groundwater and surface water quality and quantity, of these areas shall be protected and, where possible, improved or restored through: b. Meeting other criteria and direction set out in the applicable watershed planning or subwatershed plan

Section	Niagara Escarpment Plan (2017) Policies
Development Objectives **Section 1.6.8.9**	Growth and development in Minor Urban Centres shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Development Objectives **Section 1.7.5.9**	Growth and development in Urban Areas shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Development Objectives **Section 1.8.5.9**	Growth and development in Escarpment Recreation Areas shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plans in land use planning.

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
Watershed Planning	• Partnership between upper and single tier municipalities, conservation authorities, as appropriate, to ensure that watershed planning is undertaken to support a comprehensive, integrated, and long-term approach to the protection, enhancement or restoration of the quality and quantity of water within a watershed. • Planning authorities to protect, improve or restore the quality and quantity of water by, among other things, using watershed as the ecologically meaningful scale for integrated and long-term planning. • Watershed planning should inform the protection of water resource systems and decisions related to planning for growth. • Water, wastewater, and stormwater management planning should be informed by watershed planning. • Assess the sources and means by which nutrients and pollutants get into water for better planning and mitigation practices. • Negative impacts on quality of water to be assessed through environmental studies, such as water impact assessments in accordance with provincial standards.
Water Conservation (Water Quantity)	• Promote water conservation through water demand management for the efficient use of water, and through recycling to maximize reuse and recycling of water. • Undertake water budget analysis to assess if water use is sustainable, if resources are stressed or likely to become stressed.
Water Quality	• Watershed planning to consider phosphorus loading and phosphorus concentration targets to avoid the negative impacts on quality of water as well as degradation of sensitive surface water features, sensitive groundwater features, and their related hydrologic functions. • Reduce nutrient-related impacts from both urban and rural watersheds. • Develop risk management plans for chloride and pathogens in identified vulnerable areas for source protection planning. • Undertake nutrient loading assessments to ensure water quality is satisfactory for aquatic life. • Preserve the quality of surface and ground water to protect aquatic life.

Water Resource System & Natural Heritage System Mapping

Provincial policies, plans and guidance were reviewed to identify key areas of conformity and to determine existing guidance related to WRS & NHS Mapping in the context of watershed planning.

Section	Provincial Policy Statement (2020) Policies
2.2 Water **Subsection 2.2.1**	Planning authorities shall protect, improve, or restore the quality and quantity of water by: d. Identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
4.2.1 Water Resources System **Subsection 2**	Water resource systems will be identified to provide for the long-term protection of key hydrologic features, key hydrologic areas, and their functions.
4.2.2 Natural Heritage System **Subsection 4**	Provincial mapping of the Natural Heritage System for the Growth Plan does not apply until it has been implemented in the applicable upper- or single-tier official plan. Until that time, the policies in this Plan that refer to the Natural Heritage System for the Growth Plan will apply outside settlement areas to the natural heritage systems identified in official plans that were approved and in effect as of July 1, 2017.
4.2.2 Natural Heritage System **Subsection 5**	Upper- and single-tier municipalities may refine provincial mapping of the Natural Heritage System for the Growth Plan at the time of initial implementation in their official plans. For upper-tier municipalities, the initial implementation of provincial mapping may be done separately for each lower-tier municipality. After the Natural Heritage System for the Growth Plan has been implemented in official plans, further refinements may only occur through a municipal comprehensive review.

Section	Greenbelt Plan (2017) Policies
3.2.3 Water Resource System Policies **Subsection 3**	Water Resource Systems shall be identified, informed by watershed planning and other available information, and the appropriate designations and policies shall be applied in official plans to provide for the long-term protection of key hydrologic features, key hydrologic areas and their functions.
5.3 Municipal Implementation of Protected Countryside Policies	Official plans shall contain policies that reflect the requirements of this Plan together with a map(s) showing the boundaries of the Greenbelt Area, the Protected Countryside, the Natural Heritage System and the agricultural land base. Municipalities shall provide a map showing known key natural heritage features and key hydrologic features and any associated minimum vegetation protection zones identified in this Plan. The identification of the Natural Heritage System boundary will form the basis for applying the policies of section 3.2.

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
WRS	• Identify and map core features, linkages/corridors, natural features, water features, and potential areas for protection/restoration/enhancement.
Natural Hazards	• Municipalities should identify areas subject to natural hazards and develop management plans to limit exposure to public health and safety risks. • When information does not exist concerning the location of defined hazardous lands, or when existing information is identified as being out of date, municipalities, and other planning authorities are to undertake studies to identify potential risks from natural hazards. • Floodplain mapping should be undertaken to identify regulatory flood lines and demonstrate hazard areas. • Floodplain mapping and soil and stability analysis are important for informing where development may and may not occur, as well as for managing its associated impacts on natural watercourses, specifically regarding flooding and erosion — including where and how to focus mitigative measures. • Municipalities should re-visit flood mapping during the development review and approval process, ensuring that climate change considerations are incorporated, and ensuring that land use planning is integrated with municipal asset management planning.

Section	Ontario's Great Lakes Strategy
	Goal 2: Protecting Water for Human Health and Ecological Health
Reduce stormwater and wastewater impacts	d. Assist municipalities, developers, the insurance industry and others in reducing the volumes and impacts of stormwater, including: • further supporting stormwater innovation demonstration projects including green infrastructure pilots, monitoring their performance and effectiveness, and communicating the results of water innovation pilots to a broad audience • updating Ontario's municipal wastewater policies to include stormwater, green infrastructure, construction runoff and sediment management • enhancing the Province's approach to stormwater approvals with greater emphasis on effluent quality and quantity, in turn driving greater use of innovative source control measures • seeking environmental considerations such as use of low impact development and use of green infrastructure early in municipal planning decisions, so that stormwater is considered as part of project design and approvals, not after the fact • promoting innovative and cost-effective approaches for managing nutrients in wastewater and stormwater (including green infrastructure and low impact development).
Reduce stormwater and wastewater impacts	g. Consult broadly with municipal, water sector and community stakeholders on a Municipal Water Sustainability Plan Regulation under the Water Opportunities Act to: • promote consistency in the sustainability planning process for water services (including drinking water, wastewater and stormwater), and • promote consistency in development, measurement and reporting of performance indicators.
Reduce excessive nutrients	i. Seek opportunities to reduce nutrient inputs to the environment and advance monitoring of agricultural best management practices, in priority geographic areas and in agricultural production systems to enhance performance.
Reduce excessive nutrients	j. Evaluate the potential of using water quality trading in priority areas to reduce nutrient loadings, where economically and ecologically feasible and acceptable to community partners.

Section	Ontario's Great Lakes Strategy
Reduce excessive nutrients	k. Continue to promote rural and agricultural environmental stewardship practices, including water quality protection, water conservation, and the development and implementation of innovative practices related to water and nutrient recycling, agricultural drainage and green infrastructure.
Reduce excessive nutrients	l. Work to better understand and reduce harmful and nuisance algal blooms, including effectively managing conditions such as excess nutrients that contribute to these blooms. This includes collaborating on the establishment of phosphorus loadings and concentration targets for Lake Erie, and on implementing phosphorus management plans and targets in priority watersheds of Lakes Huron, Erie and Ontario. This will help support actions under the Canada-U.S. Great Lakes Water Quality Agreement.
Reduce excessive nutrients	m. Continue to work with partners to encourage the development, demonstration, and adoption of innovative technologies and approaches that reduce excess nutrients to the environment and foster the continued competitiveness of the agriculture and agri-food sectors, including support to the sector to understand the approval requirements for pilot/demonstration projects.
Protect water quality by reducing toxic chemicals	n. Continue to reduce toxics, by: • continuing to promote reduction initiatives and to support research on safer alternatives • bringing academics, industry and technology experts together through Green Centre Canada, to create green chemistry innovations, and • reviewing the lists of substances at least once every five years in consultation with experts and the public.
Protect water quality by reducing toxic chemicals	o. Update water and air pollution regulations and standards as needed to protect the health of people and the Great Lakes environment.
Protect water quality by reducing toxic chemicals	p. Research, monitor and report on chemicals of emerging concern in the Great Lakes, and adapt our standards, policies and programs as needed to address these pollutants.
Protect water quality by	q. Continue working to ensure ongoing compliance with Ontario's water-related regulations and to improve spill prevention and response.

Section	Ontario's Great Lakes Strategy
reducing toxic chemicals	
Protect water quality by reducing toxic chemicals	s. Continue to collaborate with Canada on the reduction of harmful pollutants in the Great Lakes Basin, including the identification of joint priorities for harmful pollutants. Ontario will also continue to address priority pollution issues not addressed through the amended Canada-U.S. Great Lakes Water Quality Agreement.
Improve water quality management	u. Consider Ontario's approach to managing the cumulative impact of water takings in stressed watersheds in light of the new water quantity science produced by source protection committees under the Clean Water Act, and consulting broadly on any potential changes.
Improve water quality management	v. Promote water conservation and efficiency as enabled under the Water Opportunities and Water Conservation Act, including: • establishing aspirational targets for water conservation • further promoting WaterSense labelling for water-efficient consumer products, and • developing and consulting with stakeholders on potential water conservation plans by public agencies (e.g., municipalities, universities, colleges, schools and hospitals).
Improve water quality management	w. Review the current charge for industrial and commercial water takings and discuss with stakeholders potential changes to the charge framework.
Improve water quality management	x. Work with the International Joint Commission as they consider how to manage lake levels to better balance ecological and economic interests on both Lake Ontario and the St. Lawrence River, and on the Upper Great Lakes, including work to better understand and adapt to lake level changes.
	Goal 3: Improving Wetlands, Beaches and Coastal Areas
Beaches	d. Carry out and communicate research to improve understanding of sources of high E. coli and causes of other beach impairments such as algae, to guide beach management actions.
Other coastal areas	s. Represent Ontario's interests in binational efforts to manage, evaluate and improve regulation of Great Lakes water levels and flows – efforts that further consider coastal and shoreline

Section	Ontario's Great Lakes Strategy
	environments, natural physical features and processes in shoreline management, among other interests.
	Goal 5: Enhancing Understanding and Adaptation
Deliver needed science	a. Continually assess and adapt Ontario's Great Lakes science priorities by optimizing research investments through partnerships, and by sustaining long-term monitoring capabilities.
Deliver needed science	c. Make the best use of our significant investment in watershed science for drinking water source protection plans under the *Clean Water Act*, to support other Great Lakes-related programs.
Deliver needed science	d. Improve understanding of the sources and pathways of non-point source pollution to ensure management practices and resources are focused appropriately.
Deliver needed science	f. Continue to implement research and monitoring programs to understand Great Lakes ecosystem function, structure and change. For example, to address coastal water quality and algae, science resources as available will focus on assessing nutrient-algae relationships altered by invasive species impacts, collaboratively identifying priority watersheds, developing new nearshore and tributary water quality targets, and quantifying impacts of land uses and beneficial management practices.
Deliver needed science	g. Improve understanding of the relationships between groundwater and surface water, and the role of groundwater in sustaining Great Lakes water levels and tributary water flows.
Deliver needed science	h. Continue to harness new technologies and approaches such as advanced sampling equipment, remote sensing and modelling, as resources are available.
	Goal 6: Ensuring Environmentally Sustainable Economic Opportunities and Innovation
Support the development of innovative water technologies, services and practices	a. Continue the implementation of the *Water Opportunities Act* and complementary measures. This includes supporting the work of the Water Technology Acceleration Project, which will help grow globally competitive companies and promote Ontario's water sector, while generating solutions that can help protect and improve the Great Lakes environment.

Section	Ontario's Great Lakes Strategy
Support the development of innovative water technologies, services and practices	b. Continue to support the research, development and demonstration of new innovative environmental technologies, services and practices.
Support the development of innovative water technologies, services and practices	d. Develop a long-term economic development strategy that will establish a series of goals and actions to make a cohesive and globally competitive water sector.
Support the development of innovative water technologies, services and practices	i. Encourage industrial practices that minimize water consumption, recycle water, use reclaimed wastewater or stormwater for business operations or processing, and apply low impact development to stormwater management. (e.g., permeable pavement in parking lots).
Support the development of innovative water technologies, services and practices	j. Encourage development and use of green technologies and demonstrate leadership in green building, green infrastructure such as coastal wetlands, and water and energy conservation.

1.1.1.2 Existing Regional Official Plan (2014)

Water Resource System

The ROP (2014) was reviewed to highlight the existing Regional guidance and requirements related to the WRS in the context of watershed planning.

Section	Existing Regional Official Plan (2014) Policies
	Chapter 7: Natural Environment
7.A.2 Water Resources ***Policy 7.A.2.1***	h. Development and site alteration shall only be permitted if it will not have negative impacts, including cross-jurisdictional and cross-watershed impacts, on: a. The quantity and quality of surface and ground water

Section	Existing Regional Official Plan (2014) Policies
	b. The functions of ground water recharge and discharge areas, aquifers and headwaters c. The natural hydrologic characteristics of watercourses such as base flow d. Surface or ground water resources adversely impacting on natural features or ecological functions of the Core Natural Heritage System or its components e. Natural drainage systems, stream forms and shorelines f. Flooding or erosion
7.A.2 Water Resources ***Policy 7.A.2.3***	As watershed and ground water studies identify surface and ground water features, hydrologic functions and natural heritage features and areas necessary for the ecological and hydrologic integrity of Niagara's watersheds, the Region shall consider appropriate amendments to this Plan.
7.A.2 Water Resources ***Policy 7.C.2.1***	The Region, in partnership with the Niagara Peninsula Conservation Authority and appropriate local municipalities, shall ensure that Watershed Studies are prepared for major watersheds in consultation with landowners, community groups and other public agencies and shall include: a. Inventory, analysis and assessment of ecological features and functions affecting the watershed b. Identification of key issues and objectives c. A water budget and water conservation plan d. Recommendations on actions needed to maintain and enhance ecosystem health and integrity, including policies to be incorporated into municipal planning documents e. Identification of subwatershed boundaries and establishment of guidelines and terms of reference for additional studies if needed
7.C Implementation Measures ***Policy 7.C.2.4***	Watershed and Environmental Planning Studies shall be implemented through amendments to Regional and local official plans, as appropriate, and through secondary plans and zoning by-laws providing guidance and direction for: a. The review of applications for development or site alteration b. Servicing and infrastructure proposals c. The Region's support for environmental stewardship, restoration, and other measures.
	Chapter 8: Infrastructure
Policy 8.B.11	The Region will continue to plan and design municipal water and wastewater systems that return water to the Great Lakes watershed from which the withdrawal originates.

Water Resource System & Natural Heritage System Mapping

The ROP (2014) was reviewed to highlight the existing Regional guidance and requirements related to the WRS and NHS mapping in the context of watershed planning.

Section	Existing Regional Official Plan (2014) Policies
	Chapter 7: Natural Environment
7.B The Core Natural Heritage System ***Policy 7.B.1.6***	Key hydrologic features include permanent and intermittent streams, lakes and their littoral zones, seepage areas, springs and wetlands. When key hydrologic features are identified through watershed or other studies the Region will consider an amendment to this Plan to show those features on a Schedule. In the interim, within the Greenbelt Area, if potentially permitted development is proposed in an area within the Unique Agricultural Areas where key hydrologic features have not been identified, the applicant may be required to identify the hydrologic features on the site of the proposed development as well as within 120 meters of the site boundary.
7.B The Core Natural Heritage System ***Policy 7.B.1.7***	The boundaries of Core Natural Areas, Potential Natural Heritage Corridors and Fish Habitat are shown on Schedule C. They may be defined more precisely through Watershed or Environmental Planning Studies, Environmental Impact Studies, or other studies prepared to the satisfaction of the Region and may be mapped in more detail in local official plans and zoning by-laws. Significant modifications, such as a change in the classification of a Core Natural Area, or a significant change in the spatial extent or boundaries of a feature, require an amendment to this Plan unless otherwise provided for in this Plan. Only minor boundary adjustments to Environmental Protection Areas will be permitted without Amendment to this Plan.
7.A.6 Natural Hazards ***Policy 7.A.6.1***	Hazardous lands and sites shall be as identified and mapped by the Niagara Peninsula Conservation Authority. Where an application for development or site alteration is made and such mapping is not available the location and extent of hazardous lands or sites shall be as determined by the Conservation Authority after considering an appropriate study prepared and signed by a qualified engineer and submitted with the application.

1.1.1.3 Niagara Region Priorities

In order to develop the goals and objectives for the NWP (E) document that are specific to Niagara Region, the reports completed for the Region as part of the NEWP, the Consultation Summary Report – 1st Point of Engagement (2019) and the Watershed Planning Discussion Paper (2019), were reviewed to identify key stakeholder priorities. Regional priorities identified during the NWP (E) Kick-off Meeting, which took place on May 14, 2020, were also reviewed to identify WRS priorities specific to Niagara Region.

It should be noted that any input received to date on the natural environment work program is still being evaluated by the Project Team. No final decisions on options, mapping, or policy have been made.

Water Resource System

The following key issues and priorities, specific to the WRS, were identified:

NEWP Consultation Summary Report – 1st Point of Engagement (2019)

- Produce a clear framework of roles, and responsibilities, and identify a consistent approach to undertake watershed planning.
- Promote protection of vulnerable aquifers through the management of the WRS.

NEWP Watershed Planning Discussion Paper (2019)

- Establish an understanding of conceptual water budgets and water quality/nutrient loading for the WRS on a tertiary level.
- Determine which elements of the NHS, WRS and associated natural and water-based resources should be monitored as part of broad-scale growth plans and develop a Regional monitoring framework.
- Provide clear definitions of tertiary and quaternary watershed and subwatershed.
- Define responsibility for watershed and subwatershed studies and adaptive management.
- Provide direction for new or updates to existing quaternary watershed or subwatershed studies that promote effective land use planning and management of the natural environment; subwatershed planning is necessary for site-specific land use planning decisions.

Regional Priorities from Kick-off Meeting (2019)

The Regional Priorities from the Kick-off Meeting include the following technical aspects: uniqueness of cold-water systems in the Region (e.g. Twelve Mile Creek, etc), the importance of the south Niagara aquifer and Niagara-on-the-Lake and other watercourses in the speciality crop area (concern of the agricultural community related to irrigation systems and agricultural drains).

From the policy aspect, the following should be considered:

- Classification. delineation, and naming of watersheds and subwatersheds
- Prioritization of future watershed and subwatershed studies
- Identification of any areas with particularly sensitive karst systems that should be considered
- Ensuring that the new NOP is appropriately informed by watershed planning

Niagara Stormwater Management Guidelines – Technical Memorandum #1: Background Review, Research Municipalities, Summarize Legislation (July 2020)

- Preserve the quality of surface water and groundwater through mitigation of development impacts, and other impacts such as phosphorus, chlorides, temperature.

- Replicate the existing hydrologic regime water balance, infiltration, runoff.
- Minimize development impacts to conveyance and flooding and to erosion within watercourses.

Water Resource System & Natural Heritage System Mapping

The following key issues and priorities, specific to the WRS and NHS Mapping, were identified:

NEWP Consultation Summary Report – 1st Point of Engagement (2019)

- Incorporate agricultural systems and infrastructure into the development of natural environment policies and mapping.
- Promote transparency by making available natural environment mapping through a web-based, accessible, and user-friendly mapping tool.
- Incorporate site-specific study data into Region-managed datasets and make available through a web-based, accessible, and user-friendly mapping tool.
- Use the most up-to-date and accurate datasets to map the natural environment system, incorporating site-specific study data and ground-truth features.
- Differentiate ‘natural’ and agricultural-related features during the development of natural environment policies and mapping.
- Build flexibility into policy that addresses imperfect mapping to allow refinements to Region mapping.
- Provide interactive, and high accuracy mapping including data acquired during site specific studies to represent the natural environment system.
- Integrate watercourses into mapping of agricultural systems.
- Integrate corridor along the shoreline of Great Lakes into mapping.
- Link the comprehensive water resource system to the natural environment system in mapping.

Natural Environment Work Program Watershed Planning Discussion Paper (2019)

- Build human-made features, such as stormwater ponds, into water resource system mapping.
- Refine watershed boundaries through GIS-based analysis of updated spatial data and documentation of watershed and subwatershed areas delineation.
- Establish consistent watershed delineation and naming within the Region.
- Map the water resources system to support the new Niagara Official Plan.
- Identify quaternary watersheds or subwatersheds that are most likely to be impacted by urban development. Prioritize identified watersheds for watershed planning to inform identification of suitable areas and development of management strategies to manage potential impacts for urban growth.

1.1.1.4 Goals and Objectives

Based upon applicable provincial policy, plans and guidance documents, and the key priorities identified by Regional staff and through stakeholder consultation, the following NWP (E) goal and objectives have been developed for the WRS:

Goal 1: Establish and Maintain Contemporary and Accurate Understanding and Mapping of the Watershed

a. Identify the WRS

- Review all available and relevant data sources
- Delineate Watershed at the Tertiary and Quaternary levels and Subwatershed Boundaries to establish contemporary and accurate understanding of the watershed systems
- Characterize the existing conditions of the watershed based on existing desktop data specific to natural hazards, natural features and the water resource system components, using the best available information for the area
- Identify/refine the WRS for Niagara Region, based on initial WRS from the NEWP, including key hydrologic features and key hydrologic areas
- Include areas with particularly sensitive karst systems
- Provide appropriate connections with WRS Options identified in the NEWP

a. Develop WRS Mapping

- Review all available and relevant data sources
- Delineate Watershed (tertiary and quaternary) and Subwatershed Boundaries
- Map WRS elements based on available mapping, including:
    - Key hydrologic features
    - Key hydrologic areas
    - Functional considerations, such as appropriate recognition of human-made features
- Identify gaps or deficiencies including age, quality / accuracy and/or availability of available data
- Present existing/accessible data and gaps as a mapped index to clearly illustrate this information and its use in prioritizing recommendations for future work
- Provide recommendations for consideration of WRS GIS/Data portal
- Maintain contemporary and accurate mapping of the watershed, incorporating the most recent and available data sources as part of long-term Watershed Plan refinements (e.g., aerial imagery, field studies, modelling), at the Tertiary, Quaternary and Subwatershed scales.

Goal 2: Protect Water Quality & Water Quantity

a. Develop a Water Budget for respective systems, building from a tertiary level of data

- Review Source Water Protection Plans, preliminary identification and mapping of the WRS, and other available data sources to develop water budget
- Identify water quality and water quantity concerns (e.g., nutrient loading, pollution)

b. Identify best practices for water conservation and maintaining water quality in order to plan for efficient and sustainable use of water resources

- Identify considerations for surface water features and areas

- Identify considerations for groundwater features and areas
- Provide best practices to enhance stormwater capture / infiltration

Goal 3: Adaptively Manage and Monitor the Watershed

a. Provide Best Practices for protecting, enhancing and restoring the WRS related to, among others:

- Shoreline management
- Flooding and erosion
- Buffers
- Water quality and water quantity (refer to Goal 2)

b. Monitoring and Adaptive Management

- Collate existing resources (e.g. GIS) of monitoring programs, including location and scale
- Identify NHS, WRS and associated natural and water-based resources which should be monitored as part of broad-scale growth plans (refer to Goal 5 for additional growth management objectives)
- Develop local and holistic monitoring strategies to establish a monitoring framework for Niagara Region building from existing programs including provincial, NPCA, Great Lakes Strategy initiatives and others

c. Future Studies / Priorities:

- Establish guidelines and terms of reference for additional subwatershed studies
- Provide monitoring guidance for future studies required to support growth (notably SWS) including natural and water-based systems
- Provide recommendations for gap-filling and strategic study prioritization

1.1.2 Natural Heritage System

The following section identifies relevant policies, plans and guidance related to the NHS, followed by a list of NWP (E) goals and objectives.

A Natural Heritage System is defined in the Provincial Policy Statement (2020) as:

“Natural heritage system: means a system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support hydrologic functions, and working landscapes that enable ecological functions to continue. The Province has a recommended approach for identifying natural heritage systems, but municipal approaches that achieve or exceed the same objective may also be used.”

1.1.2.1 Provincial Policies and Plans

Provincial policies, plans and guidance were reviewed to identify key areas of conformity and to determine existing guidance related to the NHS in the context of watershed planning.

Section	Provincial Policy Statement (2020) Policies
1.2 Coordination **Subsection 1.2.1**	A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including: e) ecosystem, shoreline, watershed, and Great Lakes related issues
2.1 Natural Heritage **Subsection 2.1.2**	The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.
Subsection 2.1.3	Natural heritage systems shall be identified in Ecoregions 6E & 7E1, recognizing that natural heritage systems will vary in size and form in settlement areas, rural areas, and prime agricultural areas.
2.2 Water **Subsection 2.2.1**	Planning authorities shall protect, improve, or restore the quality and quantity of water by: a. using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development b. minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts c. evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level d. identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed e. maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
2.2.8 Settlement Area Boundary Expansions **Subsection 3**	Where the need for a settlement area boundary expansion has been justified in accordance with policy 2.2.8.2, the feasibility of the proposed expansion will be determined and the most appropriate location for the proposed expansion will be identified based on the comprehensive application of all of the policies in this Plan, including the following: d. the proposed expansion, including the associated water, wastewater and stormwater servicing, would be planned and demonstrated to avoid, or if avoidance is not possible, minimize and mitigate any potential negative impacts on watershed conditions and the water resource system, including the quality and quantity of water e. key hydrologic areas and the Natural Heritage System for the Growth Plan should be avoided where possible
3.2.5 Infrastructure Corridors **Subsection 1**	In planning for the development, optimization, or expansion of existing and planned corridors and supporting facilities, the Province, other public agencies and upper- and single-tier municipalities will: d. where applicable, demonstrate through an environmental assessment, that any impacts on key natural heritage features in the Natural Heritage System for the Growth Plan, key hydrologic features and key hydrologic areas have been avoided or, if avoidance is not possible, minimized and to the extent feasible mitigated
4.2.4 Lands Adjacent to Key Hydrologic Features and Key Natural Heritage Features **Subsection 1**	Outside settlement areas, a proposal for new development or site alteration within 120 metres of a key natural heritage feature within the Natural Heritage System for the Growth Plan or a key hydrologic feature will require a natural heritage evaluation or hydrologic evaluation that identifies a vegetation protection zone, which: a. is of sufficient width to protect the key natural heritage feature or key hydrologic feature and its functions from the impacts of the proposed change b. is established to achieve and be maintained as natural self-sustaining vegetation c. for key hydrologic features, fish habitat, and significant woodlands, is no less than 30 metres measured from the outside boundary of the key natural heritage feature or key hydrologic feature
4.2.10 Climate Change	Upper- and single-tier municipalities will develop policies in their official plans to identify actions that will reduce greenhouse gas

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
Subsection 1	emissions and address climate change adaptation goals, aligned with other provincial plans and policies for environmental protection that will include: e. recognizing the importance of watershed planning for the protection of the quality and quantity of water and the identification and protection of hydrologic features and areas f. Protecting the Natural Heritage System for the Growth Plan and water resource systems

Section	Greenbelt Plan (2017) Policies
1.2.2 Protected Countryside Goals **Subsection 6**	To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside: Climate Change: a. Integrating climate change considerations into planning and managing the Agricultural System, Natural Heritage System and Water Resource System to improve resilience and protect carbon sequestration potential, recognizing that the Natural Heritage System is also a component of green infrastructure b. Integrating climate change considerations into planning and managing growth that includes incorporating techniques to reduce greenhouse gas emissions, and increasing the resilience of settlement areas and infrastructure within the Greenbelt
3.2.3 Water Resource System Policies **Subsection 6**	Municipalities shall consider the Great Lakes Strategy, the targets and goals of the Great Lakes Protection Act, 2015 and any applicable Great Lakes agreements as part of watershed planning and coastal or waterfront planning initiatives.
3.2.6 External Connections **Subsection 1**	To support the connections between the Greenbelt's Natural System and the local, regional and broader scale natural heritage systems of southern Ontario, such as the Lake Ontario shoreline, including its remaining coastal wetlands, the Great Lakes Coast, Lake Simcoe, the Kawartha Highlands, the Carolinian Zone and the Algonquin to Adirondack Corridor, the federal government, municipalities, conservation authorities, other agencies and stakeholders should: c. Undertake watershed planning, which integrates supporting ecological systems with those systems contained in this Plan.

Section	Niagara Escarpment Plan (2017) Policies
Development and Growth Objectives **Section 1.6.8.9**	Growth and development in Minor Urban Centres shall be compatible with and provide for: a. The protection of natural heritage features and functions; b. The protection of hydrologic features and functions; c. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning. f. sustainable use of water resources for ecological and servicing needs; and g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Development Objectives **Section 1.7.5.9**	Growth and development in Urban Areas shall be compatible with and provide for: a. The protection of natural heritage features and functions; b. The protection of hydrologic features and functions; c. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning. f. sustainable use of water resources for ecological and servicing needs; and g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Escarpment Recreation Area **Section 1.8.1.6**	To ensure that recreational development protects and maintains community character, hydrologic and natural heritage features and functions, and the scenic resources of the Escarpment.
Development Objectives **Section 1.8.5.10**	Growth and development in Escarpment Recreation Areas shall be compatible with and provide for: a. The protection of natural heritage features and functions; b. The protection of hydrologic features and functions; c. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning. f. sustainable use of water resources for ecological and servicing needs; and

Section	Niagara Escarpment Plan (2017) Policies
	g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Lot Creation **Section 2.4.5**	New lots must: b. protect and enhance existing natural heritage and hydrologic features and functions.
Development Affecting Water Resources **Section 2.6.7**	Where permitted, the construction and expansion of ponds shall be designed and located to avoid Escarpment slopes, key hydrologic features and key natural heritage features, and ponds shall be designed to be offline.
Development Affecting Water Resources **Section 2.7.3**	The diversity and connectivity between key natural heritage features and key hydrologic features shall be maintained, and where possible, enhanced for the movement of native plants and animals across the landscape.
Development Affecting Natural Heritage **Section 2.7.6**	If in the opinion of the implementing authority, a proposal for development within 120 metres of a key natural heritage feature has the potential to result in a negative impact on the feature and/or its functions, or on the connectivity between key natural heritage features and key hydrologic features, a natural heritage evaluation will be required that: a. demonstrates that the development, including any alteration of the natural grade or drainage, will protect the key natural heritage feature or the related functions of that feature; b. identifies planning, design and construction practices that will minimize erosion, sedimentation and the introduction of nutrients or pollutants and protect and, where possible, enhance or restore the health, diversity and size of the key natural heritage feature; c. determines the minimum vegetation protection zone required to protect and where possible enhance the key natural heritage feature and its functions; and d. demonstrates that the connectivity between key natural heritage features and key hydrologic features located within 240 metres of each other will be maintained and where possible enhanced

Section	Niagara Escarpment Plan (2017) Policies
	for the movement of native plants and animals across the landscape.
Mineral Aggregate Resources **Section 2.9.3**	In addition to all other relevant policies of this Plan, proposals for mineral aggregate operations including wayside pits and quarries, accessory uses, accessory facilities and haul routes shall: e. demonstrate how natural heritage features will be avoided and the connectivity between key natural heritage features and key hydrologic features will be maintained and where possible enhanced during and after the extraction of mineral aggregates;
Section 2.9.11	Rehabilitation shall incorporate the following: a. natural heritage and hydrologic features and functions shall be restored or enhanced;

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
NHS & WRS Linkages	• Existing natural heritage system should be identified on a watershed basis. • Natural heritage systems and water resource systems should be considered together on a watershed basis. • Identify and protect features and linkages between natural heritage systems and water resource systems. • At the subwatershed level, information regarding impervious surfaces and natural cover (including wetland cover and woodland cover) should be documented, and targets should be identified in accordance with provincial and national guidelines. • Ensure that watershed delineation and characterization provide for protection of natural heritage features and areas. Also ensure that watershed characterization considers existing and proposed natural heritage systems, and the location of existing and proposed land use changes and development. • Maximizing extent of riparian vegetation can contribute to watershed ecological objectives and provide habitat and ecosystem services.
Natural Hazards	• Areas subject to natural hazards should be identified to manage exposure to public health and safety risks and to direct development outside of hazardous lands and sites.

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
	• Municipalities should identify areas subject to natural hazards and develop management plans to limit exposure to public health and safety risks. • Integration of watershed planning with natural hazard management to reduce the risks of associated climate change impacts and severe weather events.

Section	Ontario's Great Lakes Strategy
	Goal 3: Improving Wetlands, Beaches and Coastal Areas
Beaches	f. Work with partners to make information on beaches more available and to promote the use of enhanced beach management tools to improve beaches, potentially leading to more Great Lakes beaches being available to enjoy during more of the swimming season.
Wetlands	g. Through the review of the Provincial Policy Statement, consider land use, water resource and natural heritage provisions which support Great Lakes protection – for example, prohibiting development in coastal wetlands, and enhancing protection for shoreline areas and other natural features that are important to the health of the Great Lakes ecosystem.
Wetlands	i. Conduct new and updated wetland evaluations and provide technical advice and information for municipal planning.
Wetlands	j. Investigate opportunities to make use of wetland rapid evaluation tools to help support identification of provincially significant wetlands.
Other coastal areas	o. Identify priority areas for nearshore protection, and collaborate with Great Lakes partners on initiatives to improve nearshore areas.
Other coastal areas	p. Promote sustainable coastal recreation and tourism developments (e.g., parklands, beaches and trails) and activities associated with the lakes and their waterfronts and coasts.
Other coastal areas	q. Continue to consider opportunities for growing the Greenbelt and assess potential for enhancing provisions of the Greenbelt

Section	Ontario's Great Lakes Strategy
	Plan to support Great Lakes protection during the scheduled review in 2015.
Other coastal areas	r. Address key challenges in Areas of Concern, such as non-point source pollution, contaminated sediment, habitat restoration and municipal wastewater loadings, through Ontario actions and collaboration with federal partners, First Nation and Métis communities and local partners. Ontario is poised to work with federal agencies and other partners to complete actions or achieve clean up at a number of Areas of Concern.
Other coastal areas	u. Develop provincial shoreline guidance to support the provincial policy framework, and share best management practices on coastal protection and restoration.
	Goal 4: Protecting Habitats and Species
Protect habitat and species	a. Pursue opportunities to improve habitat protection and restoration methods to help decrease loss, degradation and fragmentation of Great Lakes Basin natural areas and landscapes that provide habitat for species and valuable ecosystem services.
Protect habitat and species	b. Complete binational biodiversity conservation strategies for Lakes Erie and Superior, and work to implement the binational biodiversity conservation strategies for each of Ontario's Great Lakes and their connecting rivers, to ensure that priorities are identified and acted upon.
Protect habitat and species	d. Seek ongoing opportunities for the continued rehabilitation and maintenance of native Great Lakes species, communities and ecosystems, including through the use of incentives such as the Conservation Land Tax Incentive Program.
Protect habitat and species	e. Support community work on habitat and native species protection, such as rehabilitating wetlands and other natural habitats, through the Great Lakes Guardian Community Fund and the Species at Risk Stewardship Fund.
Protect habitat and species	f. Assess the status and improve our understanding of factors affecting the health of aquatic ecosystems, habitats, native species and food webs, including nearshore areas, to help to guide conservation efforts.

Section	Ontario's Great Lakes Strategy
Prevent new invaders	h. Work with governments to review and address gaps in laws governing invasive species in trade – live plants and animals that are sold for personal or commercial use, for example for use in aquariums, as live bait, in horticulture and water gardening, or as food fish.
Prevent new invaders	j. Enhance existing coordination of invasive species research across the Great Lakes Basin and develop common research priorities. This action will require continued collaboration with existing forums such as the Canada/Ontario Invasive Species Centre, Canadian Aquatic Invasive Species Network, and Great Lakes Fishery Commission.
Detect invaders that have entered Ontario	l. Work with partners to develop and implement scientifically defensible surveillance activities in geographic areas at high risk of invasive species introductions.
Respond rapidly to new invasions	m. Develop a rapid response framework that will assist Ontario in responding to new invaders.
Manage and adapt to the presence of invaders that have become established	n. Where invasive species are established and eradication is not feasible, develop mitigation and adaptation measures, including guidance to partners and the public through fact sheets and best management practices.
	Goal 5: Enhancing Understanding and Adaptation
Deliver needed science	e. Undertake priority collaborative science so that management of fisheries and other natural resources, and biodiversity conservation work, can adapt to changing conditions.
Deliver needed science	f. Continue to implement research and monitoring programs to understand Great Lakes ecosystem function, structure and change. For example, to address coastal water quality and algae, science resources as available will focus on assessing nutrient-algae relationships altered by invasive species impacts, collaboratively identifying priority watersheds, developing new nearshore and tributary water quality targets, and quantifying impacts of land uses and beneficial management practices.

1.1.2.2 Existing Regional Official Plan (2014)

The ROP (2014) was reviewed to identify the existing Regional guidance and requirements related to the NHS in the context of watershed planning.

Section	Existing Regional Official Plan (2014) Policies
	Chapter 4: Managing Growth
4.G Urban Growth	Our Common Objectives: Objective 3 Protect, conserve, enhance and wisely use the valuable natural resources of land, air, energy and water for current and future generations.
	Chapter 5: Rural and Agricultural
5.C Policies for Rural Areas ***Policy 5.C.6.4***	Proposals for rural residential development in the Rural Area must meet the following criteria, in addition to the other requirements of this Official Plan, the Niagara Escarpment Plan and the local official plans: f. Development will not have a significant detrimental impact on the larger surrounding ecosystem, such as a reduction in water quality and quantity or interference with natural farm drainage.
	Chapter 7: Natural Environment
7.A.1 Natural Vegetation and Wildlife ***Policy 7.A.1.1***	The Region shall support efforts to achieve the following targets through the development and implementation of watershed and environmental planning studies and through voluntary landowner stewardship and restoration: a. 30% of the land area in the Region in forest cover or wetland, with at least 10% of each subwatershed in wetland b. A 30-metre-wide naturally vegetated buffer along 70% of the length of the first to third order streams in Niagara. Agricultural uses may continue within this buffer and are encouraged to employ best management practices to protect water resources and natural heritage
7.A.2 Water Resources ***Policy 7.C.2.1***	The Region, in partnership with the Niagara Peninsula Conservation Authority and appropriate local municipalities, shall ensure that Watershed Studies are prepared for major watersheds in consultation with landowners, community groups and other public agencies and shall include: a. Inventory, analysis and assessment of ecological features and functions affecting the watershed b. Identification of key issues and objectives c. A water budget and water conservation plan d. Recommendations on actions needed to maintain and enhance ecosystem health and integrity, including policies to be incorporated into municipal planning documents

Section	Existing Regional Official Plan (2014) Policies
	e. Identification of subwatershed boundaries and establishment of guidelines and terms of reference for additional studies if needed

1.1.2.3 Niagara Region Priorities

In order to develop the goals and objectives for the NWP (E) document that are specific to Niagara Region, the reports completed for the Region as part of the NEWP, the Consultation Summary Report – 1st Point of Engagement (2019) and the Watershed Planning Discussion Paper (2019), were reviewed to identify key stakeholder priorities. The following key issues and priorities, specific to the NHS, were identified.

It should be noted that any input received to date on the natural environment work program is still being evaluated by the Project Team. No final decisions on options, mapping, or policy have been made.

NEWP Consultation Summary Report – 1st Point of Engagement (2019)

- Provide clear direction on implementation of the Growth Plan Natural Heritage System policies.
- Build flexibility into policies for buffers to determine appropriate width and compatible uses.
- Enhance natural areas through Region-managed active management, including invasive species management.
- Develop policies for the natural environment that protect significant features and areas while not impeding normal farming practices.
- Develop guidance documents to assist with interpreting policies, developing appropriate mitigation plans, and supporting management of natural features.
- Protect key features through development of clear policies and appropriate, effective and enforceable by-laws.
- Support brownfield development and repurposing of industrial areas to protect and enhance the natural environment system.
- Develop natural environment policies that are clear and adequate to protect the natural environment for future generations.
- Differentiate between agricultural related water features and ‘natural’ features in the WRS and NHS.
- Recognize the primacy of the agricultural system in natural environment policies, including exemptions for normal farming practices and from provincial plans.
- Develop a coordinated approach to invasive species.
- Develop clear, science-based buffer definitions, policies and guidelines to support appropriate implementation.
- Develop clear, strong policies that protect and enhance ‘core’ areas and features for the future.

- Identify natural heritage supporting areas: green infrastructure, increase carbon sequestration, provide opportunities for Low Impact Development (LID) technology, constructed wetlands, enhance urban canopy and biodiversity.
- Find a balance between flexible policy that incorporates site-specific information but also broad natural heritage protections at a system-level.
- Update and align NHS mapping and policies with major changes to Growth Plan.
- Develop clear, defensible policies that are consistent with federal legislation and provincial policies, provide the appropriate level of flexibility, and include definitions for key terms to promote meeting objectives and implementing policies for the natural environment.
- Monitor and work closely with the province and federal governments to help influence future decisions and legislation/planning documents, and must build some flexibility into natural environment planning (i.e., policies) to allow for required changes that may be mandated.
- Consider impact of policies related to enhancement and linkage areas on development opportunities.
- Provide clear information about the planning process through flow charts, including agency responsibilities for review/consultation.
- Develop clear policies to inform requirements for buffers and guidelines to ensure consistent interpretation and application of buffer requirements.

NEWP Watershed Planning Discussion Paper (2019)

- Align policies and criteria regarding features inside and outside of urban areas.
- Complete a review of best practices for managing impacts due to urbanization to provide appropriate insights for the new NOP.

1.1.2.4 Goals and Objectives

Based upon applicable provincial policy, plans and guidance documents, and the key priorities identified by Regional staff and through stakeholder consultation, the following NWP (E) goal and objectives has been developed for the NHS:

Goal 4: Protect and Enhance Interactions Between the NHS and WRS

a. Identify the NHS

- Incorporate preferred/recommended NHS from NEWP, and the identification of the WRS (refer to Goal 1)
- Characterize existing conditions across the tertiary watersheds based on desktop accessible information determining areas of high sensitivity and risk
- Identify gaps or deficiencies including age, quality / accuracy and/or availability of existing data and reports
- Present data and gaps as a mapped index to clearly illustrate this information and its use in prioritizing recommendations for future work

b. Identify, preserve and enhance interactions between the WRS and the NHS

- Identify interactions between the WRS and the NHS to support connectivity
- Incorporate targets for restoration and protection of the NHS from the NEWP, such as targets for wetland, riparian, forest and grassland cover

- Incorporate targets from the NEWP and Great Lakes Strategy initiatives to protect Species-at-Risk and enhance fisheries and aquatic habitat
- Identify best practices recommended in the NEWP related to, among others:
  - Management of agricultural related water features and practices
  - Buffers
  - Invasive species

1.1.3 Land Use Planning and Resiliency

The following section identifies relevant policies, plans and guidance related to Land Use Planning and Resiliency, particularly in relation to Climate Change, Cumulative Impacts and Natural Hazards Management, followed by a list of NWP (E) goals and objectives.

1.1.3.1 Provincial Policies and Plans

Provincial policies, plans and guidance were reviewed to identify key areas of conformity and to determine existing guidance related to Land Use Planning and Resiliency in the context of watershed planning.

Section	Provincial Policy Statement (2020) Policies
1.6 Infrastructure and Public Service Facilities **Subsection 1.6.1**	Infrastructure and public service facilities shall be provided in an efficient manner that prepares for the impacts of a changing climate while accommodating projected needs.
1.6.6 Sewage, Water and Stormwater **Section 1.6.6.1**	g. Planning for sewage and water services shall: b. ensure that these systems are provided in a manner that: h. 1. can be sustained by the water resources upon which such services rely; 2. prepares for the impacts of a changing climate; 3. is feasible and financially viable over their lifecycle; and 4. protects human health and safety, and the natural environment
2.2 Water **Subsection 2.2.1**	i. Planning authorities shall protect, improve, or restore the quality and quantity of water by: c. evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level;

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
2.2.8 Settlement Area Boundary Expansions **Subsection 3**	Where the need for a settlement area boundary expansion has been justified in accordance with policy 2.2.8.2, the feasibility of the proposed expansion will be determined and the most appropriate location for the proposed expansion will be identified based on the comprehensive application of all of the policies in this Plan, including the following: d. the proposed expansion, including the associated water, wastewater and stormwater servicing, would be planned and demonstrated to avoid, or if avoidance is not possible, minimize and mitigate any potential negative impacts on watershed conditions and the water resource system, including the quality and quantity of water
3.2.1 Integrated Planning **Subsection 2**	Planning for new or expanded infrastructure will occur in an integrated manner, including evaluations of long-range scenario-based land use planning, environmental planning, and financial planning, and will be supported by and should involve: b. providing sufficient infrastructure capacity in strategic growth areas; e. considering the impacts of a changing climate.
3.2.5 Infrastructure Corridors **Subsection 1**	In planning for the development, optimization, or expansion of existing and planned corridors and supporting facilities, the Province, other public agencies and upper- and single-tier municipalities will: d. where applicable, demonstrate through an environmental assessment, that any impacts on key natural heritage features in the Natural Heritage System for the Growth Plan, key hydrologic features and key hydrologic areas have been avoided or, if avoidance is not possible, minimized and to the extent feasible mitigated
3.2.6 Water and Wastewater Systems **Subsection 2**	Municipal water and wastewater systems and private communal water and wastewater systems will be planned, designed, constructed, or expanded in accordance with the following: c. a comprehensive water or wastewater master plan or equivalent, informed by watershed planning or equivalent
3.2.7 Stormwater Management **Subsection 1**	Municipalities will develop stormwater master plans or equivalent for serviced settlement areas that: a. are informed by watershed planning or equivalent; b. protect the quality and quantity of water by assessing existing stormwater facilities and systems;

Section	A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) Policies
3.2.7 Stormwater Management **Subsection 2**	Proposals for large-scale development proceeding by way of a secondary plan, plan of subdivision, vacant land plan of condominium or site plan will be supported by a stormwater management plan or equivalent, that: a. is informed by a subwatershed plan or equivalent;
4.2.3 Key Hydrologic Features, Key Hydrologic Areas and Key Natural Heritage Features **Subsection 2**	j. Outside of settlement areas, proposals for large-scale development proceeding by way of plan of subdivision, vacant land plan of condominium or site plan may be permitted within a key hydrologic area where it is demonstrated that the hydrologic functions, including the quality and quantity of water, of these areas will be protected and, where possible, enhanced or restored through: b. meeting other criteria and direction set out in the applicable watershed planning or subwatershed plans
4.2.10 Climate Change **Subsection 1**	Upper- and single-tier municipalities will develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and address climate change adaptation goals, aligned with other provincial plans and policies for environmental protection that will include: e. recognizing the importance of watershed planning for the protection of the quality and quantity of water and the identification and protection of hydrologic features and areas f. Protecting the Natural Heritage System for the Growth Plan and water resource systems

Section	Greenbelt Plan (2017) Policies
1.2.2 Protected Countryside Goals **Subsection 6**	To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside: Climate Change: y. Integrating climate change considerations into planning and managing the Agricultural System, Natural Heritage System and Water Resource System to improve resilience and protect carbon sequestration potential, recognizing that the Natural Heritage System is also a component of green infrastructure z. Integrating climate change considerations into planning and managing growth that includes incorporating techniques to reduce greenhouse gas emissions, and increasing the resilience of settlement areas and infrastructure within the Greenbelt
3.2.3 Water Resource	k. Decisions on allocation of growth and planning for water, wastewater, and stormwater infrastructure shall be informed by

Section	Greenbelt Plan (2017) Policies
System Policies **Subsection 4**	applicable watershed planning in accordance with the Growth Plan.
Subsection 5	l. Cross-jurisdictional and cross-watershed impacts need to be considered in the development of watershed plans. The development of watershed plans and watershed management approaches in the Protected Countryside shall be integrated with watershed planning and management in the NEP, the ORMCP and the Growth Plan.
Subsection 6	m. Municipalities shall consider the Great Lakes Strategy, the targets and goals of the Great Lakes Protection Act, 2015 and any applicable Great Lakes agreements as part of watershed planning and coastal or waterfront planning initiatives.
3.2.4 Key Hydrologic Areas **Subsection 1**	n. For lands within a key hydrologic area in the Protected Countryside, the following policies apply: 1. Major development may be permitted where it has been demonstrated that the hydrologic functions, including groundwater and surface water quality and quantity, of these areas shall be protected and, where possible, improved or restored through: b. Meeting other criteria and direction set out in the applicable watershed planning or subwatershed plan
o. 4.2.3 Stormwater Management and Resilient Infrastructure Policies **Subsection 4**	Applications for development and site alteration in the Protected Countryside shall be accompanied by a stormwater management plan which demonstrates that: c. Applicable recommendations, standards or targets within a subwatershed plan or equivalent and water budgets will be complied with;
p. 4.3.1 Renewable Resource Policies **Subsection 2**	o. Activities related to the use of renewable resources are permitted in the Protected Countryside, subject to the policies of this Plan and all other applicable legislation, regulations, and municipal planning documents, including the PPS. All such activities shall be undertaken in accordance with the applicable recommendations, standards or targets of any relevant watershed plan or water budget and provincial guidance.
f. 4.3.2 Non-Renewable Resource Policies	p. Municipalities should ensure that all land use activities related to the post-extraction rehabilitation of mineral aggregate operations are consistent with any relevant approved source protection plan and relevant watershed or subwatershed plan.

Section	Greenbelt Plan (2017) Policies
Subsection 11	

Section	Niagara Escarpment Plan (2017) Policies
	Development Objectives
Section 1.6.8.9	Growth and development in Minor Urban Centres shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Section 1.7.5.9	Growth and development in Urban Areas shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning.
Section 1.8.5.9	Growth and development in Escarpment Recreation Areas shall be compatible with and provide for: g. compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plans in land use planning.

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
Watershed Planning	• Planning authorities to protect, improve or restore the quality and quantity of water by, among other things, using watershed as the ecologically meaningful scale for integrated and long-term planning. • Watershed planning should inform the protection of water resource systems and decisions related to planning for growth.
Climate Change	• Planning authorities shall consider the potential impacts of climate change that may increase the risk associated with natural hazards. • The potential effects of climate change on existing and proposed land uses, infrastructure, and developments should be considered within a watershed/subwatershed

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
	boundary and should be considered in watershed planning, management, and infrastructure planning. • Municipalities should assess how current water uses and existing infrastructure could negatively impact the watershed by exaggerating climate change effects. • Climate change mitigation and adaption should be considered vital to protecting and restoring a watershed. • Watershed plans should document the potential effects on climate change on water use and management. • Promote natural features and green infrastructure to provide ecological services which can mitigate impacts of climate change.
Cumulative Impacts	• Planning authorities should use watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development and considering cross-jurisdictional and cross-watershed impacts. • Cumulative Effects Assessment (CEA) is fundamental to watershed protection and watershed planning. Watershed planning to be driven by solid and defensible CEA. • Cumulative Effects Assessment (CEA) should be completed to address assessment of cumulative, cross-jurisdictional, and cross-watershed impacts, which could be due to single, multiple, or successive development/site alteration activities. • Cumulative impacts and downstream impacts beyond a single development site or planning application should be considered as part of a comprehensive approach to management of human activities, land, water, aquatic life, and resources within a watershed. • The assessment of cumulative, cross-jurisdictional, and cross-watershed impacts should inform growth and servicing allocations and assist in determining actions to minimize negative impacts on quality and quantity of water and hydrologic functions.
Natural Hazards	• Municipalities should identify areas subject to natural hazards and develop management plans to limit exposure to public health and safety risks. • When information does not exist concerning the location of defined hazardous lands, or when existing information is identified as being out of date, municipalities, and other

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
	planning authorities are to undertake studies to identify potential risks from natural hazards. • Floodplain mapping should be undertaken to identify regulatory flood lines and demonstrate hazard areas. • Floodplain mapping and soil and stability analysis are important for informing where development may and may not occur, as well as for managing its associated impacts on natural watercourses, specifically regarding flooding and erosion — including where and how to focus mitigative measures. • Municipalities should re-visit flood mapping during the development review and approval process, ensuring that climate change considerations are incorporated, and ensuring that land use planning is integrated with municipal asset management planning.

Section	Ontario's Great Lakes Strategy
	Goal 5: Enhancing Understanding and Adaptation
Deliver needed science	f. Continue to implement research and monitoring programs to understand Great Lakes ecosystem function, structure and change. For example, to address coastal water quality and algae, science resources as available will focus on assessing nutrient-algae relationships altered by invasive species impacts, collaboratively identifying priority watersheds, developing new nearshore and tributary water quality targets, and quantifying impacts of land uses and beneficial management practices.
Climate change impacts and adaptation	l. Continue to implement adaptation actions under Climate Ready, including: • building climate adaptation into Great Lakes agreements and integrating climate change adaptation into Ontario's Great Lakes programs • examining climate change impacts on Great Lakes fisheries • increasing awareness of the health hazards associated with climate change, including emerging health issues associated with extreme weather • improving existing monitoring networks to detect climate change

Section	Ontario's Great Lakes Strategy
	• continuing to build our understanding of climate change and its impacts on the Great Lakes through investments in climate modelling and the development of rainfall intensity, duration and frequency curves.
Climate change impacts and adaptation	m. Work with Great Lakes partners to promote the use of adaptive management tools to encourage consideration of climate impacts in Great Lakes communities.
Climate change impacts and adaptation	n. Undertake a pilot infrastructure vulnerability assessment of the impacts of climate change on a municipal water treatment plant in southern Ontario in partnership with the engineering sector, municipal sector and others.
Climate change impacts and adaptation	o. Ensure climate science information, including regional climate modeling data related to the Great Lakes Basin, is available to decision makers in Great Lakes communities to support planning.
Climate change impacts and adaptation	p. Undertake an economic study to identify and quantify the economic impacts (challenges and opportunities) of climate change on key beneficial uses of the Great Lakes. The study will also quantify cost savings available through select adaptation actions.
Climate change impacts and adaptation	q. Conduct and support research to better predict the effects of climate change on new invasions and the spread of already established species.
	Goal 6: Ensuring Environmentally Sustainable Economic Opportunities and Innovation
Promote tourism and recreation opportunities	l. Identify opportunities for participation, linkages and efficiencies to better implement waterfront revitalization and increase community and visitor access to the waterfront.
Promote tourism and recreation opportunities	m. Promote and support waterfront venues, attractions and activities, including support for waterfront festivals, sporting events and heritage attractions that build Great Lakes engagement and foster shoreline sustainable use.
Promote tourism and recreation opportunities	n. Work with the cruise ship industry to capitalize on and further enhance the growing Great Lakes cruising industry to attract more visitors and generate more economic activity.
Promote tourism and	o. Continue to promote sustainable waterfront trail systems that link communities and support local economies around the

Section	Ontario's Great Lakes Strategy
recreation opportunities	Great Lakes through walking, cycling and other trail activities, such as those along the Waterfront Trail, now being extended beyond Lake Ontario and the St. Lawrence River to include the shores of Lake Erie, the Detroit River and Lake St. Clair.
Promote tourism and recreation opportunities	p. Promote water-based tourism and development, led by Regional Tourism Organizations that border the Great Lakes and St. Lawrence River.
Promote tourism and recreation opportunities	q. Support cycling tourism for exploration of local communities while providing significant contributions to local economies located along the waterfront trails of the Great Lakes and the St. Lawrence River coasts.
Promote tourism and recreation opportunities	r. Encourage increased public access to waterfront areas where possible, to enhance community and tourist appreciation for the Great Lakes as a focal point in the province.
Promote tourism and recreation opportunities	s. Encourage opportunities for sustainable public use of water-based, coastal and nearshore recreational, cultural and heritage resources.
Promote tourism and recreation opportunities	t. Conduct ongoing tourism marketing, locally and internationally, featuring the Great Lakes as a tourism icon, and enhancing marketing strategies to increase support for and enjoyment of Great Lakes-themed activities and festivals, through initiatives such as the Ontario Tourism Marketing Partnership Corporation, Regional Tourism Organizations, and Celebrate Ontario Grant Program.
Promote tourism and recreation opportunities	u. Promote "staycations," encouraging families to vacation closer to home and to enjoy Great Lakes experiences.
Ensure environmentally sustainable resource use	v. Continue support for the sustainable management and harvest of Ontario's Great Lakes commercial and recreational fisheries resources that provide benefits to society associated with wholesome food, recreation, cultural heritage, employment, and a healthy aquatic ecosystem.
Ensure environmentally sustainable resource use	w. Further explore the value of ecological services to Ontario's economy. Ecological services are the many benefits that a healthy ecosystem provides. For example, the Great Lakes and St. Lawrence River ecosystem purifies our water and air,

Section	Ontario's Great Lakes Strategy
	breaks down our wastes, provides food sources and recreation opportunities, reduces the risks of flood damage, and moderates extreme weather.
Ensure environmentally sustainable resource use	x. Support improvements to agricultural and rural runoff management by enhancing adoption of environmental farm practices and plans. This may include working with researchers and industry to enhance the development and adoption of best management practices in key sectors and geographic regions.
Ensure environmentally sustainable resource use	y. Encourage effective, sustainable soil management practices to maintain a healthy economy and environment throughout Ontario, including the Great Lakes Basin. The Province will develop a policy framework for soil management, including encouragement of best management practices to support the reuse of excess soil for beneficial uses, as long as it can be done in a way that protects human health and the environment.

1.1.3.2 Existing Regional Official Plan (2014)

The ROP (2014) was reviewed to highlight the existing Regional guidance and requirements related to Land Use Planning and Resiliency in the context of watershed planning.

Section	Existing Regional Official Plan (2014) Policies
	Chapter 4: Managing Growth
4.G Urban Growth	Our Common Objectives: Objective 3 Protect, conserve, enhance and wisely use the valuable natural resources of land, air, energy and water for current and future generations.
	Chapter 6: Resources
6.C Policies for Mineral Resources ***Policy 6.C.5***	Applications for licenses to open new pits or quarries and applications for changes to or expansions of existing licensed pits or quarries will be considered in relationship to the Niagara Escarpment Plan policies within the Niagara Escarpment Plan area and to the following conditions: c. the impact on the natural environment including surface watercourses and Groundwater
	Chapter 7: Natural Environment
7.A.2 Water Resources ***Policy 7.A.2.1***	q. Development and site alteration shall only be permitted if it will not have negative impacts, including cross-jurisdictional and cross-watershed impacts, on:

Section	Existing Regional Official Plan (2014) Policies
	a. The quantity and quality of surface and ground water b. The functions of ground water recharge and discharge areas, aquifers and headwaters c. The natural hydrologic characteristics of watercourses such as base flow d. Surface or ground water resources adversely impacting on natural features or ecological functions of the Core Natural Heritage System or its components; e. Natural drainage systems, stream forms and shorelines f. Flooding or erosion
7.A.3 Air Quality and Climate Change	Climate change poses significant economic, environmental and health risks. Many of the activities responsible for greenhouse gas emissions also cause other forms of air pollution. Policies elsewhere in this Plan make a significant contribution to reducing emissions by: d. Encouraging waste reduction and diversion, use of landfill gas and water conservation; and e. Promoting green space, tree planting and natural heritage conservation.
7.A.3 Air Quality and Climate Change ***Objective 7.A.3.C***	r. To adapt to the effects of climate change.
7.A.3 Air Quality and Climate Change ***Policy 7.A.3.4***	s. Recognizing that some climate change may be unavoidable, the Region shall develop and implement plans to adapt to potential impacts.
7.A.6 Natural Hazards ***Policy 7.A.6.1***	t. Hazardous lands and sites shall be as identified and mapped by the Niagara Peninsula Conservation Authority. Where an application for development or site alteration is made and such mapping is not available the location and extent of hazardous lands or sites shall be as determined by the Conservation Authority after considering an appropriate study prepared and signed by a qualified engineer and submitted with the application.
7.C Implementation Measures ***Policy 7.C.2.4***	Watershed and Environmental Planning Studies shall be implemented through amendments to Regional and local official plans, as appropriate, and through secondary plans and zoning by-laws providing guidance and direction for: a. The review of applications for development or site alteration;

Section	Existing Regional Official Plan (2014) Policies
	b. Servicing and infrastructure proposals; and c. The Region's support for environmental stewardship, restoration, and other measures.
	Chapter 8: Infrastructure
Policy 8.B.11	The Region will continue to plan and design municipal water and wastewater systems that return water to the Great Lakes watershed from which the withdrawal originates.

1.1.3.3 Niagara Region Priorities

In order to develop the goals and objectives for the NWP (E) document that are specific to Niagara Region, the reports completed for the Region as part of the NEWP, the Consultation Summary Report – 1st Point of Engagement (2019) and the Watershed Planning Discussion Paper (2019), were reviewed to identify key stakeholder priorities. The following key issues and priorities, specific to Land Use Planning and Resiliency, were identified.

It should be noted that any input received to date on the natural environment work program is still being evaluated by the Project Team. No final decisions on options, mapping, or policy have been made.

<u>NEWP Consultation Summary Report – 1st Point of Engagement (2019)</u>

- Develop and design natural environment policies and systems to be resilient and address threats, such as climate change and invasive species.
- Develop policies to protect and enhance the natural environment system by recognizing changes in the natural environment resulting from natural and anthropogenic impacts.
- Develop natural environment policies that consider climate change.
- Involve public and stakeholders through meaningful engagement and develop natural environment policies that support the protection of the natural environment for the future.
- Identify natural heritage supporting areas: green infrastructure, increase carbon sequestration, provide opportunities for Low Impact Development (LID) technology, constructed wetlands, enhance urban canopy and biodiversity.
- Monitor and work closely with the province and federal governments to help influence future decisions and legislation/planning documents, and must build some flexibility into natural environment planning (i.e., policies) to allow for required changes that may be mandated.
- Provide clear information about the planning process through flow charts, including agency responsibilities for review/consultation.

NEWP Watershed Planning Discussion Paper (2019)

- Examine different land use and management scenarios in watershed plans to guide urban growth or transportation infrastructure, and to identify mitigation measures or targets.
- Provide guidance on cumulative impacts through the watershed characterisation to identify areas of existing and proposed development that are impacted due to past, current and proposed development.
- Consider the impacts of climate change on infrastructure and growth, including the influence of climate change on stormwater management system planning.

Niagara Stormwater Management Guidelines – Technical Memorandum #1: Background Review, Research Municipalities, Summarize Legislation (July 2020)

- Improve climate change adaptation

1.1.3.4 Goals and Objectives

Based upon applicable provincial policy, plans and guidance documents, and the key priorities identified by Regional staff and through stakeholder consultation, the following NWP (E) goal and objectives have been relative to Land Use Planning and Resiliency:

Goal 5: Ensure Land Use Planning is Informed by Watershed Planning

a. Review Growth Scenarios to Inform Land Use Planning

- Review potential growth scenarios, potential settlement expansion areas, known areas experiencing higher levels of development or resource pressure, or are known to have functional concerns related to management of water quality or quantity.
- Identify high level constraints based on functional sensitivities in areas where the NHS & WRS are at higher risk of impact to inform growth alternatives for Niagara Region and allow for an iterative approach providing feedback through the NWP (E)
- Apply a hierarchical approach to assess prioritized locations where land use changes and growth are anticipated to have low, medium and high impacts on the WRS, to ensure effective input and direction for land use planning for the new NOP.

b. Provide Best Practices / Recommendations

- Provide balanced consideration of grey/ green infrastructure to inform the new NOP building from acceptable local area municipal approaches
- Identify and develop recommendations for prioritizing gap filling, and implementation priorities
- Provide insights into best practices for managing impacts due to urbanization

c. Provide Best Practices for protecting, enhancing and restoring the WRS related to, among others:

- Shoreline management
- Flooding and erosion

- Buffers
- Water quality and water quantity (including stormwater management) (refer to Goal 2)

Goal 6: Create Resilient Communities to Protect Human Health and Safety, and the Natural Environment

a. Manage Natural Hazards

- Review NPCA's flood hazard mapping to confirm mapping is current and consistent
- Incorporate flood hazard mapping into WRS mapping (refer to Goal 1)

b. Identify climate considerations and potential impacts to the WRS and NHS to improve resilience and inform land use and environmental planning

- Summarize lessons learned from other communities (e.g. City of Ottawa and City of Welland)
- Provide best practices/recommendations for flood hazard management
- Provide best practices/recommendations regarding climate change adjusted rainfall patterns

c. Develop Cumulative Impact Considerations

- Characterize the watershed to identify sensitivities and areas at risk
- Overlay areas of existing development and proposed growth
- Define areas anticipated to be under the greatest impact due to past, current and potential future development
- Identify flood vulnerable areas
- Provide best practices/recommendations regarding key environmental indicators and developing thresholds for future cumulative impact assessments

1.1.4 Engagement

The following section identifies relevant policies, plans and guidance related to Engagement, followed by a list of NWP (E) goals and objectives.

1.1.4.1 Provincial Policies and Plans

Provincial policies, plans and guidance were reviewed to identify key areas of conformity and to determine existing guidance related to Engagement in the context of watershed planning.

Section	Provincial Policy Statement (2020) Policies
1.2 Coordination **Subsection 1.2.1**	A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including: e) ecosystem, shoreline, watershed, and Great Lakes related issues

Section	Greenbelt Plan (2017) Policies
3.2.3 Water Resource System Policies **Subsection 2**	u. Watersheds are the most meaningful scale for hydrological planning. Municipalities, partnering with conservation authorities as appropriate, shall ensure that watershed planning is undertaken to support a comprehensive, integrated, and long-term approach to the protection, enhancement or restoration of the quality and quantity of water within a watershed.

Topic	Watershed Planning in Ontario – Guidance for Land-use Planning Authorities (Draft 2018)
Watershed Planning	• Partnership between upper and single tier municipalities, conservation authorities, as appropriate, to ensure that watershed planning is undertaken to support a comprehensive, integrated, and long-term approach to the protection, enhancement or restoration of the quality and quantity of water within a watershed.
Natural Hazards	• Coordinated and integrated approach should be adopted by all orders of government (including municipalities, agencies, and boards) on matters related to watershed planning.

Section	Ontario's Great Lakes Strategy
	Goal 1: Engaging and Empowering Communities
Local community action program	a. Fund small-scale local community actions to restore and protect the Great Lakes through the Great Lakes Guardian Community Fund. The program provides direct assistance to community groups and other local organizations as well as First Nations and Métis communities to undertake numerous small-scale projects that: • restore and protect the Great Lakes through activities like shoreline and beach clean ups and watershed improvements, and • help people re-connect and enjoy the Great Lakes through local initiatives such as promoting and developing coastal and riverside trails and participating in wetland protection and restoration.
Building awareness	b. Create more opportunities for Ontarians, young and old, to experience the Great Lakes, and to build a sense of connection with the ecosystem and with Great Lakes history and culture –

Section	Ontario's Great Lakes Strategy
	an important first step in building awareness. Actions will include: • connecting teachers and school boards with opportunities to use the Great Lakes and their watersheds as a context for teaching and learning, and • encouraging families to take part in natural heritage education programs offered by Ontario's provincial parks, and by other groups such as municipalities, colleges, universities and conservation authorities.
Collaboration and partnerships	c. Engage the Great Lakes community, including First Nations and Métis communities and organizations, municipalities, environmental organizations, conservation authorities, the scientific community, the industrial, agricultural, recreational and tourism sectors, and other interested groups, on Great Lakes matters, including: • facilitating information sharing • identifying priorities for targeted action • discussing and developing targets • identifying potential partnerships • sharing updates on actions taken under the Strategy and progress towards achieving Great Lakes Goals • discussing Great Lakes issues such as renewal of the Canada-Ontario Agreement for the Great Lakes (COA) • collaborating in Ontario's participation in binational Great Lakes work • engaging on the updating and review of Ontario's Great Lakes Strategy.
Collaboration and partnerships	d. Explore the creation of new governance and engagement opportunities for the Great Lakes community as part of a new Canada-Ontario Agreement for the Great Lakes (COA).
Collaboration and partnerships	e. Continue to strengthen and build relationships with First Nations and Métis communities, including: • exploring opportunities to collaborate on plans, protection initiatives and shared priorities • supporting cross-cultural learning opportunities related to shared interests in protecting the Great Lakes.
Collaboration and partnerships	f. Partner with Great Lakes municipalities on shared Great Lakes priorities, including ongoing collaboration with the Great Lakes and St. Lawrence Cities Initiative and other groups.
Collaboration and partnerships	g. Partner with conservation groups, watershed organizations, environmental organizations, the public and others on projects to protect the Great Lakes, such as projects to reduce pollution,

Section	Ontario's Great Lakes Strategy
	manage fisheries, conserve and restore wetlands, and recover species at risk.
Collaboration and partnerships	h. Coordinate Great Lakes activities, priorities and programs across provincial ministries through the Canada-Ontario Agreement and other inter-ministry governance forums.
Collaboration and partnerships	i. Work with the federal government by: • negotiating a new Canada-Ontario Agreement for the Great Lakes (COA) • jointly implementing agreement which should help to coordinate actions of federal, provincial and local partners on the restoration and protection of the Great Lakes, and help to deliver Ontario's priorities in this Strategy.
Collaboration and partnerships	j. Partner with U.S. Great Lakes jurisdictions, including ongoing work on binational lake plans, water quantity management, fisheries management, invasive species prevention and other shared interests.
Collaboration and partnerships	k. Continue to take a collaborative, locally-engaged approach to the protection of drinking water sources under the Clean Water Act.
	Goal 2: Protecting Water for Human Health and Ecological Health
Protect Drinking Water	c. Collaborate with municipalities, conservation authorities, source protection committees and others to support effective and ongoing implementation of source protection plans under the Clean Water Act. Discuss with stakeholders whether continuous improvement of those plans could support better protection of the Great Lakes as sources of drinking water.
Protect Drinking Water	d. Support culturally appropriate implementation strategies for drinking water source protection within First Nations communities, where relevant.
Protect Drinking Water	e. Review other jurisdictions' experience with drinking water standards, review advice from Ontario's Advisory Council on Drinking Water Quality and Testing Standards, work with stakeholders and consult with the public on proposed updates to Ontario's Drinking Water Quality Standards.
Reduce stormwater and wastewater impacts	f. Assist municipalities, developers, the insurance industry and others in reducing the volumes and impacts of stormwater, including: • engaging conservation authorities, municipalities, and other stakeholders to develop guidance by the end of 2014 to facilitate and remove barriers to the uptake of innovative source control measures that reduce stormwater volumes, such as green infrastructure and low impact development

Section	Ontario's Great Lakes Strategy
	• consulting on the development of overarching wastewater policy that includes stormwater, to support the Canadian Council of Ministers of the Environment wastewater strategy
Reduce excessive nutrients	j. Improve understanding of the effectiveness of agricultural stewardship programs and practices and enhance adoption of effective practices, including the development of community partnerships to encourage the uptake of effective agricultural best management practices.
Protect water quality by reducing toxic chemicals	r. Support opportunities for local groups to take action on water protection projects, for example through the Great Lakes Guardian Community Fund.
	Goal 3: Improving Wetlands, Beaches and Coastal Areas
Beaches	a. Work with partners to share successful and innovative best management approaches on beaches, wetlands and coasts.
Beaches	c. Work with partners, through small local projects, on opportunities to connect with Great Lakes coasts and beach ecosystems through dune restoration, beach education and other stewardship and education programs.
Wetlands	h. Continue to support strategic partnerships and collaborations that conserve and restore wetlands across the Great Lakes Basin, such as the Eastern Habitat Joint Venture and the Great Lakes Wetlands Conservation Action Plan.
Wetlands	l. Conduct workshops to profile wetland conservation successes, discuss challenges and identify future directions.
Wetlands	m. Continue to promote municipal engagement in wetland conservation.
	Goal 4: Protecting Habitats and Species
Protect habitats and species	g. Enhance the conservation of Great Lakes biodiversity through increased public awareness of its value and its contributions to Ontario's social, economic and environmental well-being.
Prevent new invaders	k. Continue collaborative efforts on education and outreach to address gaps and improve communications regarding high risk pathways and to engage a wider range of interest groups.
	Goal 5: Enhancing Understanding and Adaptation

Section	Ontario's Great Lakes Strategy
Deliver needed science	b. Continue to undertake collaborative science, and enhance integration of different types of knowledge including Traditional Ecological Knowledge, socio-economic research, Great Lakes environmental and ecological monitoring and research, and drinking water source protection science into decision making.
Deliver needed science	i. Sustain partnerships, data sharing, and other opportunities to help enhance science knowledge and capacity at conservation authorities, Ontario's universities, and among other Great Lakes research and protection partners
Sharing and communicating science	j. Sustain, and improve the management, analysis and communication of Ontario's Great Lakes information and data. This includes sharing information publicly, and providing useful and timely knowledge to support action. We will improve Great Lakes reporting through reports on progress under this Strategy, regular reports on related topics such as Ontario's water quality, binational Great Lakes reporting, and other means such as government websites and social media.
Sharing and communicating science	k. Support Great Lakes experts in sharing their results at key conferences, through publications and other communication opportunities.
Climate change impacts and adaptation	r. Work with partners on strategies that facilitate information sharing, collaboration, and adaptive management to further mitigate water level-related impacts along our Great Lakes shorelines.
	Goal 6: Ensuring Environmentally Sustainable Economic Opportunities and Innovation
Support the development of innovative water technologies, services and practices	f. Share success stories on community-based approaches, to encourage and support adoption of best practices. For example, the Showcasing Water Innovation Program has identified leaders in innovation and is fostering the transfer of knowledge between communities, in areas such as asset management/water conservation, climate change risk assessment, and innovative integrated approaches to providing water services including green infrastructure.
Support the development of innovative water technologies,	g. Encourage implementation of lessons learned from innovative projects for water, wastewater and stormwater systems (e.g., Showcasing Water Innovation projects) including encouraging innovative and cost-effective Ontario water technologies and approaches in small and remote communities and partnerships among public, private and academic sectors to migrate

Section	Ontario's Great Lakes Strategy
services and practices	innovations to potential commercial application and more widespread use.
Support the development of innovative water technologies, services and practices	h. Explore opportunities to involve Aboriginal peoples in learning about innovative technologies and potential job opportunities in the water sector and environmental stewardship initiatives.
Support the development of innovative water technologies, services and practices	k. Work with other orders of government to promote investments that contribute to the growth of Ontario's green economy, including opportunities for research and commercialization of green technologies and practices

1.1.4.2 Existing Regional Official Plan (2014)

The ROP (2014) was reviewed to highlight the municipal guidance and requirements related to Engagement in the context of watershed planning.

Section	Existing Regional Official Plan (2014) Policies
	Chapter 7: Natural Environment
7.A.2 Water Resources ***Policy 7.C.2.1***	The Region, in partnership with the Niagara Peninsula Conservation Authority and appropriate local municipalities, shall ensure that Watershed Studies are prepared for major watersheds in consultation with landowners, community groups and other public agencies and shall include: a. Inventory, analysis and assessment of ecological features and functions affecting the watershed b. Identification of key issues and objectives c. A water budget and water conservation plan d. Recommendations on actions needed to maintain and enhance ecosystem health and integrity, including policies to be incorporated into municipal planning documents e. Identification of subwatershed boundaries and establishment of guidelines and terms of reference for additional studies if needed

1.1.4.3 Niagara Region Priorities

In order to develop the goals and objectives for the NWP (E) document that are specific to Niagara Region, the reports completed for the Region as part of the NEWP, the Consultation Summary Report – 1st Point of Engagement (2019) and the Watershed Planning Discussion Paper (2019), were reviewed to identify key stakeholder priorities. The following key issues and priorities, specific to Engagement, were identified.

It should be noted that any input received to date on the natural environment work program is still being evaluated by the Project Team. No final decisions on options, mapping, or policy have been made.

NEWP Consultation Summary Report – 1st Point of Engagement (2019)

- Provide well-advertised opportunities for public review and meaningful input into the natural environment mapping and policies.
- Promote transparency by making available natural environment mapping through a web-based, accessible, and user-friendly mapping tool.
- Develop a clear framework of roles and responsibilities and identify a consistent approach to undertake watershed planning.
- Engage public in natural environment planning and provide stewardship opportunities.
- Reinstate an environmental advisory committee with adequate community representation.
- Provide clear information about the planning process through flow charts, including agency responsibilities for review/consultation.

1.1.4.4 Goals and Objectives

Goal 7: Engage communities to understand and reflect community-identified priorities and local conditions in the Niagara Watershed Plan (E)

a. NWP (E) Objectives:

- Incorporate public, stakeholder, and Indigenous Groups input and priorities identified in the NEWP Consultation Summary Report(s) into the NWP (E)
- Conduct additional public consultation (e.g. public open houses, surveys, etc.) to gather feedback from the community
- Engage with Indigenous Groups specifically on the Niagara Watershed Plan Equivalency (NWP (E)) project

b. Future Actions and Recommendations:

- Partner with NPCA (e.g. watershed planning, monitoring, mapping etc.)
- Partner with local municipalities (e.g. subwatershed planning, stormwater management etc.)
- Continue to engage with Indigenous Groups
- Develop Watershed Planning Steering and Stakeholder Committees comprised of NPCA, LAM, NGO and other interested groups
- Undertake stewardship, education and outreach opportunities on an ongoing basis, as appropriate, to ensure the NWP (E) reflects the community's priorities
- Continue to explore partnership opportunities with NPCA, such as:

- Erosion and Sediment Control / Low Impact Development educational material for local businesses and development industry
- Grant program
- Explore partnership opportunities with the Province of Ontario's Great Lakes Strategy initiatives to support the implementation of the Great Lakes Strategy goals, such as:
- Information sharing (research, workshops, public educational materials)
- Strategic partnerships (projects, plans and programs)